Public Input No. 41-NFPA 86-2024 [Section No. 1.3.9]

1.3.9 Process Hazard Analysis (PHA).

1.3.9.1*

–

A PHA shall be completed for processes involving ovens, furnaces, dryers and ~~dryers~~ thermal oxidizers, whose subsystems are not addressed by this standard.

1.3.9.

~~2~~

1.1 it is recommended that a PHA should be completed for all ovens f furnaces, dryers and thermal oxidizer f *or the purpose of identifying all worst case scenario(s) and determining how to prevent these scenario(s) from occurring.*

1.3.9.2

A PHA shall not be used to deviate from NFPA 86 requirements without following the equivalency requirements in Section 1.5.

Statement of Problem and Substantiation for Public Input

Identifying all worst case scenario(s) in a PHA and determining how to prevent scenario(s) from occurring.will mitigate the risk of a fire or explosion in an oven.The PHA will also help determine if process will exceed the capability of the oven. Modifications to process equipment prior to the oven might exceed the capability of the oven resulting in a significant event.

Submitter Information Verification

Submitter Full Name:	William Norge
Organization:	3M
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 30 14:09:00 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: The proposed revision is not written as mandatory language, and the concern is already addressed in A.1.3.9.1. Annex N also identifies who would be responsible for developing the PHA. The proposed language is more appropriate as annex material.

Public Input No. 28-NFPA 86-2024 [New Section after 3.3]

Supply Pressure

Fuel Supply Pressure: the fuel pressure measured at the outlet of the equipment isolation valve of fuel trains.

Gas Supply Pressure: the gas pressure measured at inlet of a special atmosphere gas line

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Statement of Problem and Substantiation for Public Input

Supply pressure is used in the standard but not defined. Two definitions are proposed, because there are two different uses of the term "supply pressure".

NFPA 54 defines Supply pressure as "The gas pressure measured at the inlet to the appliance"

Submitter Information Verification

Submitter Full Name:	Kevin Carlisle
Organization:	Karl Dungs, Inc.
Affiliation:	IHEA
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 16:29:38 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: The proposed new terms do not appear in the document and cannot be defined in Chapter 3 per the NFPA manual of style. Further, the proposed definitions limit supply pressure to apply only to fuels, but NFPA 86 uses the term supply pressure in regards to more than just fuels.

Public Input No. 49-NFPA 86-2024 [New Section after 3.3]

3.3.xxx* Combustion Chamber. The space where burners operate which may be internal or external to an oven or furnace.

A.3.3.xxx A combustion chamber may also be a heating chamber. This would involve direct-fired internal heating systems defined in 3.3.35.4.

3.3.xxx Damage-Limiting Construction. Any set of construction elements, used individually or in combination, which will act to limit damage from an explosion, including open structures, pressure relieving construction, or pressure resistant construction. [30, 2024]

3.3.xxx Deflagration. Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium. [68, 2023]

3.3.xxx Explosion. The bursting or rupture of an enclosure or a container due to the development of internal pressure from a deflagration. [69, 2024]

3.3.xxx Heating Chamber. The space in an oven or furnace where work is processed.

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Statement of Problem and Substantiation for Public Input

Definitions are added to help provide some clarity to the requirements in section 5.3. Existing definitions from other NFPA documents were used where appropriate.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	New definitions

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 15:54:50 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-2-NFPA 86-2024

Statement: This revision provides a definition for a term that is used throughout the document, that is susceptible to misinterpretation. By defining this term, users and AHJs will understand the proper use and intent of the terms in NFPA 86.

Public Input No. 62-NFPA 86-2024 [Section No. 3.3]

3.3 General Definitions.

Damage-Limiting Construction . Any set of construction elements, used individually or in combination, which will act to limit damage from an explosion, including open structures, pressure relieving construction, or pressure resistant construction. [GR1]

Explosion. The bursting or rupture of an enclosure or a container due to the development of internal pressure from a deflagration. [**69** , 2024]

Deflagration. Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium. [**68,** 2023]

3.3. XX Heating Chamber. The space in an oven or furnace where work is processed.

3.3.XY * Combustion Chamber. The space where burners operate which may be internal or external to an oven or furnace. [GR1]

A.3.3.XY A combustion chamber may also be a heating chamber. This would involve direct-fired internal heating systems defined in 3.3.35.4.

NEW ANNEX O INFORMATIONAL REFERENCES

FM Global Property Loss Prevention Data Sheets 1 -44, *Damage-Limiting Construction* , 2023

3.3.1 Air.

3.3.1.1 Burnout Air.

Air introduced into a furnace chamber for the purpose of burning out flammable atmospheres, residual soot, or other carbonaceous material.

3.3.1.2 Combustion Air.

The air necessary to provide for the complete combustion of fuel and usually consisting of primary air, secondary air, and excess air. [**211,** 2019]

3.3.1.3 Primary Air.

All air supplied through the burner.

3.3.1.4 Process Control Air.

Air introduced to a furnace containing a special atmosphere to establish a controlled oxygen level or carbon potential.

3.3.1.5 Reaction Air.

All the air that, when reacted with gas in an endothermic generator by the indirect addition of heat, becomes a special atmosphere gas.

3.3.1.6 Secondary Air.

All the combustion air that is intentionally allowed to enter the combustion chamber in excess of primary air.

3.3.2 Automatic Fire Check.

A flame arrester equipped with a check valve to shut off the fuel gas supply automatically if a backfire occurs.

3.3.3 Backfire Arrester.

A flame arrester installed in fully premixed air–fuel gas distribution piping to terminate flame propagation therein, shut off fuel supply, and relieve pressure resulting from a backfire.

3.3.4 Burner.

A device or group of devices used for the introduction of fuel, air, oxygen, or oxygen-enriched air into a furnace at the required velocities, turbulence, and concentration to maintain ignition and combustion of fuel.

3.3.4.1 _ Atmospheric Burner.

A burner used in a low-pressure fuel gas or atmospheric system that requires secondary air for complete combustion.

3.3.4.2 _ Atomizing Burner.

A burner in which oil is divided into a fine spray by an atomizing agent, such as steam or air.

3.3.4.3 _ Blast Burner.

A burner delivering a combustible mixture to the combustion zone under a pressure that is normally above 0.3 in. w.c. (75 kPa).

3.3.4.4 _ Combination Fuel Gas and Oil Burner.

A burner designed to burn either fuel gas or oil or to burn both simultaneously.

3.3.4.5 _ Dual-Fuel Burner.

A burner designed to burn either fuel gas or oil but not to burn both simultaneously.

3.3.4.6 _ Line Burner.

A burner whose flame is a continuous line.

3.3.4.7 _ Multiple-Port Burner.

A burner having two or more separate discharge openings or ports.

3.3.4.8 _ Nozzle Mixing Burner.

A burner in which the fuel and air are introduced separately to the point of ignition.

3.3.4.9 _ Premix Burner.

A burner in which the fuel and air are mixed prior to the point of ignition.

3.3.4.10 _ Pressure Atomizing Burner.

An atomizing burner in which oil under high pressure is forced through small orifices to emit liquid fuel in a finely divided state.

3.3.4.11 _ Radiant Burner.

A burner designed to transfer a significant part of the combustion heat in the form of radiation.

3.3.4.12 _ Radiant Tube Burner.

A burner designed to provide a long flame within a tube to ensure substantially uniform radiation from the tube surface.

3.3.4.13 _ Rotary Atomizing Burner.

An atomizing burner in which oil is atomized by applied centrifugal force, such as by a whirling cone or plate.

3.3.4.14 _ Self-Piloted Burner.

A burner in which the pilot fuel is issued from the same ports as the main flame or merges with the main flame to form a common flame envelope with a common flame base.

3.3.5 * _ Burner Management System.

The field devices, logic system, and final control elements dedicated to combustion safety and operator assistance in the starting and stopping of fuel preparation and burning equipment and for preventing misoperation of and damage to fuel preparation and burning equipment. [**85,** 2019]

3.3.6 _ Burner System.

One or more burners operated as a unit by a common safety shutoff valve(s).

3.3.7 _ Burner Turndown.

The ratio of maximum to minimum burner fuel–input rates.

3.3.8 _ Burn-In.

The procedure used in starting up a special atmosphere furnace to replace air within the heating chamber(s) and vestibule(s) with flammable special atmosphere.

3.3.9 _ Burn-Out.

The procedure used in shutting down or idling a special atmosphere to replace flammable atmosphere within the heating chamber(s) and vestibule(s) with nonflammable atmosphere.

3.3.10 _ Combustion Safeguard.

A safety device or system that responds to the presence or absence of flame properties using one or more flame detectors and provides safe start-up, safe operation, and safe shutdown of a burner under normal and abnormal conditions.

3.3.11 _ Controller.

3.3.11.1 _ Continuous Vapor Concentration Controller.

A device that measures, indicates, and directly or indirectly controls the concentration of a flammable vapor–air mixture as expressed in percentage of the lower flammable limit (LFL).

3.3.11.2 _ Continuous Vapor Concentration High-Limit Controller.

A device designed to initiate reduction of the vapor concentration if the concentration exceeds a predetermined set point.

3.3.11.3 _ Programmable Controller.

A digital electronic system designed for use in an industrial environment that uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions to control, through digital or analog inputs and outputs, various types of machines or processes.

3.3.11.4 _ Temperature Controller.

A device that measures the temperature and automatically controls the input of heat into the furnace.

3.3.12 _ Cooling Systems.

3.3.12.1 _ Closed Cooling Systems.

A cooling system that does not utilize unrestricted sight drain(s) observable by the operator(s).

3.3.12.2 _ Open Cooling Systems.

A cooling system that utilizes unrestricted sight drain(s) observable by the operator(s).

3.3.13 ***** _ Cryogenic Fluid.

A fluid produced or stored at very low temperatures.

3.3.14 ***** _ Cut-Away Damper.

A restricting airflow device that, when placed in the maximum closed position, still allows the required flow for safety ventilation.

3.3.15 _ Direct-Fired Air Makeup Unit.

A Class B fuel-fired heat utilization unit operating at approximately atmospheric pressure used to heat outside replacement air for the process.

3.3.16 ***** _ Direct Heat Recovery System.

A system comprising a blower and ductwork that recirculates hot exhaust from a thermal oxidizer into the work-chamber of an oven to reduce the oven's energy consumption.

3.3.17 ***** _ Explosion-Resistant (Radiant Tube).

A radiant tube or radiant tube heat recovery system that does not fail catastrophically when subjected to the maximum deflagration pressure caused by the ignition of an accumulation of a stoichiometric mixture of the selected fuel(s) and air.

3.3.18 _ Flame Arrester.

A device that prevents the transmission of a flame through a flammable gas/air mixture by quenching the flame on the surfaces of an array of small passages through which the flame must pass. [**69,** 2019]

3.3.19 * _ Flame Curtain.

A type of line burner used to provide an ignition source of flammable gases exiting a furnace or to reduce the ingress of air into a furnace.

3.3.20 _ Flame Detector.

A safety device directly responsive to flame properties that senses the presence or absence of flame using flame sensors.

3.3.21 _ Flame Failure Response Time (FFRT).

The period of time that starts with the loss of flame and ends with the de-energizing of the safety shutoff valve(s).

3.3.22 * _ Flame Propagation Rate.

The speed at which a flame progresses through a combustible fuel–air mixture.

3.3.23 * _ Flame Rod.

A sensor that employs an electrically insulated rod of temperature-resistant material that extends into the flame being supervised, with a voltage impressed between the rod and a ground connected to the nozzle or burner.

3.3.24 * _ Flammable Limits.

The range of concentration of a flammable gas in air within which a flame can be propagated, with the lowest flammable concentration known as the lower flammable limit (LFL) and the highest flammable concentration known as the upper flammable limit (UFL).

3.3.25 _ Fuel Gas.

A gas used as a fuel source, including natural gas, manufactured gas, sludge gas, liquefied petroleum gas–air mixtures, liquefied petroleum gas in the vapor phase, and mixtures of these gases. [**820,** 2020]

3.3.26 _ Fuel Gas System.

3.3.26.1 _ High Pressure Fuel Gas System.

A fuel gas system using the kinetic energy of a jet of 1 psig (7 kPa) or higher gas pressure to entrain from the atmosphere all, or nearly all, the air required for combustion.

3.3.26.2 _ Low Pressure or Atmospheric Fuel Gas System.

A fuel gas system using the kinetic energy of a jet of less than 1 psig (7 kPa) gas pressure to entrain from the atmosphere a portion of the air required for combustion.

3.3.27 _ Fuel Oil.

A liquid fuel used as a fuel source, including Grades 2, 4, 5, or 6 fuel oils as defined in ASTM D396, *Standard Specifications for Fuel Oils* .

3.3.28 _ Fume Incinerator.

Any separate or independent combustion equipment or device that entrains the process exhaust for the purpose of direct thermal or catalytic destruction, which can include heat recovery.

3.3.29 _ Furnace.

3.3.29.1 _ Atmosphere Furnace.

A furnace built to allow heat processing of materials in a special processing atmosphere.

3.3.29.2 _ Batch Furnace.

A furnace into which the work charge is introduced all at once.

3.3.29.3 * _ Class A Furnace.

An oven or furnace that has heat utilization equipment wherein there is a potential explosion or fire hazard that could be occasioned by the presence of flammable volatiles or combustible materials processed or heated in the furnace.

3.3.29.4 * _ Class B Furnace.

An oven or furnace that has heat utilization equipment wherein there are no flammable volatiles or combustible materials being heated.

3.3.29.5 * _ Class C Furnace.

An oven or furnace that has a potential hazard due to a flammable or other special atmosphere being used for treatment of material in process.

3.3.29.6 * _ Class D Furnace.

An oven or furnace that is a pressure vessel that operates under vacuum for all or part of the process cycle.

3.3.29.7 _ Continuous Furnace.

A furnace into which the work charge is more or less continuously introduced.

3.3.29.8 _ Molten Salt Bath Furnace.

A furnace that employs salts heated to a molten state, excluding aqueous alkaline baths, hot brine, or other systems utilizing salts in solution.

3.3.29.9 _ Plasma Arc Furnace.

A furnace that employs the passage of an electric current between a pair of electrodes or between electrodes and the work and that ionizes a gas (such as argon) and transfers energy in the form of heat.

3.3.30 _ Gas.

3.3.30.1 _ Ballast Gas.

Atmospheric air or a dry gas that is admitted into the compression chamber of rotary mechanical pumps to prevent condensation of vapors in the pump oil by maintaining the partial pressure of the condensable vapors below the saturation value.

3.3.30.2 _ Inert Gas.

See 3.3.71.5 , Inert Special Atmosphere (Purge Gas).

3.3.30.3 _ Reaction Gas.

A gas that, when reacted with air in an endothermic generator by the addition of heat, becomes a special atmosphere gas.

3.3.31 _ Gas Analyzer.

A device that measures concentrations, directly or indirectly, of some or all components in a gas or mixture.

3.3.32 * _ Gas Quenching.

The introduction of a gas into a furnace for the purpose of cooling the work.

3.3.32.1 _ High Pressure Gas Quenching.

Gas-cooling at pressures greater than 15 psig.

3.3.33 _ Guarded.

Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger. [**70:** 100]

3.3.34 * _ Hardwired.

The method of interconnecting signals or interlocks to a logic system or between logic systems using a dedicated interconnection for each individual signal.

3.3.35 _ Heating System.

3.3.35.1 * _ Dielectric Heating System.

A heating system similar to an induction heater, but using frequencies that generally are higher (3 MHz or more) than those used in induction heating.

3.3.35.2 _ Direct-Fired External Heating System.

A heating system in which the burners are in a combustion chamber effectively separated from the heating chamber and arranged so that products of combustion from the burners are discharged into the heating chamber by a circulating fan or blower.

3.3.35.3 * _ Direct-Fired Heating System.

A heating system in which the products of combustion enter the heating chamber.

3.3.35.4 _ Direct-Fired Internal Heating System.

A heating system in which the burners are located within the heating chamber.

3.3.35.5 _ Indirect-Fired Heating System.

A heating system in which the products of combustion do not enter the heating chamber.

3.3.35.6 * _ Indirect-Fired Internal Heating System.

A heating system of gastight radiators containing burners not in contact with the oven atmosphere.

3.3.35.7 * _ Induction Heating System.

A heating system by means of which a current-carrying conductor induces the transfer of electrical energy to the work by eddy currents.

3.3.35.8 _ Radiant Tube Heating System.

A heating system with tubular elements open at one or both ends in which each tube has an inlet burner arrangement where combustion is initiated, a suitable length where combustion occurs, and an outlet that discharges outside the heating chamber for the combustion products formed.

3.3.35.9 * _ Resistance Heating System.

A heating system in which heat is produced by current flow through a resistive conductor.

3.3.35.10 _ Tubular Heating System.

A radiant heating system in which resistive conductors are enclosed in glass, quartz, or ceramic envelopes that can contain a special gas atmosphere.

3.3.36 _ Ignition Temperature.

The lowest temperature at which a gas–air mixture can ignite and continue to burn; also referred to as *auto-ignition temperature* .

3.3.37 * _ Implosion.

The rapid inward collapsing of the walls of a vacuum component or device as the result of failure of the walls to sustain the atmospheric pressure.

3.3.38 * _ Impulse Line.

A pipe or tube used to connect a device to a point in the system to sense pressure.

3.3.39 _ Interlock.

3.3.39.1 _ 1400°F (760°C) Bypass Interlock.

A device designed to permit specific permitted logic when the combustion chamber is proved to be above 1400°F (760°C).

3.3.39.2 _ Excess Temperature Limit Interlock.

A device designed to cut off the source of heat if the operating temperature exceeds a predetermined temperature set point.

3.3.39.3 _ Safety Interlock.

A device required to ensure safe startup and safe operation and to cause safe equipment shutdown.

3.3.40 * _ Limiting Oxidant Concentration (LOC).

The concentration of oxidant below which a deflagration cannot occur.

3.3.41 _ LOC.

See 3.3.40 , Limiting Oxidant Concentration (LOC).

3.3.42 _ Lower Flammable Limit (LFL).

See 3.3.24 , Flammable Limits.

3.3.43 _ Mixer.

3.3.43.1 _ Air–Fuel Gas Mixer.

A mixer that combines air and fuel gas in specific proportions for use in combustion.

3.3.43.2 * _ Air Jet Mixer.

A mixer using the kinetic energy of a stream of air issuing from an orifice to entrain the fuel gas required for combustion.

3.3.43.3 _ Gas Jet Mixer [Atmospheric Inspirator (Venturi) Mixer].

A mixer using the kinetic energy of a jet of fuel gas issuing from an orifice to entrain all or part of the air required for combustion.

3.3.43.4 _ Proportional Mixer.

A mixer comprising an inspirator that, when supplied with air, draws all the fuel gas necessary for combustion into the airstream, and a governor, zero regulator, or ratio valve that reduces incoming fuel gas pressure to approximately atmospheric.

3.3.44 _ Mixing Blower.

A motor-driven blower to supply air–fuel gas mixtures for combustion through one or more fuel burners or nozzles on a single-zone industrial heating appliance or on each control zone of a multizone installation.

3.3.45 _ Mixing Machine.

An externally powered mechanical device that mixes fuel and air and compresses the resultant mixture to a pressure suitable for delivery to its point of use.

3.3.46 _ Molten Bath Salt.

See 3.3.29.8 , Molten Salt Bath Furnace.

3.3.47 _ Muffle.

An enclosure within a furnace to separate the source of heat from the work and from any special atmosphere that might be required for the process.

3.3.48 _ Oil Separator.

An oil reservoir with baffles used to minimize the discharge of oil mist from the exhaust of a rotary mechanical vacuum pump.

3.3.49 _ Operator.

An individual trained and responsible for the startup, operation, shutdown, and emergency handling of the furnace and associated equipment.

3.3.50 _ Outgassing.

The release of adsorbed or occluded gases or water vapor, usually by heating, such as from a vacuum tube or other vacuum system.

3.3.51 _ Oven.

See 3.3.29.1 through 3.3.29.9 , Furnace definitions.

3.3.51.1 * _ Low-Oxygen Oven.

An oven that utilizes a low-oxygen atmosphere to evaporate solvent to facilitate solvent recovery.

3.3.52 * _ Oxidizer Systems.

3.3.52.1 _ Afterburner.

See 3.3.52.4 , Thermal Oxidizer.

3.3.52.2 _ Catalytic Oxidizer.

An independently controlled, enclosed oxidizer system whose purpose is to destroy VOC, HC gases or vapors, or both, using moderately elevated temperature, residence time, mixing, and excess oxygen, in the presence of catalysts.

3.3.52.3 _ Fume Incinerator.

See 3.3.52.4 , Thermal Oxidizer.

3.3.52.4 _ Thermal Oxidizer.

An independently controlled, enclosed oxidizer system whose purpose is to destroy VOC, HC gases or vapors, or both, using elevated temperature, residence time, mixing, and excess oxygen without catalysts.

3.3.53 _ Partial Pressure.

The pressure, in absolute units, exerted by a particular gas in a gas mixture. [**99,** 2021]

3.3.54 _ Pilot.

A flame that is used to light the main burner.

3.3.54.1 _ Burn-off Pilot.

A pilot that ignites special processing atmosphere discharging from the furnace or generator.

3.3.54.2 _ Continuous Pilot.

A pilot that burns throughout the entire period that the heating equipment is in service, regardless of whether the main burner is firing.

3.3.54.3 _ Flame Curtain Pilot.

A pilot that ignites a flame curtain.

3.3.54.4 _ Intermittent Pilot.

A pilot that burns during light-off and while the main burner is firing.

3.3.54.5 _ Interrupted Pilot.

A pilot that is ignited and burns during light-off and is automatically shut off at the end of the trial-for-ignition period of the main burner(s).

3.3.54.6 _ Proved Pilot.

A pilot whose flame is supervised by a flame detector that senses the presence of the pilot flame.

3.3.55 _ Pipe Burner.

A burner consisting of a tube or pipe with ports or tips spaced over its length.

3.3.56 _ Plasma Arc.

A heating process in which an ionized gas, such as nitrogen or argon, is used to conduct electrical current.

3.3.57 _ Pressure Regulator.

A device placed in a gas line for reducing, controlling, and maintaining the pressure in that portion of the piping system downstream of the device.

3.3.57.1 Line Pressure Regulator.

A pressure regulator placed in a gas line between the service regulator and the appliance (equipment) regulator.

3.3.57.2 Monitoring Pressure Regulator.

A pressure regulator in a nonregulated state and set in series with another pressure regulator for the purpose of automatically taking over, in an emergency, control of the pressure downstream of the regulator in cases where pressure exceeds a set maximum.

3.3.57.3 Series Pressure Regulator.

A pressure regulator in series with one service or line pressure regulator.

3.3.57.4 Service Pressure Regulator.

A pressure regulator installed by the serving gas supplier to reduce and limit the service line gas pressure to delivery pressure.

3.3.58 Pressure Relief Valve.

A valve that automatically opens and closes a relief vent, depending on whether the pressure is above or below a predetermined value. [**54,** 2021]

3.3.59 Pump.

3.3.59.1 Diffusion Pump.

A vacuum pump in which a stream of heavy molecules, such as those of mercury or oil vapor, carries gas molecules out of the volume being evacuated.

3.3.59.2 Gas Ballast Pump.

A mechanical pump (usually of the rotary type) that uses oil to seal the clearances between the stationary and rotating compression members. The pump is equipped with an inlet valve through which a suitable quantity of atmospheric air or “dry” gas (ballast gas) can be admitted into the compression chamber to prevent condensation of vapors in the pump oil by maintaining the partial pressure of the condensable vapors in the oil below the saturation value (sometimes called a *vented-exhaust mechanical pump*).

3.3.59.3 Holding Pump.

A backing (fore) pump used to hold a diffusion pump at efficient operating conditions while a roughing pump reduces system pressure to a point at which a valve between the diffusion pump and the system can be opened without stopping the flow of vapor from the nozzles.

3.3.59.4 Rotary Blower Pump.

A pump without a discharge valve that moves gas by the propelling action of one or more rapidly rotating members provided with lobes, blades, or vanes; also referred to as *mechanical booster pump* where used in series with a mechanical backing (fore) pump.

3.3.59.5 * Roughing Pump.

The pump used to reduce the system pressure to the level at which a diffusion or other vacuum pump can operate.

3.3.59.6 Vacuum Pump.

A compressor for exhausting air and noncondensable gases from a space that is to be maintained at subatmospheric pressure.

3.3.60 Pump-Down Factor.

The product of the time to pump down to a given pressure and the displacement (for a service factor of 1) divided by the volume of the system ($F = tD/V$).

3.3.61 Pump Fluid.

The operating fluid used in diffusion pumps or in liquid-sealed mechanical pumps (sometimes called *working medium, working fluid* , or *pump oil*).

3.3.62 _ Purge.

The replacement of a flammable, indeterminate, or high-oxygen-bearing atmosphere with another gas that, when complete, results in a nonflammable final state.

3.3.63 _ Readily Accessible.

Capable of being reached quickly and safely for effective use under emergency conditions without the aid of tools. [**302,** 2020]

3.3.64 _ Roughing Line.

A line running from a mechanical pump to a vacuum chamber through which preliminary pumping is conducted to a vacuum range at which a diffusion pump or other high vacuum pump can operate.

3.3.65 * _ Safe-Start Check.

A test incorporated in a combustion safeguard that prevents start-up if a flame-detected condition exists due to component failure within the combustion safeguard or flame detector(s) due to the presence of actual or simulated flame.

3.3.66 _ Safety Blowout.

A device or combination of devices that quench a flame, relieve pressure, and provide a means for automatic shutoff of the air–gas mixture flow in the event of a flashback in air–fuel gas mixture piping.

3.3.67 * _ Safety Device.

An instrument, a control, or other equipment that acts, or initiates action, to cause the furnace to revert to a safe condition in the event of equipment failure or other hazardous event.

3.3.68 _ Safety Relay.

A relay listed for safety service.

3.3.69 * _ Safety Shutdown.

Stopping heating operations by means of a safety control or interlock that shuts off heating energy in a manner necessitating manual restart.

3.3.70 _ Scf.

One cubic foot of gas at 70°F (21°C) and 14.7 psia (an absolute pressure of 101 kPa).

3.3.71 _ Special Atmosphere.

A prepared gas or a gas mixture that is introduced into the heating chamber of a furnace to replace air, generally to protect or intentionally change the surface of the material undergoing heat processing (heat treatment).

3.3.71.1 _ Carrier Gas Special Atmosphere.

A gas or liquid component of a special atmosphere that represents a sufficient portion of the special atmosphere gas volume in the furnace so that, if the flow of the gas or liquid component ceases, the total flow of the special atmosphere in the furnace is not sufficient to maintain a positive pressure in the furnace.

3.3.71.2 _ Flammable Special Atmosphere.

A special atmosphere in which gases are known to be flammable and predictably ignitible where mixed with air.

3.3.71.3 _ Generated Special Atmosphere.

A special atmosphere created in an ammonia dissociator, exothermic generator, or endothermic generator by dissociation or chemical reaction of reaction air and reaction gas.

3.3.71.4 _ Indeterminate Special Atmosphere.

A special atmosphere that contains components that, in their pure state, are flammable but that, in the mixtures used (diluted with nonflammable gases), are not reliably and predictably flammable.

3.3.71.5 _ Inert Special Atmosphere (Purge Gas).

A special atmosphere of nonflammable gases that contains less than 1 percent oxygen.

3.3.71.6 _ Nonflammable Special Atmosphere.

A special atmosphere of gases that are known to be nonflammable at any temperature.

3.3.71.7 _ Synthetic Special Atmosphere.

A special atmosphere such as those of anhydrous ammonia, hydrogen, nitrogen, or inert gases obtained from compressed gas cylinders or bulk storage tanks and those derived by chemical dissociation or mixing of hydrocarbon fluids, including mixtures of synthetic and generated atmospheres.

3.3.72 _ Supervised Flame.

A flame whose presence or absence is detected by a flame detector.

3.3.73 _ Switch.

3.3.73.1 _ Closed Position Indicator Switch.

A switch that indicates when a valve is within 0.040 in. (1 mm) of its closed position but does not indicate proof of closure.

3.3.73.2 _ Differential Flow Switch.

A switch that is activated by the flow of a gaseous or liquid fluid. This flow is detected by measuring pressure at two different points to produce a pressure differential across the sensor.

3.3.73.3 _ Flow Switch.

A switch that is activated by the flow of a fluid in a duct or piping system.

3.3.73.4 _ Limit Switch.

A switch that actuates when an operating limit has been reached.

3.3.73.5 _ Manual Emergency Switch.

A discrete electromechanical push button–type self-latching device that is used to initiate a safety shutdown.

3.3.73.6 _ Pressure Switch.

3.3.73.6.1 _ Atomizing Medium Pressure Switch.

A pressure-activated switch arranged to effect a safety shutdown or to prevent the oil burner system from being actuated in the event of inadequate atomizing medium pressure.

3.3.73.6.2 _ Combustion Air Pressure Switch.

A pressure-activated switch arranged to effect a safety shutdown or to prevent the burner system from being actuated when the combustion air pressure is below its design set point.

3.3.73.6.3 _ High Fuel Pressure Switch.

A pressure-activated switch arranged to effect a safety shutdown of the burner system in the event of abnormally high fuel pressure.

3.3.73.6.4 _ Low Fuel Pressure Switch.

A pressure-activated switch arranged to effect a safety shutdown of the burner system in the event of abnormally low fuel pressure.

3.3.73.7 * _ Proof-of-Closure Switch.

A switch installed in a safety shutoff valve that activates only after the valve is fully closed.

3.3.73.8 _ Rotational Switch.

A switch that usually is driven directly by the fan wheel or fan motor shaft and in which a switch contact closes when the speed of the fan shaft or drive motor reaches a certain predetermined rate.

3.3.74 Tank.

3.3.74.1 Integral Liquid or Salt Media Quench-Type Tank.

A quench-type tank connected to the furnace so that the work is under a protective atmosphere from the time it leaves the heating zone until it enters the tank containing a combustible, noncombustible, or salt quench medium.

3.3.74.2 Open Liquid or Salt Media Quench-Type Tank.

A quench-type tank in which work from the furnace is exposed to air before and upon entering the tank containing a combustible, noncombustible, or salt quench medium.

3.3.75 Time.

3.3.75.1 Evacuation Time.

The time required to pump a given system from atmospheric pressure to a specified pressure; also referred to as *pump-down time* or *time of exhaust*.

3.3.75.2 Roughing Time.

The time required to pump a given system from atmospheric pressure to a pressure at which a diffusion pump or other high vacuum pump can operate.

3.3.76 Trial-for-Ignition Period (Flame-Establishing Period).

The interval of time during light-off that a combustion safeguard allows the fuel safety shutoff valve to remain open before the flame detector is required to supervise the flame.

3.3.77 Vacuum.

A space in which the pressure is far below atmospheric pressure so that the remaining gases do not affect processes being carried out in the space.

3.3.77.1 High Vacuum.

A vacuum with a pressure between 1×10^{-3} torr and 1×10^{-5} torr (millimeters of mercury).

3.3.77.2 Low Vacuum.

A vacuum with a pressure between the local ambient pressure and 1×10^{-3} torr (millimeters of mercury).

3.3.78 Vacuum Gauge.

A device that indicates the absolute gas pressure in a vacuum system.

3.3.79 Vacuum Pumping System.

A system of pumps, valves and associated piping and wiring, related protective equipment, and measuring and control instrumentation that produce and control the level of vacuum in a vacuum furnace.

3.3.80 Vacuum System.

A chamber with walls capable of withstanding atmospheric pressure and an opening through which gas can be removed through a pipe or manifold to a pumping system, and including all pumps, gauges, valves, and other components.

3.3.81 Vacuum-Type Insulation.

A highly reflective double-wall structure with high vacuum between the walls; used as insulation in cryogenic systems for the reduction of heat transfer.

3.3.82 Valve.

3.3.82.1 Air Inlet Valve.

A valve used for letting atmospheric air into a vacuum system; also called a *vacuum breaker*.

3.3.82.2 Emergency Shutoff Valve.

A manual shutoff valve to allow the fuel to be turned off in an emergency.

3.3.82.3 _ Equipment Isolation Valve.

A manual shutoff valve for shutoff of the fuel to each piece of equipment.

3.3.82.4 * _ Safety Shutoff Valve.

A normally closed valve installed in the piping that closes automatically to shut off the fuel, atmosphere gas, or oxygen in the event of abnormal conditions or during shutdown.

3.3.83 * _ Valve Proving System.

A system used to check the closure of safety shutoff valves by detecting leakage.

3.3.84 _ Vent Limiter.

A fixed orifice that limits the escape of gas from a vented device into the atmosphere.

3.3.85 _ Ventilation.

A supply of fresh air to, and exhaust from, a furnace that provides a vigorous, distributed flow of air through all sections of the furnace.

3.3.85.1 * _ Safety Ventilation.

The ventilation necessary to dilute atmosphere within a Class A oven to not exceed the maximum permitted percent of the Lower Flammable Limit (LFL).

3.3.86 _ Water-Cooling System for Vacuum Furnaces.

The apparatus, equipment, and method used to cool vacuum chamber walls, electrical terminals, seals, workload, and the interior of the furnace where applicable.

Statement of Problem and Substantiation for Public Input

Definitions to submit related PI addressing section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 60-NFPA 86-2024 [Section No. 5.3]	

Submitter Information Verification

Submitter Full Name:	Saoirse George
Organization:	Tokio Marine America, Inc.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 03 20:24:41 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 8-NFPA 86-2023 [Section No. 3.3.10]

3.3.10 Combustion Safeguard.

A safety device or system that responds to the presence or absence of flame properties using one or more flame detectors and ~~provides~~ participates in the safe start-up, safe operation, and safe shutdown of a burner ~~under normal and abnormal conditions~~ through its interaction with the burner management system or safety PLC .

Statement of Problem and Substantiation for Public Input

The terms "combustion safeguard" and "burner management system" are often incorrectly believed to be synonymous. The prior wording of this definition for combustion safeguard inaccurately co-opted some of the functions of a BMS which exacerbated the confusion. A combustion safeguard, as used in NFPA 86, means the flame sensor, interconnect wiring that transmits the flame signal, and the electronics that judges whether the flame signal is or isn't strong enough to conclude a flame is present. The output of a Combustion Safeguard is a binary input to the BMS and it may be used by the BMS for safe-start-check, trial-for-ignition, and flame failure determinations.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 9-NFPA 86-2023 [New Section after A.3.3.5]	

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Jan 20 18:08:34 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-46-NFPA 86-2024

Statement: This revision clarifies that the "combustion safeguard" and BMS are not the same. The terms "combustion safeguard" and "burner management system" are often misinterpreted to be synonymous.

Public Input No. 26-NFPA 86-2024 [New Section after 3.3.25]

TITLE OF NEW CONTENT

3.3.25.1 Hydrogen Gas

Hydrogen gas having a purity greater than 95% by volume or the minimum concentration defined in the most current edition of NFPA 2.

3.3.25.2 Hydrogen Gas Mixtures

Gas mixtures having a concentration greater than 10% hydrogen by volume or the maximum concentration defined in the most current edition of NFPA 2, whichever is greater.

Statement of Problem and Substantiation for Public Input

The terms Hydrogen Gas and Hydrogen Gas Mixtures are used in NFPA 86:2023 clause 1.3.4 (1) (f) but are not defined in this Standard nor are they defined in the NFPA Glossary of Terms.
NFPA 86:2023 Standard defined a 10% hydrogen by volume limit in clause 6.2.10.2.6:

Submitter Information Verification

Submitter Full Name:	Ted Jablkowski
Organization:	Fives North American Combustion
Affiliation:	Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 15:16:57 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: CI-21-NFPA 86-2024

Statement: The proposed definitions include requirements which does not align with the NFPA Manual of Style. At the Second Draft meeting the committee will reconsider these definitions along with what percent concentration of hydrogen, within a hydrogen gas mixture, will need to apply within NFPA 86. In an effort to harmonize with other NFPA documents, this committee will also consider what actions the technical committees of NFPA 2 and NFPA 54 have taken in regards to hydrogen gas mixture concentrations.

Public Input No. 34-NFPA 86-2024 [New Section after 3.3.35]

TITLE OF NEW CONTENT

New Definition after 3.3.35 and renumber thereafter:

3.3.xx Hydrogen Equipment Enclosure (HEE).

A prefabricated area designed to protect hydrogen equipment that is confined by at least three walls and a roof not routinely occupied, and has a total area less than 450 ft2 (41.8 m2). (NFPA 2, 2019)

Statement of Problem and Substantiation for Public Input

The term will be used in the proposed new 6.2.14 but is not defined.

Submitter Information Verification

Submitter Full Name:	Ted Jablkowski
Organization:	Fives North American Combustion
Affiliation:	Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 17:41:51 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-15-NFPA 86-2024
Statement:	The unique properties of hydrogen necessitate the construction of special enclosures. NFPA 2 has scope over hydrogen and hydrogen enclosure requirements that the user needs to follow to maintain safety.

Public Input No. 46-NFPA 86-2024 [Section No. 5.3]

5.3* Explosion ~~Relief~~ Control .

5.3.1*

~~The work chamber of Class A ovens that require safety ventilation shall be equipped with unobstructed explosion relief for freely relieving internal explosion pressures~~ Additional explosion control for Class A ovens where flammable constituents evolve in the process of heating except in the following cases:

(1) ~~Explosion relief shall not~~ No additional explosion control shall be required for low-oxygen atmosphere ovens designed and protected in accordance with Section 11.7.

(2) ~~Explosion relief shall not~~ No additional explosion control shall be required in the heating chamber of indirect-fired ovens where it is demonstrated by calculation that the combustible concentration in the heating chamber cannot exceed 25 percent of the lower flammable limit (LFL) under any operating conditions.

~~*~~ ~~Explosion relief shall not be required in the heating chamber of~~

(3) No additional explosion control shall be required for the combustion chamber of an indirect-fired oven that incorporates a single combustion airflow path through the heat exchanger and does not recirculate the products of combustion.

(4) * No additional explosion control shall be required for direct-fired ovens where all of the following conditions are met:

(5) It is demonstrated by calculation that the combustible concentration in the heating chamber cannot exceed 25 percent of the LFL

~~under any operating conditions~~

(a) when operating in accordance with the design parameters .

~~The~~

(a) LFL aspirating detection is provided to monitor flammable concentrations in each direct-fired combustion chamber and interlocked to prevent start-up or initiate a safety shutdown upon detecting a concentration greater than 10 percent of the LFL.

(b) Where recirculating direct-fired systems are implemented, the LFL aspirating detection system is calibrated for all possible flammable gases that could be present as a result of the process or incomplete combustion.

(c) The LFL aspirating detection sensing intake ports are located in the region of each combustion chamber that is most likely to accumulate flammable gases as a result of a gas leak or incomplete combustion.

(d) Documentation of the LFL aspirating detection system calibration is maintained and posted at each system.

(e) The calibration of the LFL aspirating detection systems is performed in accordance with the manufacturer's instructions.

(f) The calibration of the LFL aspirating detection systems is performed at least once per month.

(6)* ~~Explosion relief shall not~~ No additional explosion control shall be required for ~~the combustion chamber of an indirect~~ a direct gas -fired oven ~~that incorporates a single combustion airflow path through the heat exchanger and does not recirculate the products of combustion~~ where the process exhaust is not recirculated through the air heater and it is demonstrated by calculation that the combustible concentration cannot exceed 25 percent of the lower flammable limit (LFL) when operating in accordance with the design parameters .

5.3.2

Where required by 5.3.1, additional explosion control shall consist of one or more of the following control methods:

(1) Damage-limiting constuction

(2) Deflagration prevention

5.3.2.1

Where the explosion control method requires continued safety ventilation or monitoring, provisions shall be made for power outages by one of the following:

(1) An emergency standby power generator is provided for emergency shutdown during a power failure.

(2) Alternative safety shutdown procedures for power failure are employed.

5.3.2.2 * –

~~Explosion relief~~

Where the explosion control method results in a shutdown where flammable vapors may remain within the oven volume, provisions shall be made to purge the oven. Upon completion of the purge, verification measurements shall be taken at the exhaust to ensure the concentration is below 25 percent of the lower flammable limit (LFL) prior to energizing the air heating source.

5.3.3 *

Damage-Limiting Construction. Damage-limiting construction shall be based on one of the following:

(1) The amount of ~~explosion relief~~ deflagration vent area shall be at least 1 ft^2 (0.093 m^2)~~- of relief area for~~ for each 15 ft^3 (0.424 m^3) of furnace volume.

(2) The amount of ~~explosion relief shall~~ deflagration vent area shall be based on the requirements of NFPA 68.

(3) Deflagration pressure containment in accordance with NFPA 69

(4) * Approved damage-limiting construction in accordance with available standards.

5.3.3 .1

Deflagration vents shall be allowed to release into the space adjacent to the oven.

5.3.3.1.1

If venting to the space adjacent to the oven creates a secondary hazard that cannot be mitigated by other means, then a deflagration prevention method shall be used.

5.3.3.2

Hinged panels, openings, or access doors equipped with approved ~~explosion-relief~~ deflagration vent hardware shall be permitted to be included in the ~~ratio~~ vent area specified in 5.3.3(1) or 5.3.3(2) .

5.3.~~4~~ 3.3

~~Explosion-relief~~ Deflagration vents shall be arranged so that, when open, the full vent opening provides an effective relief area.

5.3.~~4~~ 3 .3. 1

The operation of deflagration vents to their full capacity shall not be obstructed.

5.3.~~4~~ 3 .3. 2

Warning signs shall be posted on the deflagration vents.

5.3.~~5~~ 3.4 *

~~Explosion-relief~~ Deflagration vent(s) shall be located as close as practical to each known source of ignition to minimize damage.

5.3.~~6~~ 3.5

~~Explosion-relief~~ Deflagration vents shall be located or retained so that personnel are not exposed to injury by operation of the vents.

5.3.~~7~~ 3.6 *

Where ~~explosion relief~~ deflagration venting is required, ~~explosion-relief~~ deflagration vents shall activate at a surge pressure that does not exceed the design pressure of the oven enclosure.

5.3.~~8~~ 3.7 *

~~Explosion-relief~~ Deflagration vents for a long furnace shall be distributed throughout the entire furnace length with the maximum distance between ~~explosion-relief~~ deflagration vents not to exceed five times the oven's smallest inside dimension (width or height).

5.3.4

Deflagration Prevention Systems. Deflagration prevention systems shall be in accordance with one or more of the following:

(1) Oxidant concentration reduction in accordance with NFPA 69

(2) Combustible concentration reduction in accordance with NFPA 69

(3) Deflagration suppression system in accordance with NFPA 69

Statement of Problem and Substantiation for Public Input

The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Class A ovens may require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 49-NFPA 86-2024 [New Section after 3.3]	
Public Input No. 50-NFPA 86-2024 [Section No. A.5.3]	
Public Input No. 51-NFPA 86-2024 [Section No. A.5.3.1]	
Public Input No. 52-NFPA 86-2024 [Section No. A.5.3.1(3)]	
Public Input No. 53-NFPA 86-2024 [Section No. A.5.3.1(4)]	
Public Input No. 54-NFPA 86-2024 [Section No. A.5.3.2]	
Public Input No. 55-NFPA 86-2024 [Section No. A.5.3.5]	
Public Input No. 56-NFPA 86-2024 [Section No. A.5.3.7]	
Public Input No. 57-NFPA 86-2024 [New Section after A.5.3.2]	
Public Input No. 58-NFPA 86-2024 [New Section after A.5.3.1(4)]	
Public Input No. 59-NFPA 86-2024 [Section No. O.1.2.10]	

Submitter Information Verification

Submitter Full Name:	Geoffrey Raifsnider
Organization:	Global Finishing Solutions
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 03 11:19:14 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 60-NFPA 86-2024 [Section No. 5.3]

5.3* Explosion ~~Relief.~~ Control

5.3.1*

~~The work chamber of Class A ovens that require safety ventilation shall be equipped with unobstructed explosion relief for freely relieving internal explosion pressures~~ Additional explosion control shall be provided for lass A ovens where _ flammable constituents evolve in the process of heating except in the following cases:

(1) ~~Explosion relief~~ No additional explosion control shall not be required for low-oxygen atmosphere ovens designed and protected in accordance with Section 11.7.

(2) ~~Explosion relief~~ No additional explosion control shall not be required in the heating chamber of indirect-fired ovens or electrically heated ovens where it is demonstrated by calculation that the combustible concentration in the heating chamber cannot exceed 25 percent of the lower flammable limit (LFL) ~~under any operating conditions~~ whenoperating in accordance with design parameters .

*

(3) Explosion

~~relief~~

(4) control shall not be required

~~in~~

(5) for the

~~heating chamber of direct-fired~~

(6) combustion chamber of an indirect-fired oven that incorporates a single combustion airflow path through the heat exchanger and does not recirculate the products of combustion.

(7) Additional explosion control shall not be required for a direct gas-fired oven where the process exhaust is not recirculated through the air heater and it is demonstrated by calculation that the combustible concentration cannot exceed 25 percent of the lower flammable limit (LFL) when operating in accordance with the design parameters.

(8) * No additional explosion control shall required for direct-fired ovens where all of the following conditions are met:

(9) It is demonstrated by calculation that the combustible concentration in the heating chamber cannot exceed 25 percent of the LFL

~~under any operating conditions~~

(a) _ hen operating in accordance with the design parameters.

(b) The LFL aspirating detection is provided to monitor flammable concentrations in each direct-fired combustion chamber and interlocked to prevent start-up or initiate a safety shutdown upon detecting a concentration greater than 10 percent of the LFL.

(c) Where recirculating direct-fired systems are implemented, the LFL aspirating detection system is calibrated for all possible flammable gases that could be present as a result of the process or incomplete combustion.

(d) The LFL aspirating detection sensing intake ports are located in the region of each combustion chamber that is most likely to accumulate flammable gases as a result of a gas leak or incomplete combustion.

(e) Documentation of the LFL aspirating detection system calibration is maintained and posted at each system.

(f) The calibration of the LFL aspirating detection systems is performed in accordance with the manufacturer’s instructions.

(g) The calibration of the LFL aspirating detection systems is performed at least once per month.

(10)* Explosion relief shall not be required for the combustion chamber of an indirect-fired oven that incorporates a single combustion airflow path through the heat exchanger and does not recirculate the products of combustion.

5.3.2*

~~Explosion relief shall be~~

Where required by section 5.3.1, additional explosion control shall consist of one or more of the following control methods:

(1) Damage-limiting construction

(2) Deflagration prevention

5.3.2.1

Where the explosion control method requires continued safety ventilation or monitoring, provision shall be made for power outages by one of the following: [GS1]

(1) An emergency standby power generator is provided for emergency shutdown during a power failure.

(2) Alternative safety shutdown procedures for power failure are employed.

5.3.2.2 *

Where the explosion control method results in a shutdown where flammable vapors may remain within the oven volume, provisions shall be made to purge the oven. Upon completion of the purge, verification measurements shall be taken at the exhaust to ensure concertation is below 25% of LFL prior to energizing the air heating source.

A.5.3.2.2 See 8.4.1. This preignition purge is required for all types of heating systems.

5.3.3 * Damage-Limiting Construction.

Damage-Limiting Construction shall be based on one of the following:

(1) The amount of

~~explosion relief~~

deflagration vent area shall be at least 1 ft^2 (0.093 m^2) of

~~relief~~

vent area for each 15 ft^3 (0.424 m^3) of furnace volume.

(2) The amount of

~~explosion relief~~

deflagration venting shall be based on the requirements

~~of NFPA 68.~~

of NFPA 68.

(3) Deflagration pressure containment in accordance with NFPA 69

(4) * Approved damage-limiting construction in accordance with available standards.

5.3.3

_

.1 Deflagration vents shall be allowed to release into the space adjacent to the oven.

5.3.3.1.1 If venting to the space adjacent to the oven creates a hazard, then a deflagration prevention method shall be used.

5.3.3.2 Hinged panels, openings, or access doors equipped with approved

~~explosion-relief~~

deflagration vent hardware shall be permitted to be included in the

~~ratio specified in~~

vent area specified in 5.3.3(1) or 5.3. 3(2) .

5.3.

~~4~~
3.3 _

~~Explosion-relief~~ Deflagragion vents shall be arranged so that, when open, the full vent opening provides an effective relief area.

5.3.~~4~~ 3 .3. 1

The operation of deflagration vents to their full capacity shall not be obstructed.

5.3.~~4~~ 3 .3. 2–

Warning signs shall be posted on the deflagration vents.

5.3.~~5~~ 3.4 *

~~Explosion-relief~~ Deflagration vent(s) shall be located as close as practical to each known source of ignition to minimize damage.

5.3.~~6~~ 3.5

~~Explosion-relief~~ Deflagration vents shall be located or retained so that personnel are not exposed to injury by operation of the vents.

5.3.~~7~~ 3.6 *

Where ~~explosion relief~~ deflagration venting is required, ~~explosion-relief~~ vents shall activate at a surge pressure that does not exceed the design pressure of the oven enclosure.

~~5.3.8~~ 3.7 *

~~Explosion-relief~~ Seflagration vents for a long furnace shall be distributed throughout the entire furnace length with the maximum distance between ~~explosion-relief~~ vents not to exceed five times the oven's smallest inside dimension (width or height).

5.3.4 Deflagration Prevention Systems. Deflagration prevention systems shall be in accordance with one or more of the following prevention methods:

(1) Oxidant concentration reduction in accordance with NFPA 69

(2) Combustible concentration reduction in accordance with NFPA 69

(3) Deflagration suppression system in accordance with NFPA 69

5.3.6 Deflagration Avoidance Designs.

5.3.6.1 * Deflagration avoidance designs for simple continuous Class A Ovens ~ *tbd - unders consideration by task group*

5.3.6.2 Deflagration avoidance designs for simple batch Class A Ovens ~ *tbd - unders consideration by task group*

5.3.9.1 An explosion control method shall not be required for continuous Class A Ovens that have all of the following characteristics:

(1) * Design operation and use of the oven shall not result in flammable concentrations in excess of 25% LFL.

(2) The oven exhaust, safety ventilation, recirculation paths have no identified failure modes other than loss of monitored and interlocked airflow that can result in pockets of flammable gas/air mixtures in the explosive range.

(3) The oven is not used for the processing of combustible workpieces that can introduce flammable vapors additional to those from the designed curing process if ignited.

(4) The continuous oven is designed to permit stripping the oven of product without introducing additional product immediately following activation of the flammable vapor high limit controller interlocks. [GR1]

(5) The continuous oven is not dependent on the operation of an oxidizer or other air pollution control device for the continued operation of process, safety, and deflagration avoidance ventilation systems.

(6) The oven shall be equipped with deflagration avoidance ventilation systems that is independent of and redundant to the process and safety ventilation systems. [GR2]

(7) The deflagration avoidance ventilation system shall be capable of driving preventing accumulations in excess of 50% LFL during a worst case credible upset release of solvent or flammable gases into the work chamber.

(8) The deflagration avoidance ventilation system shall be interlocked to:

(a) automatically operate in the event of a concentration of flammable gases and vapors in excess of the control's set point, not to exceed 50% LFL.

(b) discontinue introduction of solvent or parts for curing into the work chamber

(c) continue removal of product from the work chamber until empty (strip the oven)

(d) transmit an audible and visual alarm both locally and through the facilities fire alarm system to a constantly attended location.

Additional Proposed Changes

File Name	Description	Approved
Proposal_-_Explosion_Control_-_240531b.docx	Source document for pl	

Statement of Problem and Substantiation for Public Input

The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Class A ovens may require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 62-NFPA 86-2024 [Section No. 3.3]	
Public Input No. 64-NFPA 86-2024 [Sections A.5.3, A.5.3.1, A.5.3.1(3), A.5.3.1(4), A.5.3.2, A...]	

Submitter Information Verification

Submitter Full Name: Saoirse George
Organization: Tokio Marine America, Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 19:54:36 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 66-NFPA 86-2024 [Section No. 5.3.2]

5.3.2*

Explosion relief shall be based on one of the following:

(1) ~~The~~ In the absence of additional calculations, the amount of explosion relief area shall be at least 1 ft^2 (0.093 m^2) of relief area for each 15 ft^3 (0.424 m^3) of furnace volume.

(2) Reduced releif area ratios are allowed where the strength of the enclosure is demonstrated by calculation to exceed 1.0 psi (0.7 bar). The amount of explosion relief shall be based on the requirements of NFPA 68.

Statement of Problem and Substantiation for Public Input

As stated in A3.5.3.2, "The historic application of 1 SqFt of relief area to 15 CuFt of volume, which is based on industry experience and traditional construction methods, has provided an acceptable level of damage control and personnel protection";. The NFPA86:2019 explosion relief exception [5.3.1(1)] for 3/16" (4.8mm) plate construction was also based on industry experience and construction methods. The "traditional construction methods" for industrial ovens which were practiced when the 1:15 ratio was implemented were often 3" insulated tongue-and-groove panels using 20 gauge (1.0mm) sheet metal with 20 gaage internal rails with little or no external supporting structure. The welded plate construction method often has formed heavy gauge or structural steel internal rails and/or structural steel external supports.. That type of design makes the oven enclosures significantly stronger than the sheet metal tongue-and-groove panel design. The more robust (and energy efficient) design using plate construction has a significantly higher Pred value and, therefore, requires less than the 1:15 ratio to obatin an equal level of risk reduction to the furnace and personnel.

Submitter Information Verification

Submitter Full Name: Steven Onsager

Organization: Horizon Performance Technologies

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jun 04 12:18:20 EDT 2024

Committee: OVE-AAA

Committee Statement

Resolution: The concerns raised by the public input have been addressed in a separate action to Section 5.3, see First Revision No. 1.

Public Input No. 29-NFPA 86-2024 [Section No. 6.2.3.3]

6.2.3.3*

Piping from the point of delivery to the equipment isolation valve shall comply with the applicable national standards for fluid and service conditions. *(See 6.2.4.2.)*

6.2.3.3.1 For natural gas and propane gas, the requirements in NFPA 54 and ASME B31.3 shall be followed.

6.2.3.3.2 For hydrogen gas and hydrogen gas mixtures, the requirements in NFPA 2 and ASME B31.12 shall be followed.

6.2.3.3.3 For mixed gas and manufactured gas, the applicable requirements shall be followed.

Statement of Problem and Substantiation for Public Input

The existing requirement in 6.2.3.3 is vague in its reference to non-mandatory Annex material.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski

Organization: Fives North American Combustion

Affiliation: Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.

Street Address:

City:

State:

Zip:

Submittal Date: Thu May 23 17:29:29 EDT 2024

Committee: OVE-AAA

Committee Statement

Resolution: FR-3-NFPA 86-2024

Statement: As hydrogen, hydrogen mixtures, and other fuels have become more prevalent within the industry, this revision addresses the need to direct the user to specific piping requirements to improve safety.

Public Input No. 35-NFPA 86-2024 [Section No. 6.2.4.2]

6.2.4.2* Piping and Fittings.

6.2.4.2.1*

Piping materials shall be compatible with the fluid and service conditions.

6.2.4.2.1.1

Where threaded fuel gas piping is used it shall be a minimum schedule 40.

6.2.4.2.2

Fuel gas piping shall be sized to provide flow rates and pressure to maintain a stable flame over the burner operating range.

6.2.4.2.3*

The interior of gas pipe, tubing, and fittings shall be free of debris before putting into service.

<u>6.2.4.2.4 Flanged connections shall comply with the applicable requirements of ASME B16 or ASME B31 standards for pipe flanges, fittings, and gaskets or ISO 7005 standards for pipe flanges and fittings.</u>

Statement of Problem and Substantiation for Public Input

This clarifies that use of ISO flanged connections is allowed on the fuel train.

Submitter Information Verification

Submitter Full Name: Kevin Carlisle
Organization: Karl Dungs, Inc.
Affiliation: IHEA
Street Address:
City:
State:
Zip:
Submittal Date: Thu May 23 17:46:17 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: The proposed revision references a series of ASME and ISO documents, and not specific documents that the user must follow. Only specific documents can be identified. This is a piping and fitting section, so additional clarity is needed to avoid the misinterpretation that such a revision would not apply to specific components.

Public Input No. 31-NFPA 86-2024 [Section No. 6.2.4.2.1]

6.2.4.2.1*

Piping materials shall be compatible with the fluid and service conditions.

6.2.4.2.1.1 – For natural gas and propane gas, the requirements in NFPA 54 and ASME B31.3 shall be followed.

6.2.4.2.1.2 For hydrogen gas and hydrogen gas mixtures, the requirements in NFPA 2 and ASME B31.12 shall be followed.

6.2.4.2.1.3 For mixed gas and manufactured gas, the applicable requirements shall be followed.

6.2.4.2.1.4

Where threaded fuel gas piping is used it shall be a minimum schedule 40.

Statement of Problem and Substantiation for Public Input

The existing requirement in 6.2.4.2.1 is vague with its asterisk only reference to non-mandatory Annex material and can allow self-certification in meeting the requirement to be “compatible with the fluid and service conditions”.

Submitter Information Verification

Submitter Full Name:	Ted Jablkowski
Organization:	Fives North American Combustion
Affiliation:	Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 17:34:08 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-5-NFPA 86-2024
Statement:	As hydrogen, hydrogen mixtures, and other fuels have become more prevalent within the industry, this revision addresses the need to direct the user to specific piping requirements to improve safety.

Public Input No. 1-NFPA 86-2022 [New Section after 6.2.5.1]

6.2.5.1.1

The requirement in 6.2.5.1 shall not preclude a single sediment trap that protects two separate gas stream branches designed in accordance with Figure 6.2.5.1.1, and where all of the following are achieved:

(1) The final sediment trap is the lowest point in a single vertical run of pipe lengths and tees, per the figure.

(2) The sediment trap captures all of the large particles that are dominated by the force of gravity and are too large to follow the gas flow as it makes a right angle turn through the two horizontal branches.

(3) Two downstream filters are installed that comply with 6.2.5.3 and are designed to capture all of the small particles that are small enough to follow the gas flow as it makes a right angle turn through the two horizontal branches.

Additional Proposed Changes

File Name	Description	Approved
Figure_6.2.5.1.1.pdf	Figure 6.2.5.1.1 to accompany Public Input to add new requirement at 6.2.5.1.1	

Statement of Problem and Substantiation for Public Input

Requiring each burner fuel gas train to have its own sediment trap upstream of the small particle filter (or strainer) that is required by 6.2.5.3 is not physically necessary if the sediment trap receives all the large particles and the filters are sufficient to remove all the small particles. The design should have horizontal gas velocities comparable in each of the two branch streams in order to ensure that neither of the filters receives large particles that are meant for the sediment trap.

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Dec 29 19:36:37 EST 2022
Committee: OVE-AAA

Committee Statement

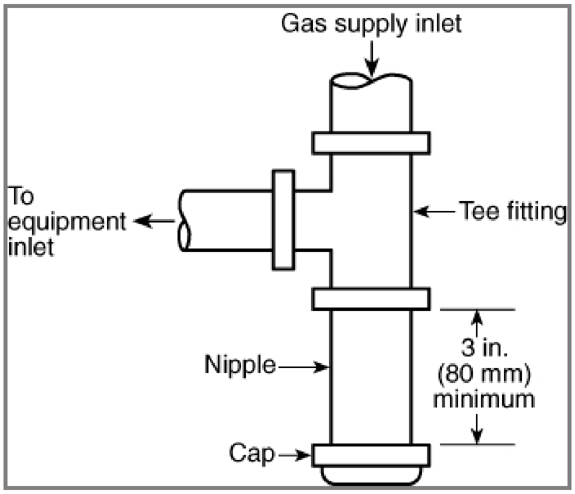
Resolution: The existing requirements already address the concerns of the proposed revision, see 6.2.5.2.

Public Input No. 15-NFPA 86-2023 [Section No. 6.2.5.2]

6.2.5.2

Sediment traps shall ~~have~~ be in a vertical ~~leg with a~~ pipe run with the supply gas flowing down, that uses a tee fitting to direct the gas flow horizontally to the equipment inlet while continuing vertical for the sediment trap. It shall be located between the equipment isolation valve and the gas filter or strainer. The sediment trap shall have a minimum length of three pipe ~~diameters~~ diameters [minimum of 3 in. (80 mm)] of the same size as the supply pipe as shown in Figure 6.2.5.2.

Figure 6.2.5.2 Method of Installing a Tee Fitting Sediment Trap. [54:Fig. 9.6.8]



Statement of Problem and Substantiation for Public Input

The verbiage in 6.2.5.2 does not fully describe the drawing in figure 6.2.5.2. I have seen "sediment traps" installed on a horizonal pipe run with very little written evidence to dispute other than the picture. A sediment trap in a horizonal pipe run does not have the same effect on foreign material in the gas vapor and it should be clear that it should only be on a vertical pipe run. Also the location of the sediment trap should be better commutated similar to the gas filter in 6.2.5.3.

Submitter Information Verification

Submitter Full Name:	Kenneth Graf
Organization:	Burner Design & Control Inc.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri Feb 10 15:31:04 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution: CI-6-NFPA 86-2024

Statement: A sediment trap in a horizonal pipe run does not have the same effect on foreign material in the gas vapor and requirements need to be clarified that sediment traps and filters should only be on a vertical pipe run. At the Second Draft meeting the committee will review revising this section to better communicate the proper location to install a sediment trap.

Public Input No. 2-NFPA 86-2023 [Section No. 6.2.6.1]

6.2.6.1

A pressure regulator shall be furnished wherever the ~~plant~~ facility's fuel gas supply pressure exceeds the burner operating or design parameters or wherever the plant supply pressure is subject to fluctuations, unless otherwise permitted by 6.2.6.2.

Statement of Problem and Substantiation for Public Input

Most of the subsections under 6.2 Fuel-gas fired units exclusively address fuel-gas piping, valves, and instruments - but not all. For example, subsection 6.2.2 exclusively addresses combustion air and flue gas recirculation.

Thus, readers may be confused as to whether the requirements in 6.2.6 are addressed to both fuel and air regulators, valves, and switches - or if they are exclusively addressed to fuel-gas valves and instruments.

The change makes it clear that the requirement only addresses fuel-gas devices.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 3-NFPA 86-2023 [Section No. 6.2.8]	
Public Input No. 3-NFPA 86-2023 [Section No. 6.2.8]	

Submitter Information Verification

Submitter Full Name: Richard Martin

Organization: Martin Thermal Engineering Inc

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 06 12:48:56 EST 2023

Committee: OVE-AAA

Committee Statement

Resolution: FR-7-NFPA 86-2024

Statement: Requirements of 6.2.6 are not limited to fuel-gas, as detailed in A.6.2.6. The term plant has been deleted since it is not needed for the requirement to be understood. Combustion system has been added to clarify that components other than burner may have operating pressure requirements that are different than the burner operating pressure requirements.

Public Input No. 36-NFPA 86-2024 [Section No. 6.2.6.4]

6.2.6.4*

When used with fuel gases containing less than 25 percent hydrogen, Fuel gas regulators, ratio regulators, and zero governors, shall not be required to be vented to an approved location in the following situations:

(1) Where backloaded from combustion air lines, air–gas mixture lines, or combustion chambers, provided that gas leakage through the backload connection does not create a hazard

(2) Where a listed regulator–vent limiter combination is used

(3) Where a regulator system is listed for use without vent piping

(4) A regulator incorporating a- ~~leak limiting system~~ - safety diaphragm that contains a vent-limiting device , which prevents or restricts the escape of gas into a space large enough and with sufficient natural ventilation so that the escaping gas does not present a hazard

Statement of Problem and Substantiation for Public Input

Not requiring a vent should be permitted only up to fuel gas having less than 25% H2. H2 has a very wide explosive limit, which increase its risk of venting to the ambient space.

Revised vent limiting system to safety diaphragm that contains a vent limiter to clarify the language.

Submitter Information Verification

Submitter Full Name: Kevin Carlisle
Organization: Karl Dungs, Inc.
Affiliation: IHEA
Street Address:
City:
State:
Zip:
Submittal Date: Thu May 23 17:48:10 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-8-NFPA 86-2024

Statement: This revision identifies fuel gas at 25 percent or less by volume because at this amount the hydrogen mixture behaves like natural gas. The allowable volume of propane referenced in UL 353 has been updated to properly reflect the UL document. An annex has been added to provide examples of different types of leak limiting devices.

Public Input No. 3-NFPA 86-2023 [Section No. 6.2.8]

6.2.8 Overpressure Protection for fuel-gas components .

6.2.8.1

Overpressure protection shall be provided in either of the following cases:

(1) Where the supply pressure exceeds the maximum operating pressure of any downstream component

(2) Where the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the maximum operating pressure of any downstream component

6.2.8.2

Overpressure protection shall be provided by any one of the following:

(1) A series regulator in combination with a line regulator or service pressure regulator

(2) A monitoring regulator installed in combination with a line regulator or service pressure regulator

(3) * A full-capacity pressure relief valve

(4) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a rated shutoff valve

6.2.8.3*

The overpressure protection device shall be set no higher than the maximum operating pressure of the downstream component having the lowest rated pressure.

Statement of Problem and Substantiation for Public Input

Most of the subsections under 6.2 Fuel-gas fired units exclusively address fuel-gas piping, valves, and instruments - but not all. For example, subsection 6.2.2 exclusively addresses combustion air and flue gas recirculation.
Thus, readers may be confused as to whether the requirements in 6.2.8 are addressed to overpressure protection for air lines and their components - or if they are exclusively addressed to fuel-gas valves and instruments.
The change makes it clear that the requirement only addresses fuel-gas devices.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 86-2023 [Section No. 6.2.6.1]	Similar concern about current text
Public Input No. 2-NFPA 86-2023 [Section No. 6.2.6.1]	

Submitter Information Verification

Submitter Full Name: Richard Martin

Organization: Martin Thermal Engineering Inc

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 06 12:56:15 EST 2023

Committee: OVE-AAA

Committee Statement

Resolution: The requirements of 6.2.8 are not limited to just fuel-gas components.

Public Input No. 30-NFPA 86-2024 [Section No. 6.2.8]

6.2.8 Overpressure Protection.

6.2.8.1

Overpressure protection shall be provided in either of the following cases:

(1) Where the supply pressure exceeds the maximum operating pressure of any downstream component

(2) Where the failure of a single upstream line regulator or service pressure regulator results in a supply pressure exceeding the maximum operating pressure of any downstream component

6.2.8.2

Overpressure protection shall be provided by any one of the following:

(1) A series regulator in combination with a line regulator or service pressure regulator

(2) A monitoring regulator installed in combination with a line regulator or service pressure regulator

(3) * A full-capacity pressure relief valve

(4) An overpressure cutoff device, such as a slam-shut valve or a high-pressure switch in combination with a rated shutoff valve

6.2.8.3*

The overpressure protection device shall be set no higher than the ~~maximum operating pressure~~ maximum pressure rating of the downstream component having the lowest rated pressure. The maximum pressure rating shall be determined as follows :

(1) For a safety shutoff valve, slam-shut valve, or a vent valve, the maximum pressure rating shall be its **maximum operating pressure differential** rating.

(2) For a pressure sensing device, pressure regulator, relief valve, the maximum pressure rating shall be its **maximum rated inlet pressure**

(3) For a control valve or any other device or component, the maximum pressure rating shall be its **maximum design pressure.**

New Definitions

(1) **maximum operating pressure differential:** The maximum difference between the pressure at an inlet port and the pressure at an outlet port against which the valve is intended to operate.

(2) **maximum rated inlet pressure:** the greatest inlet pressure for which the regulator, relief valve or pressure sensing device is intended to be used.

(3) **Maximum design pressure:** the greatest pressure at which fuel will not leak to the atmosphere.

Statement of Problem and Substantiation for Public Input

Revised to better apply OPD settings. For example, how do we apply OPD settings to gages with low operating pressure ranges. If I put a pressure gage with dial range 0-20"WC, it's operating pressure max is 20"WC; higher than that, the gage dial breaks. Does this mean that the OPD setting needs to be 20"WC? Gage body pressure should be considered, but not it's operating pressure.

maximum operating pressure differential comes from UL 429, electrically operated valves. This term is not in the NFPA glossary.
maximum rated inlet pressure comes from ANSI Z21.18 for gas appliance pressure regulators. UL 353, which applies to gas pressure sensing controls, uses the term maximum rated pressure.
I made a new definition for maximum design pressure. This should cover everything else on a gas train, and for everything else, I believe all we care about is the ability for the device/component to contain the fuel pressure and prevent it from leaking to the atmosphere.

Submitter Information Verification

Submitter Full Name:	Kevin Carlisle
Organization:	Karl Dungs, Inc.
Affiliation:	IHEA
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 17:31:18 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: CI-9-NFPA 86-2024

Statement: The committee is considering revision to the overpressure protection device pressure sensing requirements.

Public Input No. 42-NFPA 86-2024 [Section No. 6.2.8.2]

6.2.8.2

Overpressure protection shall be provided by any one of the following:

(1) A series regulator in combination with a line regulator or service pressure regulator

(2) A monitoring regulator installed in combination with a line regulator or service pressure regulator

(3) * A full-capacity pressure relief valve

(4) An overpressure cutoff device, such as a slam-shut ~~valve or a~~ safety regulator.

(5) A high-pressure switch in combination with a rated shutoff valve

Statement of Problem and Substantiation for Public Input

The way is was written, item #4 was two completely different ways of providing overpressure protection and should be separated. Also, I think it should be clearer when it talks about slam shut valves, that a slam shut safety regulator is permitted.

Submitter Information Verification

Submitter Full Name: Kenneth Graf
Organization: Burner Design & Control Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Fri May 31 15:01:06 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-10-NFPA 86-2024

Statement: Overpressure cutoff devices can have different terms. The annex has been added to provide clarity to the user as to what can qualify as an overpressure device, without limiting the requirement to specific devices.

Public Input No. 11-NFPA 86-2023 [New Section after 6.2.9]

6.2.9.1

Where an oven or its subsystems adheres to the requirements of *IEC 61511 Functional Safety: Safety Instrumented Systems for the Process Industry Sector*, the installation shall not be required to comply with 6.2.9.

Statement of Problem and Substantiation for Public Input

According to the annex content at Section A.8.2, employment of a “performance-based” approach to safety control for industrial combustion systems can be considered equivalent to the “prescription-based” approach that NFPA 86 was historically based upon in the last century. Clearly, for such a safety-instrumented-system, the concept of employing physical limiting means and locking devices on a SIL 3 capable flow valve is neither safe nor useful, so ignoring 6.2.9 would actually be safer than adhering to it. If the Safety Integrity Level requirements of flow valves includes self-checking features or if the controller compares feedback from flow transmitters against the setpoints utilized by the controller for that processing step, it would be a grave mistake to require crude steps such as drilling holes in the wafer or welding an obstruction into the valve body internals.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Jan 22 23:56:42 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution: FR-11-NFPA 86-2024

Statement: The mechanical stop of a locking device to prevent an unintentional change in settings does not conflict with A.8.2. This revision clarifies that the limiting means and locking device are separate methods that can be utilized to align with the requirement.

Public Input No. 12-NFPA 86-2023 [Section No. 6.2.10.2.1]

6.2.10.2.1

Piping shall be designed to provide a mixture velocity profile that is sufficiently uniform and a mixture ~~flow of pressure and velocity needed for~~ pressure that is sufficiently steady to permit isometric and stable burner operation.

Statement of Problem and Substantiation for Public Input

The current language is strange and not particularly helpful. The phrase "mixture flow of velocity and pressure" is very hard to visualize what is meant.
The revision focuses on isometric velocities (sufficiently uniform in space) and steady pressures (sufficiently constant in time) to permit the burner to operate safely and without deformities.

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 23 00:38:49 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-12-NFPA 86-2024

Statement: This revision refines the requirement to be more enforceable while also maintaining that the piping be arranged (or designed) to provide a mixture that is needed to maintain a stable burner operation. The term "uniform" has been changed to "design" to be more achievable in aligning with the requirement and enforceable.

Public Input No. 32-NFPA 86-2024 [Section No. 6.2.10.2.6]

6.2.10.2.6

Mixing blowers and mixing machines shall not be used with fuel gases containing more than 10 percent free hydrogen (H_2).

Statement of Problem and Substantiation for Public Input

The restriction on using hydrogen mixtures in mixing blowers needs to be extended to mixing machines which is a mixing blower operating at higher pressure.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski

Organization: Fives North American Combustion

Affiliation: Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.

Street Address:

City:

State:

Zip:

Submittal Date: Thu May 23 17:37:59 EDT 2024

Committee: OVE-AAA

Committee Statement

Resolution: The need to extend hydrogen limitation on mixing machines equal to blower mixers in practice is unnecessary because mixing machines are already required to be equipped with flashback prevention (blowout valves and flame arrestors) in the code. Those devices have been proven effective for up to 100% hydrogen / premix.

Public Input No. 33-NFPA 86-2024 [New Section after 6.2.13]

TITLE OF NEW CONTENT

New requirement 6.2.14

6.2.14 The Hydrogen Equipment Enclosure shall be protected according to the applicable requirements in the most current edition of NFPA 2.

Statement of Problem and Substantiation for Public Input

A new requirement is needed to address the hazards identified in NFPA 2.

Submitter Information Verification

Submitter Full Name:	Ted Jablkowski
Organization:	Fives North American Combustion
Affiliation:	Submitted on behalf of the NFPA 86 Fundamental Chapters and Class B Task Group.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 17:39:58 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-14-NFPA 86-2024
Statement:	The unique properties of hydrogen necessitate the construction of special enclosures. NFPA 2 has scope over hydrogen and hydrogen enclosure requirements that the user needs to follow to maintain safety.

Public Input No. 6-NFPA 86-2023 [Section No. 6.5.1]

6.5.1

A means shall be provided to ensure ~~ventilation~~ proper exhaust venting of the products of combustion from fuel-fired equipment.

Statement of Problem and Substantiation for Public Input

In NFPA 86, the term ventilation has the connotation of "safety ventilation" in the context of Class A solvent ovens, where it is necessary to ensure sufficient dilution air is admitted to the oven so solvent vapors do not reach the LFL. In the context of fuel-fired heating equipment generally, the term ventilation really has no generic meaning, because "safety ventilation" is not required for Class B or C furnaces.

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 18 18:41:10 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-16-NFPA 86-2024

Statement: This revision clarifies that the products of combustion must be removed to maintain the flow of combustion air to burners and avoid incomplete combustion. The term "ventilation" in NFPA 86 is used to connotate "safety ventilation" in the context of Class A solvent ovens, where it is necessary to ensure sufficient dilution air is admitted to the oven to mitigate solvent vapors from reaching the LFL. In the context of fuel-fired heating equipment, the term "ventilation" does not have a generic meaning because "safety ventilation" is not required for Class B or C furnaces.

Public Input No. 38-NFPA 86-2024 [New Section after 7.1.4.1]

A.7.1.4.1

This task should be the responsibility of both the user and manufacturer. It is more likely to happen if both parties are responsible, and while the user may know their process better than the manufacturer, the manufacturer knows the oven design better.

Statement of Problem and Substantiation for Public Input

Annex material clarification of why both user and manufacturer are responsible.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 24 12:47:18 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-17-NFPA 86-2024
Statement:	This revision identifies in the annex material why it can be impactful for both the user and the manufacturer to be involved in developing the commissioning plan.

Public Input No. 37-NFPA 86-2024 [New Section after 7.2.4]

A.7.2.4

The commissioning entity should consider giving a written and/or practical test to employees who will operate and/or maintain the oven.

Statement of Problem and Substantiation for Public Input

It is generally accepted that learning objectives are better met when the taught content is tested.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 24 12:43:27 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-18-NFPA 86-2024
Statement:	The proposed revision is already addressed in the annex material of 7.2.1. This revision directs the user to that annex instead of creating a new annex under this sub-section.

Public Input No. 40-NFPA 86-2024 [New Section after 7.4.2]

7.4.2.1

The manufacturer shall ensure that the oven is designed to be free of impediments to proper cleaning and removal of combustible debris during scheduled downtime.

Statement of Problem and Substantiation for Public Input

Proper housekeeping relies on the absence of impediments (e.g. covers, sheet metal fixtures, structural obstructions) that could prevent thorough cleaning during downtime of the oven.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 24 12:55:10 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: CI-19-NFPA 86-2024

Statement: The committee will continue to consider requirements for the proper cleaning of ovens.

Public Input No. 39-NFPA 86-2024 [New Section after 7.4.3]

7.4.3.1

The user shall establish a cleaning/houskeeping schedule that helps ensure combustible material being heated does not accumulate in quantities sufficient to spontaneously ignite at the nominal oven temperature.

Statement of Problem and Substantiation for Public Input

Inadequate housekeeping is often the first step in the initiation of an oven fire. Housekeeping is a subcategory of maintenance, since it only occurs when equipment is down.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 24 12:51:50 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: CI-19-NFPA 86-2024

Statement: The committee will continue to consider requirements for the proper cleaning of ovens.

Public Input No. 27-NFPA 86-2024 [Section No. 7.4.10 [Excluding any Sub-Sections]]

> Valve seat leakage testing of safety shutoff valves and valve proving systems shall be performed in accordance with the manufacturer's instructions. A normally open vent valve between the safety shutoff valves, where installed, shall also be tested for leakage.

Statement of Problem and Substantiation for Public Input

There are a lot of ovens, dryers and furnaces that have normally open vent valves and even though they are not required by NFPA 86, if installed, should also be tested annually. We have found many cases where the NOVV is leaking when energized and causing large amounts of gas into the atmosphere. Even though it should be venting into a safe location, that is not always the case and it still causes and environmental hazard along with waisted resources.

Submitter Information Verification

Submitter Full Name:	Kenneth Graf
Organization:	Burner Design & Control
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 23 15:31:15 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-50-NFPA 86-2024
Statement:	While not required by the standard, ovens, dryers, and furnaces might have normally open vent valves (NOVVs) which are subject to leakage when energized, fail to close, and cause large amounts of gas into the atmosphere which can cause environmental hazards along with wasted resources. Therefore, this revision requires that a valve seat leakage test be performed on NOVVs.

Public Input No. 22-NFPA 86-2024 [Section No. 8.2.1]

8.2.1*

Except as permitted by Section 8.3 or 8.2.10 , combustion safeguards, flame detectors, excess temperature limit interlocks, and safety shutoff valves shall be listed for combustion safety service or approved if a listed device is not commercially available.

Statement of Problem and Substantiation for Public Input

The current 8.2.1 refers to Section 8.3, however, Section 8.3 does not exclude implementing the Excess Temperature Limit Input function in the safety PLC based Burner Management System logic. The proposed text revision would allow for the Excess Temperature Limit Input function to also be able to be implemented using a SIL 2 temperature transmitter as defined in 8.2.10 and with safety logic implemented in compliance with sections 8.2 and 8.3.

Related Public Inputs for This Document

Related Input	**Relationship**
Public Input No. 23-NFPA 86-2024 [Section No. 8.2.10]	

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 18 09:46:21 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-25-NFPA 86-2024

Statement: The requirement referred to Section 8.3, however, Section 8.3 does not exclude implementing the excess temperature limit input function in the safety PLC based burner management system logic. This revision allows for the excess temperature limit input function to also be able be implemented using a SIL 2 temperature transmitter per 8.2.10 and with safety logic implemented in compliance with sections 8.2 and 8.3.

Public Input No. 43-NFPA 86-2024 [Section No. 8.2.7.1]

8.2.7.1

The requirement in 8.2.7 shall not prohibit safety device testing and maintenance in accordance with 8.2.5. Where a system includes a “built-in” test mechanism that bypasses any safety device, it shall be ~~interlocked to~~ interlocked to prevent operation of the system while the device is in the test mode, unless listed for that purpose. Where bypass valves are used for testing, they must be locked with a keyed lock in the non-test position except when testing is being performed.

Statement of Problem and Substantiation for Public Input

On large systems it can be advantageous to use a small shut-off valve to isolate the pressure switches for testing. With these valves, you don't have to perform a line break and bleed the gas off to be able to test. To make these valves a lockable and to use a keyed lock similar to a LOTO lock, would replace the requirement to interlock these valves with the control system. Interlocking these valves would be very hard and expensive.

Submitter Information Verification

Submitter Full Name:	Kenneth Graf
Organization:	Burner Design & Control Inc.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 31 15:39:12 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: CI-23-NFPA 86-2024

Statement: The committee will continue to review the requirements of this section to identify a manual test method that is equivalent to 8.2.7.1, to ensure the system is out of operation during testing, to ensure safety deices are returned to their normal operating state when testing is complete, and to ensure that the system is returned to operation with all of its safety devices operational.

Public Input No. 23-NFPA 86-2024 [Section No. 8.2.10]

8.2.10*

Where transmitters are used in place of switches, Excess Temperature Limit Interlocks, or 1400 F (760 C) Bypass Interlocks for safety functions, the following shall apply:

(1) The transmitter shall be safety integrity level (SIL) 2 capable.

(2) Transmitter failure shall be detected and initiate a safety shutdown.

Statement of Problem and Substantiation for Public Input

see PI No. 22

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 22-NFPA 86-2024 [Section No. 8.2.1]	

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 18 09:57:52 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-24-NFPA 86-2024

Statement: The revision allows for the excess temperature limit and 1400 F (760 C) bypass interlocks functions to also be able to be implemented using a SIL 2 temperature transmitter as defined in 8.2.10 and with safety logic implemented in compliance with sections 8.2 and 8.3.

Public Input No. 45-NFPA 86-2024 [Section No. 8.2.14]

8.2.14

Safety interlocks shall meet one or more of the following criteria:

(1) Be hardwired without relays in series and ahead of the controlled device

(2) Be connected to an input of a programmable controller logic system complying with Section 8.3

(3) Be connected to a relay that represents a single safety interlock that is configured to initiate safety shutdown

(4) * Be connected to a listed safety relay with monitoring that represents one or more safety interlocks and initiates safety ~~shutdown shutdown~~

(5) Where hardwired safety interlocks wired in series to a flame safety device are being monitored by a PLC or other electronic device, the monitoring device shall use only optically isolated inputs.

Statement of Problem and Substantiation for Public Input

By requiring optically isolated inputs on a PLC or other non safety rated electronic monitoring devices, it lowers the possibility of a problem on the input board causing a short circuit around the limit device that's being monitored. The inputs of a PCI Telefault, Honeywell S7830 and other safety monitors use optically isolated inputs for this reason and there should be a requirement for PLCs used for limit monitoring purposes to use isolated inputs.

.

Submitter Information Verification

Submitter Full Name: Kenneth Graf
Organization: Burner Design & Control Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 09:15:08 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: Concern over the operational characteristics of the optical relay on the safety devices, the lack of identification of optical couples by PLC input card manufacturers and existing conflict with 8.2.14(2).

Public Input No. 4-NFPA 86-2023 [Section No. 8.5]

8.5– Airflow Safety Devices.

8.5.1*

Where a fan is essential for purge of an oven or allied ~~equipment~~ equipment or for exhaust of oven effluent , fan operation shall be proved and interlocked into the burner management system.

8.5.1.1*

Electrical interlocks and flow switches shall be arranged in the safety control circuit so that loss of ventilation or airflow shuts down one of the following:

(1) Heating system of the affected section

(2) Entire heating system as well as the conveyor

8.5.1.2

Air pressure switches shall not be used to prove airflow where valves or dampers downstream of the pressure switch can be closed to the point of reducing airflow below the minimum required.

8.5.1.3

Air suction switches shall not be used to prove airflow where valves or dampers upstream of the pressure switch can be closed to the point of reducing airflow below the minimum required.

8.5.1.4

Switches used to prove airflow on systems where the air is contaminated with any substance that might condense or otherwise create a deposit shall be selected and installed to prevent interference with the performance of the switch.

8.5.2*

Safety ventilation installed and proved in accordance with Section 11.6 shall be interlocked into the burner management system.

8.5.3

Dampers capable of being adjusted to a position that can result in an airflow below the minimum required shall be equipped with one of the following features arranged to prevent oven operation when airflow is below the minimum required:

(1) Mechanical stops

(2) Cut-away dampers

(3) Limit switches interlocked into the safety circuitry

Statement of Problem and Substantiation for Public Input

This subsection heading was changed in the prior cycle from "Ventilation Safety Devices" to "Safety Devices". Admittedly, the latter has a connotation of "Safety Ventilation", which is a concept that is limited to Class A ovens and address in Chapter 8 with a reference to Section 11.6, but the chosen heading "Safety Devices" is lacking context and is confusing. By changing the subsection heading to "Airflow Safety Devices" and adding the reference to "exhaust of oven effluent" in Section 8.5.1, it is made clear that more than just "clean, fresh air" is intended by the proposed new subsection name.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Jan 08 18:11:20 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-51-NFPA 86-2024
Statement:	The concept of "Safety Ventilation" is limited to Class A ovens. The prior heading, "Safety Devices" is lacking context and is confusing. By changing the subsection heading to "Airflow Safety Devices" and adding the reference to "exhaust of oven effluent" in Section 8.5.1, it is made clear that more than just "clean, fresh air" is intended by the proposed new subsection name.

Public Input No. 20-NFPA 86-2024 [Section No. 8.6.3]

8.6.3*

Motor controlling devices on equipment required for combustion of the fuel shall be interlocked into the burner management system.

Exception: If operation of motor controlling devices is proven using a switch in accordance with 8.6.6.

Statement of Problem and Substantiation for Public Input

Many available flame safeguards have provisions to prove a change in state of air pressure or flow switch, however these controls do not have the ability to also monitor the contacts from a motor starter or VFD while maintaining the ability to independently monitor the air pressure switch. If the pressure switch and the starter contacts are wired to the air pressure switch input of these flame safeguards, the air pressure switch could still be jumpered since the starter contact is changing states. The motor starter contacts can not be placed in the limit string of these controls because if the starter is closed by the flame safeguard, the starter contact would permanently interrupt the limit string keeping the safeguard from starting.

Motor operation should be able to be proved using a switch if you are proving that before the fan was started, there was no pressure or flow and after the fan was started, there was pressure or flow.

Submitter Information Verification

Submitter Full Name: Chris Harwick
Organization: Thermal Solutions Inc
Street Address:
City:
State:
Zip:
Submittal Date: Thu May 02 05:45:08 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: The proposed exception to the interlock has not been adopted. One of the reasons for 8.6.3 interlocking the motor starter contact is to drop out the safety circuit immediately when the combustion air blower is turned off and not waiting until the blower spins down and the flow/pressure switch drops out. Additionally, alignment with both 8.6.3 and 8.6.6 is required.

Public Input No. 24-NFPA 86-2024 [Section No. 8.7.1.12.3]

8.7.1.12.3

Where multiple burners or pilots operate as a burner system firing into a common chamber of a fuel gas system or oil system, the upstream safety shutoff valve shall close when any of the following conditions occur:

(1) Upon activation of any safety interlock common to the burner system

(2)* Where the individual burner safety shutoff valves do not have proof of closure and it is demonstrated, based on available airflow, that the number of failed burners will result in the furnace being above 25 percent of the LFL, assuming the single burner safety shutoff valve(s) fails in the open position

(3) Where each burner is equipped with a single safety shutoff valve as permitted in 8.7.1.12.2 and individual burner safety shutoff valves have proof of closure and any of the following conditions occur:

  (4) Where flame supervision is used, the individual burner safety shutoff valve not proved closed after loss of flame signal

  (5) Where flame supervision is not used, the individual burner safety shutoff valve not proved closed when the furnace is not proved to be above 1400°F (760°C)

(6) Upon loss of flame signal at all burners in the burner system

Statement of Problem and Substantiation for Public Input

The proposed revisions are to more clearly define that when using a single safety shutoff valve at each burner (or burner system) each individual burner (or burner system) safety shutoff valve must be equipped with a Proof of Closure switch.

Also, moving the present requirement in (3)(c) to a new item (4) more clearly defines all conditions when the required common upstream safety shutoff valve must be de-energized.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 18 10:02:28 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-41-NFPA 86-2024

Statement: This revision clearly defines that when using a single safety shutoff valve at each burner (or burner system) each individual burner (or burner system) safety shutoff valve must be equipped with a proof of closure switch. This also, moves the present requirement in (3) (c) to a new item (4) to more clearly define all conditions when the required common upstream safety shutoff valve must be de-energized.

Public Input No. 18-NFPA 86-2023 [Section No. 8.7.2.2.1]

8.7.2.2.1

A proved closed condition shall be accomplished by either of the following means:

(1) A proof-of-closure switch incorporated in a listed safety shutoff valve assembly in accordance with the terms of the listing

(2) A valve proving system that is listed or meets the requirements of Section 8.~~3~~ 2

Statement of Problem and Substantiation for Public Input

I believe item 8.3 was cited incorrectly.

If 8.2 is cited, and a Valve Proving System is implemented via PLC, "8.2.1 Except as permitted by Section 8.3..." closes the loop.

NFPA 2023
8.2 Safety Device Requirements and Burner Management Systems.
8.3 Programmable Logic Controller Systems.

Submitter Information Verification

Submitter Full Name: Felipe Garcia
Organization: Age Engenharia
Street Address:
City:
State:
Zip:
Submittal Date: Sat Sep 30 13:06:16 EDT 2023
Committee: OVE-AAA

Committee Statement

Resolution: Section 8.3 is the correct cross-reference for PLC-based systems listed for combustion safety, as stated in 8.3. The current requirement is that a valve proving system (VPS), incorporated into a PLC per 8.3 is to be equivalent to a listed VPS. The proposed language instead favors a listed VPS, which does not follow how the standard is purposefully structured.

Public Input No. 19-NFPA 86-2024 [Section No. 8.8.2]

8.8.2

A high fuel pressure switch or sensor meeting the following criteria shall be provided:

(1) It shall be interlocked into the burner management system.

(2) * It shall be located downstream of the final pressure-reducing regulator and safety shutoff valves .

Statement of Problem and Substantiation for Public Input

I have seen many systems with the HGPS located upstream of the main shutoff valves. This causes high pressure gas to be trapped when the valves close that trips the switch but does not allow the switch to be reset without bleeding the pressure. It also causes a tendency to set the switch setpoint higher than it should to avoid a false condition that requires the pressure to be bled off . The typical location is downstream of the safety shutoff valves, but the way it is written, you could make an argument that it should be before the valves. Clarification is needed.

Submitter Information Verification

Submitter Full Name:	Kenneth Graf
Organization:	Burner Design & Control Inc.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Feb 22 12:32:48 EST 2024
Committee:	OVE-AAA

Committee Statement

Resolution: The high pressure switch location is not a safety consideration and designs may be successfully implemented in positions both upstream and downstream of SSOVs.

Public Input No. 7-NFPA 86-2023 [Chapter 10]

Chapter 10 ~~Thermal~~ Oxidizer Systems

10.1 General.

For the purposes of this chapter, the term ~~*thermal*~~ *oxidizer systems* shall include the following:

(1) Afterburners

(2) Direct thermal oxidizers

(3) Direct catalytic oxidizers

(4) Fume incinerators

(5) Recuperative thermal oxidizers

(6) Recuperative catalytic oxidizers

(7) Regenerative thermal oxidizers

(8) Regenerative catalytic oxidizers

(9) Flameless thermal oxidizers

(10) ~~Other devices that can restrict ventilation of ovens~~

10.2 Location and Construction.

10.2.1*

The design and construction of oxidizer systems shall comply with all requirements for Class A ovens in this standard, except for the requirements for explosion relief.

10.2.2

Precautions shall be taken to reduce fire hazards where the relative location of equipment or the type of fumes generated are such that combustible liquids can condense or solids can be deposited between the generating process and the oxidizer systems.

10.2.3* Direct Fuel Injection Systems.

10.2.3.1

Two safety shutoff valves in series shall be provided in the fuel injection supply line.

10.2.3.2

A filter or fine-mesh strainer shall precede the upstream safety shutoff valve.

10.2.3.3

Safety shutoff valves shall not be used as modulating control valves unless they are designed as both safety shutoff and modulation valves and tested for concurrent use.

10.2.3.4

Means for testing all fuel safety shutoff valves for valve seat leakage shall be installed.

10.2.3.5

Local visual position indication shall be provided for each safety shutoff valve.

10.2.3.5.1

The position indication shall directly indicate the physical position, closed and open, of the valve.

10.2.3.5.2

Where lights are used for position indication, the absence of light shall not be used to indicate open or closed position.

10.2.3.5.3

Indirect indication of valve position, such as by monitoring operator current voltage or pressure, shall not be permitted.

10.2.3.6

The safety shutoff valves in 10.2.3.1 shall shut off the injected fuel after interruption of the holding medium by any one of the interlocking safety devices or operating controls.

10.2.3.7

Where the introduced capacity exceeds 400,000 Btu/hr (117 kW), at least one of the safety shutoff valves in 10.2.3.1 shall be proved closed and interlocked with the preignition purge interval.

10.2.3.7.1

A proved closed condition shall be accomplished by either of the following means:

(1) A proof-of-closure switch incorporated in a listed safety shutoff valve assembly in accordance with the terms of the listing

(2) A valve proving system that is listed or meets the requirements of Section 8.3

10.2.3.7.2

Auxiliary and closed position indicator switches shall not satisfy the proved-closed requirement of 8.7.2.2.1.

10.3 Heating Systems. (Reserved)

10.4 Commissioning, Operations, Maintenance, Inspection, and Testing. (Reserved)

10.5 Fire Protection.

10.5.1* Fume Source Fire Protection System Interlocks.

An interlock shall be provided so that activation of the source automatic fire protection system initiates an interruption of the source of fumes to the oxidizer system.

10.6 Safety Equipment and Application.

10.6.1*

Thermal oxidizers shall not reduce the required safety ventilation specified in this standard.

10.6.2* Purging.

A source air mixture shall not be introduced into a running thermal oxidizer unless one of the following conditions is met:

(1) It shall be demonstrated that the flammable vapor concentration entering the thermal oxidizer cannot exceed 50 percent of the LFL under all anticipated normal and abnormal operating conditions.

(2) * Where it is not permitted to discharge the source air mixture directly to atmosphere, the source equipment, connecting ductwork, and thermal oxidizers used to oxidize the source air mixture shall have explosion-prevention and explosion-protection systems designed and installed in accordance with the requirements of NFPA 69.

10.6.3* Direct-Fired Oxidizer Systems.

10.6.3.1*

The design and operation of oxidizer systems and controls shall comply with all parts of this standard pertaining to direct-fired ovens.

10.6.3.2* Excess Temperature Limit Interlock.

10.6.3.2.1

An excess temperature limit interlock shall be installed to prevent uncontrolled temperature rise in the oxidizer system.

10.6.3.2.2

Operation of an excess temperature interlock shall cause the following:

(1) Interruption of fuel to the oxidizer system

(2)* Interruption of the source of fumes to the oxidizer system

10.6.4 Direct Heat Recovery Systems.

10.6.4.1

Proved fresh air shall be introduced into the system to provide the oxygen necessary for combustion of hydrocarbons as well as primary burner fuel.

10.6.4.2

Fresh air shall be introduced through openings that supply air directly to each zone circulating system.

10.6.4.3*

Where direct heat recovery systems are employed and portions of the oxidizer system exhaust gases are utilized as the heat source for one or more of the zones of the fume-generating oven, one of the following precautions shall be taken to prevent recycling unburned solvent vapors and unburned fuel.

(1) Mechanical means such as fixed dampers shall be used to ensure that the ratio of fresh air to recycled exhaust cannot reduce the destruction efficiency of the oxidizer system below specification or 90 percent, whichever is higher.

(2) Oxygen sensors in the air stream to the oxidizer system are interlocked to divert recycled exhaust gases to atmosphere if levels drop below specifications for the oxidizer system.

(3) A continuous vapor concentration high-limit controller is provided in accordance with 11.6.10.

10.6.5* Catalytic Oxidizer Systems.

10.6.5.1

The requirements in 10.6.3 for direct-fired fume oxidizer systems shall apply to catalytic fume oxidizer systems.

10.6.5.2* Excess Temperature Limit Interlock.

10.6.5.2.1

An additional excess temperature limit interlock shall be located downstream from the discharge of the catalyst bed for thermal protection of the catalyst elements.

10.6.5.2.2

Operation of an excess temperature interlock shall cause the following:

(1) Interruption of fuel to the burner

(2)* Interruption of the source of fumes

10.6.5.3*

Process exhaust ventilation shall be provided to maintain vapor concentrations that cannot generate temperatures at which thermal degradation of the catalyst can occur.

10.6.5.4* Differential Pressure High Limit Switch.

10.6.5.4.1

A differential pressure (*P*) high limit switch, measuring across the catalyst bed, shall be used to detect particulate contamination.

10.6.5.4.2

Operation of a differential pressure (*P*) high limit switch shall cause the following:

(1) Interruption of fuel to the oxidizer system

(2)* Interruption of the source of fumes to the oxidizer system

10.6.5.5*

Where catalysts are utilized with direct heat recovery, a maintenance program shall be established, and frequent tests of catalyst performance shall be conducted so that unburned or partially burned vapors are not reintroduced into the process oven.

Statement of Problem and Substantiation for Public Input

In the most recent cycle, the 86 Technical Committee changed the terminology from Thermal Oxidizers to Oxidizer Systems, but we forgot to change the chapter title and the name given in the first section. The deletion of item (10) in 10.1 General is appropriate because "other devices that can restrict ventilation of ovens" would include recuperative heat exchangers, heat recovery boilers, baghouses, spray quenches, scrubbers, and many other items that treat effluent from an oven. The primary purpose of Chapter 10 is to ensure safe operation of oxidizer systems - which by definition are a particular type of oven (...a heated enclosure used for processing materials). Lumping together items that are not ovens into this chapter is a bad idea.

To the extent an individual requirement in Chapter 10 is related exclusively to the "reduced ventilation" effect that is created by the presence of any downstream device that is not an oven, I recommend we move those requirements to a new subsection in Chapter 6 Heating Systems.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jan 19 16:56:22 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution:	FR-30-NFPA 86-2024
Statement:	The chapter title has been changed from Thermal Oxidizer to Oxidizer System to match the terminology of the chapter.

Public Input No. 13-NFPA 86-2023 [Section No. 10.4]

10.4 Commissioning, Operations, Maintenance, Inspection, and Testing . - ~~(Reserved)~~

10.4.1 Commissioning (reserved)

10.4.2 Operations

10.4.2.1 Operations staff shall be responsible for ensuring the VOC source's exhaust stream is not in the flammable range for the mixture of VOC being destroyed in the oxidizer system.

10.4.2.2 Where it cannot be demonstrated that the VOC source's exhaust cannot exceed 25% of LFL, the owner/operator of the oxidizer system shall install both of the following:

(1) at least one continuous vapor concentration high limit interlock in the duct that conveys the VOC/air mixture to the oxidizer system, in accordance with 11.6.9.3.1.

(2) a 3-way diverter valve that redirects the oven exhaust flow to an exhaust stack that leads directly to atmosphere.

10.4.2.3 The location of the continuous vapor concentration high limit interlock's sensor shall be as close as possible to the point where the VOC conveying duct leaves the source oven.

10.4.2.3.1 Redundant continuous vapor concentration high limit interlock sensors shall be permitted to be installed downstream of the nearest upstream sensor by a distance of approximately two duct diameters.

10.4.2.4 The location of the 3-way diverter valve shall be as close as possible to the tie-point for the downstream oxidizer system.

10.4.2.4.1 The 3-way diverter valve shall be located at least 200 ft (61 m) downstream of the primary continuous vapor concentration high limit interlock sensor location.

10.4.2.5 The automatic action to be taken when any of the continuous vapor concentration high limit interlocks is tripped shall include all of the following:

10.4.2.5.1 The source oven's heating system shall be shut off.

10.4.2.5.2 The introduction of new feed material into the source oven shall be halted.

10.4.2.5.3 The source of VOC fumes shall be diverted to atmosphere until the vapor concentration limit interlock is clear and the fault has been reset by the operator.

10.4.2.6 The continuous vapor concentration controller may be used to initiate an additional dilution process that minimizes solvent reduction concentration (see 11.6.10.9) before it reaches the high-limit threshold.

10.4.2.7 Before a VOC + air fume stream is re-introduced to an operating thermal oxidizer by deactivating the 3-way diverter valve after an interlock trip, the operator shall ensure the VOC concentration is less than 25% of LFL.

10.4.3 Maintenance (reserved)

10.4.4 Inspection (reserved)

10.5.5 Testing (reserved)

Statement of Problem and Substantiation for Public Input

In the last cycle, the NFPA 86 Technical Committee began to codify more explicitly how solvent ovens and oxidizer systems can work together for enhanced safety from explosions. The proposed changes here continue that progress from the perspective of the owner of the oven and oxidizer system. The new content includes explicit requirements for diverting a VOC fume stream to atmosphere and for re-introducing it to the oxidizer system.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 14-NFPA 86-2023 [New Section after A.10.2.3]	
Public Input No. 17-NFPA 86-2023 [Section No. 10.4]	

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 25 11:12:29 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-40-NFPA 86-2024

Statement: This revision more explicitly codifies how solvent ovens and oxidizer systems can work together for enhanced safety from explosions. The adopted content introduces explicit requirements for diverting the fume stream of volatile organic compounds to atmosphere and for re-introducing it to the oxidizer system.

Diverter valves that emit uncontrolled VOC to the atmosphere are not considered environmentally friendly. The adopted annex section is to assist equipment designers in expressing that the exhaust gas diverter valve is preferred in an environmental sense, and that good faith efforts to minimize such emissions should be utilized as a better alternative to a "one-size-fits-all" mindset that puts less focus on worker safety and mitigation of explosions.

Public Input No. 17-NFPA 86-2023 [Section No. 10.4]

10.4 Commissioning, Operations, Maintenance, Inspection, and Testing. ~~(Reserved)~~

10.4.1 Commissioning (reserved)

10.4.2 Operations

10.4.2.1 The oxidizer system shall be started and brought to operating temperature prior to introducing fume (dirty gas) flow.

Statement of Problem and Substantiation for Public Input

This section had previously been "reserved" but a new requirement is proposed to help ensure safe operation of oxidizer systems.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 13-NFPA 86-2023 [Section No. 10.4]	

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Feb 23 08:24:32 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-40-NFPA 86-2024

Statement: This revision more explicitly codifies how solvent ovens and oxidizer systems can work together for enhanced safety from explosions. The adopted content introduces explicit requirements for diverting the fume stream of volatile organic compounds to atmosphere and for re-introducing it to the oxidizer system.

Diverter valves that emit uncontrolled VOC to the atmosphere are not considered environmentally friendly. The adopted annex section is to assist equipment designers in expressing that the exhaust gas diverter valve is preferred in an environmental sense, and that good faith efforts to minimize such emissions should be utilized as a better alternative to a "one-size-fits-all" mindset that puts less focus on worker safety and mitigation of explosions.

Public Input No. 67-NFPA 86-2024 [Section No. 11.4.1.1]

11.4.1.1 Solvent Atmosphere Ovens.

The safety design data form or nameplate for solvent atmosphere ovens shall include all of the following design data:

(1) Solvent used

(2) ~~Number of~~ Quantity in gallons (liters) ~~per batch or~~ or pounds (kg) per batch or per hour of solvent and volatiles entering the oven

(3) Required purge time

(4) Oven operating temperature

(5) Exhaust blower rating for the number of gallons (liters) of solvent per hour or batch at the maximum operating temperature

Additional Proposed Changes

File Name	Description	Approved
86_PC1_Hold.pdf	86_PC1	

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 1 of the (A2022) Second Draft Report for NFPA and per the Regs. At 4.4.8.3.1 and needs to be reconsidered by the TC for the next edition of the document.

In many industrial facilities, solvents are added on a weight basis, not a volumetric basis. This permits the facility flexibility in reporting units that are consistent with the method of batch preparation. Explanatory material A1.11.4.1(a) and (b) should also be revised accordingly.

Submitter Information Verification

Submitter Full Name: NFPA Holds
Organization: Technical Committee on Ovens and Furnaces
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 06 19:07:30 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-43-NFPA 86-2024

Statement: In many industrial facilities, solvents are added on a weight basis, not a volumetric basis. This revision allows the facility flexibility in reporting units that are consistent with the method of batch preparation.

Public Input No. 68-NFPA 86-2024 [Section No. 11.6.1.3]

11.6.1.3

The determination of safety ventilation shall be based on all of the following:

(1) Volume of products of combustion entering the oven heating chamber

(2) Weight or volume of flammable or combustible constituents released during the heating process, based on maximum loading

(3) ~~Solvent that requires the greatest amount of ventilation air per gallon (liter) when a combination of solvents is used~~

(4) Design of the oven heating and ventilation system with regard to all of the following:

    (5) Materials to be processed

    (6) Temperature to which processed materials are raised

    (7) Method of heating with regard to direct or indirect venting of combustion products versus alternative use of steam or electrical energy

    (8) General design of the oven with regard to continuous or batch-type operation

    (9) Type of fuel and chemicals to be used and any by-products generated in the heating chamber

Additional Proposed Changes

File Name	Description	Approved
86_PC2_Hold.pdf	86_PC2	

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 2 of the (A2022) Second Draft Report for NFPA and per the Regs. At 4.4.8.3.1 and needs to be reconsidered by the TC for the next edition of the document.

The code does not explain how this point should be used in the calculation of the safety ventilation volume. Delete for clarity. Alternatively, provide an explanation for how an oven processing multiple solvents should be used.

Submitter Information Verification

Submitter Full Name: NFPA Holds
Organization: Technical Committee on Ovens and Furnaces
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 06 19:10:35 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: The requirement in item (3) identifies the solvent with the greatest amount of ventilation air per gallon (or liters), where multiple solvents are present, to use in the calculation.

Public Input No. 69-NFPA 86-2024 [Section No. 11.6.6.1]

11.6.6.1

The method for calculating the ventilation rate for products of combustion shall be as follows:

(1) The minimum oven exhaust volume for safety ventilation in continuous process ovens, including powder coating ovens, where a direct-fired combustion system (within or remote from the oven chamber) is used shall include the volume of combustion products from burners.

(2) The value used for the products of combustion shall be 183 scfm (5.18 standard m^3/min) per 1,000,000 Btu/hr (293.1 kW) burner rating.

(3) The products of combustion shall be adjusted for the oven operating temperature and the altitude as described in section 11 .6.6.2.

(4) The adjusted value shall be added to the value determined from 11.6.8.4.

Additional Proposed Changes

File Name	Description	Approved
86_PC3_Hold.pdf	86_PC3	

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as “Reject but Hold” in Public Comment No. 3 of the (A2022) Second Draft Report for NFPA and per the Regs. At 4.4.8.3.1 and needs to be reconsidered by the TC for the next edition of the document.

Revising for clarity.

Submitter Information Verification

Submitter Full Name: NFPA Holds
Organization: Technical Committee on Ovens and Furnaces
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 06 19:12:49 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-44-NFPA 86-2024

Statement: This revision added cross-references to assist the user in complying with the requirement of 11.6.6.1.

Public Input No. 5-NFPA 86-2023 [Section No. 13.5.14.3.2.2]

13.5.14.3.2.2

The cooling system shall be constructed with an external heat exchanger, and the following criteria also shall be met:

(1) The cooling system shall be controlled so that any leakage is from the oil to the water.

(2) 13.5.14.3.2.2.1 shall not be required if the system is designed so that any water will leak to the atmosphere without the possibility of water entering the oil .

(3) Water-cooling coils shall not be installed within the quench tank.

(4) Loss of the controlled condition shall be alarmed.

Additional Proposed Changes

File Name	Description	Approved
Produktblad-Plattva_rmeva_xlare-Sondex.pdf		

Statement of Problem and Substantiation for Public Input

Heat exchanger manufacturers have designed plate heat exchangers with air gaps between the plates in contact with the process fluids, with these gaps being open to the outside of the heat exchanger. In the event of a leak, the leaked fluid flows out of the heat exchanger without mixing. This also allows leaks to be detected with a visual inspection.
Since a leaking plate will not result in water to oil contamination, the requirement for controlling the relative pressures is not necessary in this arrangement.

Submitter Information Verification

Submitter Full Name: Andrew Stoeckle
Organization: AFC Holcroft LLC
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 11 15:10:53 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-45-NFPA 86-2024

Statement: The base requirement is to prevent water from leaking into the oil. This revision clarifies that to the user.

Public Input No. 9-NFPA 86-2023 [New Section after A.3.3.5]

A.3.3.10 A combustion safeguard receives input from a flame sensor and sends binary output to a BMS or PLC that indicates presence or absence of flame. The BMS performs logic decisions such as safe start check, trial for ignition, and flame failure based on input from the combustion safeguard.

Statement of Problem and Substantiation for Public Input

This annex material is meant to amplify the new proposed definition of combustion safeguard at 3.3.10.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 8-NFPA 86-2023 [Section No. 3.3.10]	Annex material for the related content

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri Jan 20 18:18:36 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution: FR-46-NFPA 86-2024

Statement: This revision clarifies that the "combustion safeguard" and BMS are not the same. The terms "combustion safeguard" and "burner management system" are often misinterpreted to be synonymous.

Public Input No. 50-NFPA 86-2024 [Section No. A.5.3]

A.5.3

~~Explosion hazards can be mitigated by the following methods:~~

(1) ~~Containment~~

(2) ~~Explosion relief~~

(3) ~~Location~~

(4) ~~Explosion suppression~~

(5) ~~Damage-limiting construction~~

~~For additional information regarding explosion protection of equipment and buildings, see NFPA 68 and NFPA 69.~~

Many ovens include an explosion hazard related to the heating fuels, flammable vapors released from work-in-process, or the use of special atmospheres. To control these hazards, several methods from NFPA 69 are applied and include the following:

(1) Avoiding combustion through the control of the following:

- (a) Combustible concentration (e.g., keeping combustible material below its LFL).
- (b) Oxidant concentration (e.g., reducing oxygen below the level needed for ignition).

(2) Limiting damage by confining deflagration pressures.

The following table provides a view of the explosion controls applied to different classes of ovens.

Deflagration control method	Oven Class		
	A	B	C
Controlling combustible concentration			
Safety shutoff valves per Chapter 8	X	X	X
Pre-ignition purge per Chapter 8	X	X	X
Trials-for-ignition per Chapter 8	X	X	X
Flame supervision per Chapter 8	X	X	X
Safety ventilation per Chapter 11	X		
Controlling oxidant concentration			
Low oxygen atmosphere oven per Chapter 11	X		
Special atmosphere control per Chapter 13			X
Confining deflagration pressure			
Pressure vessel design per Chapter 14			

Beyond the explosion controls discussed above, section 5.3 provides additional guidance on explosion control options for Class A ovens. Explosion hazards can be mitigated based on oven design considerations (such as the heat source or recirculation of the exhaust air), added controls (such as LFL monitoring), and the use of deflagration venting.

For additional information regarding deflagration venting see NFPA 68.

Statement of Problem and Substantiation for Public Input

Modification to annex material based upon changes to section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updates to annex material

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider

Organization: Global Finishing Solutions

Street Address:

City:

State:

Zip:

Submittal Date: Mon Jun 03 15:58:46 EDT 2024

Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 64-NFPA 86-2024 [Sections A.5.3, A.5.3.1, A.5.3.1(3), A.5.3.1(4), A.5.3.2, A...]

Sections A.5.3, A.5.3.1, A.5.3.1(3), A.5.3.1(4), A.5.3.2, A.5.3.5

A.5.3

~~Explosion hazards can be mitigated by the following methods:~~

(1) ~~Containment~~

(2) ~~Explosion relief~~

(3) ~~Location~~

(4) ~~Explosion suppression~~

(5) ~~Damage-limiting construction~~

~~For additional information regarding explosion protection of equipment and buildings, see NFPA 68 and NFPA 69~~

Many ovens include an explosion hazard related to the heating fuels, flammable vapors released from work-in-process, or the use of special atmospheres. To control these hazards, several methods from NFPA 69 are applied and include the following:

(1) Avoiding combustion through the control of the following:

(a) Combustible concentration (e.g., keeping combustible material below its LFL).

(b) Oxidant concentration (e.g., reducing oxygen below the level needed for ignition).

(2) Limiting damage by confining deflagration pressures.

The following table provides a view of the explosion controls applied to different classes of ovens.

Deflagration control method	**Oven Class**			
	A	**B**	**C**	
Controlling combustible concentration				
Safety shutoff valves per Chapter 8	**X**	**X**	**X**	
Pre-ignition purge per Chapter 8	**X**	**X**	**X**	
Trials-for-ignition per Chapter 8	**X**	**X**	**X**	
Flame supervision per Chapter 8	**X**	**X**	**X**	
Safety ventilation per Chapter 11	**X**			
Controlling oxidant concentration				
Low oxygen atmosphere oven per Chapter 11	**X**			
Special atmosphere control per Chapter 13			**X**	
Confining deflagration pressure				
Pressure vessel design per Chapter 14				

Beyond the explosion controls discussed above, section 5.3 provides additional guidance on explosion control options for Class A ovens. Explosion hazards can be mitigated based on oven design considerations (such as the heat source or recirculation of the exhaust air), added controls (such as LFL monitoring), and the use of deflagration venting.

For additional information regarding deflagration venting see NFPA 68.

A.5.3.1

The exceptions identified in this section are scenarios where an explosion hazard does not exist by virtue of the configuration of the equipment [GR1] or a limitation on the presence of sufficient fuel for a deflagration.

A.5.3.1 (3)

~~For additional information regarding relief of equipment and buildings housing the equipment, see NFPA 68.~~

Because the combustion air has only one path from the combustion blower through the supervised powered exhaust, there is no buildup of products of combustion in the heat exchanger. The minimum exhaust rate for the heat exchanger should be determined using 11.6.6.1 , which states 183 scfm (5.18 standard m ^{3} /min) per 1,000,000 Btu/hr (293.1 kW) burner rating. Refer to Figure A.5.3.1(4) .

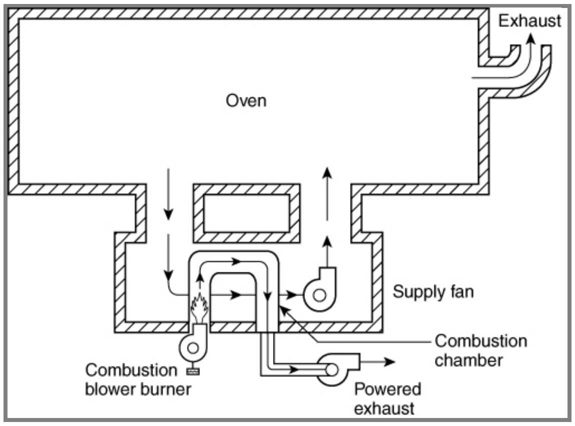
A.5.3.1(

~~3~~

4)

Because the combustion air has only one path from the combustion blower through the supervised powered exhaust, there is no buildup of products of combustion in the heat exchanger. The minimum exhaust rate for the heat exchanger should be determined using 11.6.6.1 , which states 183 scfm (5.18 standard m ^{3} /min) per 1,000,000 Btu/hr (293.1 kW) burner rating. Refer to Figure A.5.3.1(4) .

Figure A.5.3.1(4) Example of a Non-Recirculating, Indirect-Fired Oven.



A.5.3.1(5) For reliable operation, the LFL detection sensing location(s) should be located in the region of the combustion chamber most likely to accumulate flammable gases as a result of a gas leak or incomplete combustion. This should be determined by a qualified engineer because numerous factors need to be taken into account (properties of gases, source, expected airflows, etc.). In some cases, it might be necessary to provide multiple ports in a single combustion chamber to reliably monitor potential flammable gas accumulations.

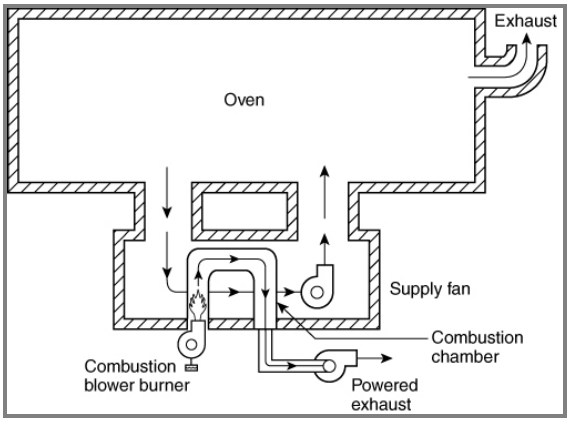
In addition, the detection sensing system should be selected to detect all potential explosive gases that could be developed as a result of the process and burner systems. This could require multiple sensing systems as LFL calibration for different gases might not be the same. Alternatively, the calibration should be such that no potential flammable gas could exceed a concentration of 10 percent LFL without tripping the sensor (with the side effect that some gases might trip the sensor at much lower LFL percentage concentrations).

A.5.3.

~~1(4)~~ —

~~Because the combustion air has only one path from the combustion blower through the supervised powered exhaust, there is no buildup of products of combustion in the heat exchanger. The minimum exhaust rate for the heat exchanger should be determined using 11.6.6.1 , which states 183 scfm (5.18 standard m ^{3} /min) per 1,000,000 Btu/hr (293.1 kW) burner rating. Refer to Figure A.5.3.1(4) .~~

~~Figure A.5.3.1(4) Example of a Non-Recirculating, Indirect-Fired Oven.~~



~~A.5.3.~~

~~2~~ —

~~The intent of providing explosion relief in furnaces is to limit damage to the furnace and to reduce the risk of personnel injury due to explosions.~~

~~The historic application of the 1 ft ^{2} (0.093 m ^{2}) of relief area for each 15 ft ^{3} (0.424 m ^{3}) of volume, which is based on industry experience and traditional construction methods, has provided an acceptable level of damage control and personnel protection. Furthermore, controls on fuel concentration (e.g., safety shutoff valves, safety ventilation interlocks) ensure that an upset condition results in only a localized concentration of flammable vapors within the oven volume, thus limiting the energy of the deflagration.~~

~~However, the oven designer, manufacturer, and end user should review their specific application and consider the probability of abnormal or “upset” conditions that could lead to concentrations in excess of 25 percent of the LFL distributed throughout the oven volume. A worst-case event involving an explosive mixture distributed throughout the oven volume is likely to require construction and venting design in accordance with NFPA 68 to avoid catastrophic failure of the oven and hazard to personnel and equipment in the vicinity.~~

~~Users of this standard are also encouraged to seek out innovative solutions for deflagration venting as a means of overcoming impracticalities associated with traditional venting solutions. Such innovative solutions include weak seam or weak joint construction, damage-limiting construction, self-relieving enclosures, tethered panels, and lifting enclosures. As with any deflagration venting solution, personnel protection is to be considered foremost in the event of a vent-relieving incident.~~

~~A.5.3. 2.2~~ ~~See 8.4.1. This preignition purge is required for all types of heating systems.~~

~~A. 5 .3.5~~ —

~~The location for explosion relief is a critical concern and should be close to the ignition source. The heater box is part of the oven system and needs to have explosion relief provided. Personnel considerations and proximity to other obstructions can affect the location selected for explosion-relief vents.~~

~~A.5.3.6.1~~ ~~Deflagration avoidance designs for simple continuous Class A Ovens are intended for common (simple) designs with operational limitations that are well understood by designer, manufacturer and user. This is a prescriptive approach not suitable for complex or experimental designs and implementations. See 5.3.9.1 for a list of required characteristics of these ovens.~~

~~The designer, manufacturer and user are cautioned that failure to understand the limitations of deflagration avoidance systems in the event of an uncontrolled upset condition can result in unacceptable risk of loss of life, injury, or loss of property.~~

~~A.5.3.9.1(1)~~ ~~The oven design has taken into account the variable solvent loads possible so that rapid swings in concentration cannot exceed the designed mitigation's control response time or capability to maintain the oven in a safe operating range.~~

~~A.5.3.16.2~~ ~~– tbd - under task group consideration~~

Additional Proposed Changes

File Name	Description	Approved
Proposal_-_Explosion_Control_-_240531b.docx	For Annex Text	

Statement of Problem and Substantiation for Public Input

Clarifies referenced PI regarding section 5.3

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 60-NFPA 86-2024 [Section No. 5.3]	

Submitter Information Verification

Submitter Full Name: Saoirse George
Organization: Tokio Marine America, Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 20:30:50 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 51-NFPA 86-2024 [Section No. A.5.3.1]

A.5.3.1

~~For additional information regarding relief of equipment and buildings housing the equipment, see NFPA 68~~ The exceptions identified in this section are scenarios where an explosion hazard does not exist by virtue of the configuration of the equipment or a limitation on the presence of sufficient fuel for a deflagration .

Statement of Problem and Substantiation for Public Input

Updated annex material to reflect changes in section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:01:12 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 52-NFPA 86-2024 [Section No. A.5.3.1(3)]

A.5.3.1(~~3~~ 4)

For reliable operation, the LFL detection sensing location(s) should be located in the region of the combustion chamber most likely to accumulate flammable gases as a result of a gas leak or incomplete combustion. This should be determined by a qualified engineer because numerous factors need to be taken into account (properties of gases, source, expected airflows, etc.). In some cases, it might be necessary to provide multiple ports in a single combustion chamber to reliably monitor potential flammable gas accumulations.

In addition, the detection sensing system should be selected to detect all potential explosive gases that could be developed as a result of the process and burner systems. This could require multiple sensing systems as LFL calibration for different gases might not be the same. Alternatively, the calibration should be such that no potential flammable gas could exceed a concentration of 10 percent LFL without tripping the sensor (with the side effect that some gases might trip the sensor at much lower LFL percentage concentrations).

Statement of Problem and Substantiation for Public Input

Renumbering based upon changed order in section 5.3.1.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material. Renumbering.

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:03:40 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 58-NFPA 86-2024 [New Section after A.5.3.1(4)]

A.5.3.2.2

See 8.4.1. This preignition purge is required for all types of heating systems.

Statement of Problem and Substantiation for Public Input

Annex material to support new language in section 5.3. Provided pointer to existing purge requirements and provides guidance that this applies to all heating systems as 8.4.1 is for direct gas-fired heaters.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	New annex.

Submitter Information Verification

Submitter Full Name:	Geoffrey Raifsnider
Organization:	Global Finishing Solutions
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 03 16:15:24 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

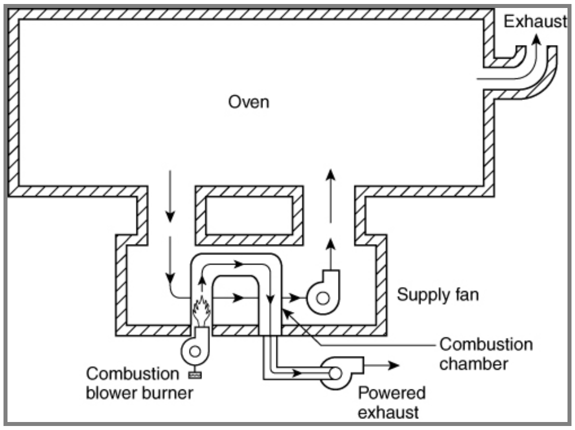
Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 53-NFPA 86-2024 [Section No. A.5.3.1(4)]

A.5.3.1(~~4~~ 3)

Because the combustion air has only one path from the combustion blower through the supervised powered exhaust, there is no buildup of products of combustion in the heat exchanger. The minimum exhaust rate for the heat exchanger should be determined using 11.6.6.1, which states 183 scfm (5.18 standard m^3/min) per 1,000,000 Btu/hr (293.1 kW) burner rating. Refer to Figure A.5.3.1(~~4~~ 3).

Figure A.5.3.1(~~4~~ 3) Example of a Non-Recirculating, Indirect-Fired Oven.



Statement of Problem and Substantiation for Public Input

Renumbered base upon new order in section 5.3.1.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material. Renumbering.

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:05:09 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 57-NFPA 86-2024 [New Section after A.5.3.2]

A.5.3.3(4)
Guidance can be found in FM Data Sheet 1-44 *Damage-Limiting Construction* .

Statement of Problem and Substantiation for Public Input

New annex material to give guidance on types of available standards.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	New annex material
Public Input No. 59-NFPA 86-2024 [Section No. O.1.2.10]	

Submitter Information Verification

Submitter Full Name:	Geoffrey Raifsnider
Organization:	Global Finishing Solutions
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 03 16:13:06 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 54-NFPA 86-2024 [Section No. A.5.3.2]

A.5.3.~~2~~ 3

The intent of providing explosion relief in furnaces is to limit damage to the furnace and to reduce the risk of personnel injury due to explosions.

The historic application of the 1 ft^2 (0.093 m^2) of relief area for each 15 ft^3 (0.424 m^3) of volume, which is based on industry experience and traditional construction methods, has provided an acceptable level of damage control and personnel protection. Furthermore, controls on fuel concentration (e.g., safety shutoff valves, safety ventilation interlocks) ensure that an upset condition results in only a localized concentration of flammable vapors within the oven volume, thus limiting the energy of the deflagration.

However, the oven designer, manufacturer, and end user should review their specific application and consider the probability of abnormal or “upset” conditions that could lead to concentrations in excess of 25 percent of the LFL distributed throughout the oven volume. A worst-case event involving an explosive mixture distributed throughout the oven volume is likely to require construction and venting design in accordance with NFPA 68 to avoid catastrophic failure of the oven and hazard to personnel and equipment in the vicinity.

Users of this standard are also encouraged to seek out innovative solutions for deflagration venting as a means of overcoming impracticalities associated with traditional venting solutions. Such innovative solutions include weak seam or weak joint construction, damage-limiting construction, self-relieving enclosures, tethered panels, and lifting enclosures. As with any deflagration venting solution, personnel protection is to be considered foremost in the event of a vent-relieving incident.

Statement of Problem and Substantiation for Public Input

Renumbered based upon changes in section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material. Renumbering.

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:07:46 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 55-NFPA 86-2024 [Section No. A.5.3.5]

~~A.5.3.5~~ 3.4

The location for ~~explosion relief is~~ deflagration venting is a critical concern and should be close to the ignition source. The heater box is part of the oven system and needs to have ~~explosion relief~~ deflagration venting provided. Personnel considerations and proximity to other obstructions can affect the location selected for ~~explosion-relief~~ deflagration vents.

Statement of Problem and Substantiation for Public Input

Renumbered and updated language using deflagration vent(ing) to be consistent with changes to section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material.

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:09:11 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 56-NFPA 86-2024 [Section No. A.5.3.7]

A.5.3.~~7~~ 3.6

Industry experience indicates that a typical oven enclosure built to withstand a minimum of a gauge pressure of 0.5 psi (3.45 kPa) surge overpressure with ~~explosion-relief~~ deflagration vent panels having a maximum weight per area of 5 lb/ft^2 (24.4 kg/m^2) meets the requirements of 5.3.7.

Statement of Problem and Substantiation for Public Input

Renumbered and updated language to use deflagration vent(ing) to be consistent with changes to section 5.3.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated annex material

Submitter Information Verification

Submitter Full Name:	Geoffrey Raifsnider
Organization:	Global Finishing Solutions
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 03 16:11:21 EDT 2024
Committee:	OVE-AAA

Committee Statement

Resolution: FR-1-NFPA 86-2024

Statement: The purpose of NFPA 86 is to provide requirements to minimize the risks from fire and explosion hazards. Requirements exist throughout the standard that are intended to control the potential for an explosion. Some Class A ovens might require additional explosion control methods. Section 5.3 has been expanded from addressing explosion relief to providing requirements for various explosion control methods. Methods are broken down into two categories, deflagration prevention and damage-limiting construction. Deflagration prevention addresses an explosion hazard by preventing the event that may lead to the failure of the enclosure (explosion). Damage-limiting construction includes deflagration venting and deflagration containment which provide means to limit the impact of a deflagration. It is important to offer both control methods as there are situations in which explosion venting is not practicable or may create additional hazards. The options offered should cover the broad range of Class A oven types that may require additional explosion control. This addresses the unintended consequences that arose from the removal of the 3/16 inch plate and buckstay exception from the 2023 edition by included additional control options (i.e., there was interpretation within the industry that the 3/16 inch plate and buckstay were no longer permitted).

Public Input No. 65-NFPA 86-2024 [Section No. A.8.2.3]

A.8.2.3

Consideration should be given to the effects of radiant heat on the safety devices. Radiant heat can cause safety devices to be exposed to temperatures greater than their ratings. Adequate insulation, heat shields, ventilation, or other measures should be used in cases where radiant heat causes safety devices to reach temperatures above their ratings.

The requirements for the use of self-checking flame detectors are listed in the manufacturer's instructions.

The requirements for the use of safety shutoff valves used in Open-Close Cycling Applications are listed in the manufacturer's instructions.

Statement of Problem and Substantiation for Public Input

Questions are often asked about the NFPA 86 Standard being silent on type of flame detector required for compliance. The suggested Annex material reinforces the need to consult the safety device manufacturer's instructions for the correct application of flame detectors. Also, the addition of information about Open-Closed Cycling Applications for safety shutoff valves is suggested to serve as a reminded that high cycle rated safety shutoff valves are required for certain applications.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 04 09:20:58 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-22-NFPA 86-2024

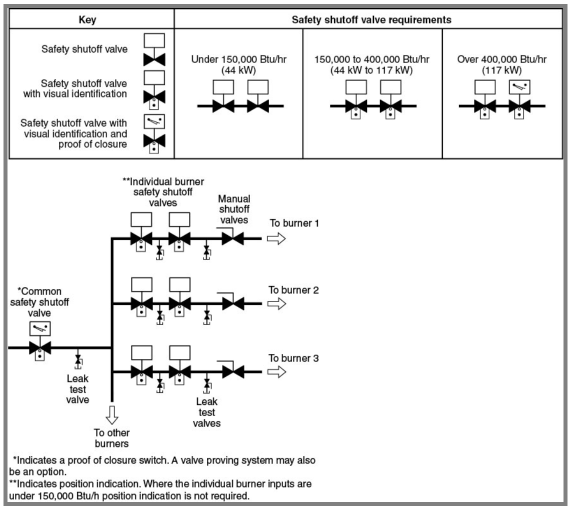
Statement: This new Annex material reinforces the need to consult the safety device manufacturer's instructions for the correct application of flame detectors. The addition of this information about open-closed cycling applications for safety shutoff valves is suggested to serve as a reminded that high cycle rated safety shutoff valves are required for certain applications.

Public Input No. 21-NFPA 86-2024 [Section No. A.8.4.1.2.3(2)]

A.8.4.1.2.3(2)

See Figure A.8.4.1.2.3(2).

Figure A.8.4.1.2.3(2) Example for Multiple Burner System with Independently Operated Burners Using a Common SSOV with Single Proved Closed Interlock for Pre-purge.



*Indicates a proof of closure switch. A valve proving system may also be an option.
**Indicates position indication. Where the individual burner inputs are under 150,000 Btu/h position indication is not required.

Additional Proposed Changes

File Name	Description	Approved
NFPA_86_2023_Public_Input_A.8.4.1.2.3_2_tj240518.pdf	Marked up copy of A.8.4.1.2.3(2) showing proposed deletion.	

Statement of Problem and Substantiation for Public Input

The portion of the diagram proposed for deletion causes confusion as to when a proof of closure switch is required. The “safety shutoff valve requirements” diagram heading implies that on any double safety shutoff valve arrangement used on a path over 400,000 Btu/h that one (1) valve must have a proof of closure switch. This is not a requirement in the mandatory text.

This Annex also does not seem to add explanatory material to 8.4.1.2.3(2) and may be more appropriate to be the added to Annex A.8.7.2.2.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 18 09:25:25 EDT 2024

Committee: OVE-AAA

Committee Statement

Resolution: CI-26-NFPA 86-2024

Statement: The committee is evaluating Figure A.8.4.1.2.3(2) to determine if the figure as whole or portions of the figure should be move to another section of the document, such as A.8.7.2.3.

Public Input No. 10-NFPA 86-2023 [Section No. A.8.4.1.2.4]

A.8.4.1.2.4

A preignition airflow interlock can be provided by a variety of devices. Most commonly, a fixed orifice plate is used to generate a differential pressure at the desired (calculated) preignition airflow rate. A differential pressure switch, used in conjunction with the fixed orifice, provides the electrical permissive to verify the presence of air movement at the required flow rate.

Similarly, a differential pressure switch can be used as an airflow interlock by monitoring the differential pressure across a burner, either in single or multiburner systems. Single burner applications would include package burner assemblies. Burners provide a fixed airflow rate at a known pressure; therefore, a burner can be utilized as the flow element. Burner manufacturer's literature will typically provide the pressure-flow data for each specific burner size available. Valves that can restrict airflow below the minimum required preignition airflow rate should not be installed downstream of the pressure switch location. *(See Figure A.8.6.4.)* If the furnace internal pressure is operated above atmospheric pressure, the reference connection on the pressure switch should be connected to the furnace heating chamber in lieu of an atmospheric pressure reference.

A vane- or paddle-type flow switch is another example of a device that can be used to provide the required preignition airflow interlock. When utilizing a vane flow switch, the purge time should be calculated based on the minimum airflow for the particular vane size being used. Manufacturer's literature will typically specify the airflow range for each size vane available. ~~Use of a flow measurement device, such as a mass flow~~ A mass flow sensor, can be used to measure the current system flow and provide the preignition airflow interlock. A Pitot-style probe measures velocity pressure which can be converted to airflow rate if the pipe area and fluid density are known.

The fundamental metering variable should be taken into account when selecting a conservative value for the trip setpoint for a low flow switch (FSL). The metering variable for paddle-, Pitot-, and orifice-type devices is velocity pressure $p_{vel} = ½\rho V^2$. The metering variable for vane-type devices is velocity V . The metering variable for thermal anemometer devices is mass flow rate $\dot{m}$.

The purge requirement in 8.4.1.2.1 states that at least four system volumes of fresh air or inert gas shall be introduced during the purging cycle.

(1) If the metering principle is velocity pressure p vel p_{vel} the FSL setpoint should be chosen based on the velocity pressure that corresponds to the highest likely fresh air density ρ ρ . For example, consider two cases where the volumetric flows and cross-sectional areas are equal [$\dot{V}_A = \dot{V}_B$ and $A_A = A_B$], but the air density for Case B is half the air density for Case A [$\rho_B = ½\rho_A$]. From the mass flow equation $\dot{m} = \rho AV$, we can see that the velocity of Case B must be equal to the velocity of Case A $[V_A = V_B]$. Then, from the velocity pressure equation, we see that the velocity pressure of Case A is double the velocity pressure of Case B [$½\rho_A V_A^2 = 2(½\rho_B V_B^2)$] – even though the two volumetric flows are equal $\dot{V}_A = \dot{V}_B$. Thus, it would not be conservative for the FSL setpoint to correspond to a *hypothetical* Case B if the *actual* density was that of Case A, because it the interlock would be tripped at a volumetric flow rate that was too low to ensure an effective purge volume in the available duration.

(2) If the metering principle is velocity V , the FSL setpoint may be chosen based on the velocity that corresponds to the highest fresh air density ρ_{max} , because volumetric flow is independent of fluid density when the cross-sectional areas and velocities are equal.

(3) If the metering principle is mass flow rate $\dot{m}$, the FSL setpoint should be chosen based on the mass flow rate that corresponds to the highest likely fresh air density ρ_{max} . For example, consider two cases where the volumetric flows and cross-sectional areas are equal [$\dot{V}_C = \dot{V}_D$ and $A_C = A_D$], but the air density for Case D is half the air density of Case C [$\rho_D = ½\rho_C$]. From a different format of the mass flow equation $\dot{m} = \rho\dot{V}$, we

see that the mass flow rate of Case C must be double the mass flow rate of Case D [$\dot{m}_C = 2\dot{m}_D$] – even though the two volumetric flow rates are equal. Thus, it would not be conservative for the FSL setpoint to correspond to a hypothetical Case D if the actual density was that of Case C, because it would trip at a volumetric flow rate that was too low to ensure an effective purge volume in the available duration.

If the combustion airflow is measured by a device that uses a transmitter to send data to a PLC where the signal is used for safety functions, the transmitter should be SIL 2 capable (See 8.2.10).

Additional Proposed Changes

File Name	Description	Approved
Word_Doc_for_A.8.4.1.2.4.docx	Word document with equation text for PI at A.8.4.1.2.4	

Statement of Problem and Substantiation for Public Input

Successful purges require accurate knowledge of volumetric flow rate. Volumetric flowrate can vary with fluid density. Different flow metering devices have different fundamental metering variables. This added text helps users select a conservative value for purge airflow rate, based on the likely ambient temperature and pressure of the air being admitted for purge.

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Sun Jan 22 12:58:03 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-27-NFPA 86-2024

Statement: Successful purges require accurate knowledge of volumetric flow rate. Volumetric flowrate can vary with fluid density. Different flow metering devices have different fundamental metering variables. This revision provides text to help users select a conservative value for purge airflow rate, based on the likely ambient temperature and pressure of the air being admitted for purge.

Public Input No. 25-NFPA 86-2024 [Section No. A.8.6.3]

A.8.6.3

Motor operation can be proven with an auxiliary contact from a motor starter, or a signal from a motor controlling device, such as a variable frequency drive (VFD) made while the motor is running.

Statement of Problem and Substantiation for Public Input

The mandatory requirements in 8.6.3 do not preclude the use of a communication signal from a motor controlling device to implement an interlock.

The proposed revision explains the allowance for the use of communicate signals implemented in a Burner Management System meeting the requirements of Chapter 8 can also be used prove the operation of combustion air fans.

Submitter Information Verification

Submitter Full Name: Ted Jablkowski
Organization: Fives North American Combustion
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 18 10:12:27 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: The proposed language has not been adopted since such a revision would not enhance the understanding of the user to meet the requirement of 8.6.3. For instance motor controlling devices are already identified in 8.6.3.

Public Input No. 14-NFPA 86-2023 [New Section after A.10.2.3]

A.10.4.2.5.3

Oxidizer systems are nearly always installed to mitigate the environmental impact of airborne VOC emissions from processes such as solvent drying ovens, by destroying the VOC before the exhaust is emitted to atmosphere. This process is beneficial for the environment and for the health of nearby residents. However, if the solvent in the exhaust gas stream approaches a flammable concentration, protecting the safety of the personnel and nearby structures becomes a more important goal than protecting the environmental from emitting several ounces (or a few hundred grams) of a volatile pollutant compound. This is a simple observation that some risks are more dangerous than others, and mitigating the greater risk (to the temporary detriment of the smaller risk) is the prudent choice. The only practical method of explosion protection for an unintentional excursion of VOC concentration into a dangerous proximity to the LFL is by temporarily diverting the exhaust gas flow away from an oxidizer system and to the outdoor atmosphere (preferably at the top of a tall stack), as required by the language in this subchapter.

Explosion safety professionals who understand the need for an emergency diversion of fume gas that is nearly flammable may get pushback from air pollution authorities who do not want pollutants ever to be emitted to atmosphere. Anecdotes about air pollution regulators who have rejected engineering plans that include a diverter valve upstream of an oxidizer system are relatively common. This annex content is intended to be used by operating entities who are seeking construction permits and operating permits for air pollution equipment that contain a diverter valve as a vital safety feature that the fire safety community deems to be a requirement.

Entities who own and operate ovens and oxidizer systems that require an emergency diverter valve should be willing to express their dedication to the principle that any safety-driven diversion of VOC compounds to atmosphere will be as short-lived as possible and will emit the smallest mass of VOC possible. This principle can be demonstrated by the owner's willingness to employ measures that immediately reduce the production of the VOC during any period when a diversion to atmosphere is necessary. Such measures include shutting down the oven's heating system and halting the introduction of new, solvent-laden material into the oven. Owners of oxidizer systems should also be willing to offer to provide process data (e.g., datalogger values of the continuous vapor concentration controller's LFL percentage and the time period for which the diverter valve is open) that parallels routine stack data already provided to the environmental regulating authority (e.g. stack gas velocity, temperature, carbon dioxide, oxygen). Oxidizer system owners should also be willing to pledge their willingness to pay appropriate fines for excursions of VOC emissions. In process industries where equipment and instruments can fail and accidental releases of airborne pollutants can happen, such fines are simply a cost of doing business.

As a fallback, if air quality regulators are intransigent about relaxation of their rules to permit safety venting of flammable mixtures that could otherwise cause an explosion, the following safety measures should be considered. None of these are as simple or as effective as a 3-way flow diverter valve, but they are mentioned here as a last resort.

A. Introduce a dilution airstream to ensure vapor concentration is below 25% LEL prior to being introduced to the operating oxidizer system.

B. When purging equipment that contains an indeterminate (possibly flammable) atmosphere, introduce airflow to the equipment being purged slowly, and open the damper to the oxidizer gradually, thereby reducing vapor concentration in the ductwork. The purge timer would start after minimum purge airflow rate is reached.

C. Use another engineered system (e.g. extra residence time in pre-oxidizer ductwork combined with extra dilution air) specifically designed to prevent a slug of high-concentration gas flow from reaching the oxidizer.

See also FM standards for Regenerative Thermal Oxidizers for additional guidance.

Statement of Problem and Substantiation for Public Input

Diverter valves that emit uncontrolled VOC to the atmosphere are unpopular with environmental regulators. This annex text should be present in the NPFA 86 standard so equipment designers can persuade the air pollution control agency that an exhaust gas diverter valve is the lesser of two evils, and that good faith efforts to minimize such emissions should be accepted as the better alternative to a "one-size-fits-all" mindset from air regulators that ignores worker safety and prevention of explosions.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 13-NFPA 86-2023 [Section No. 10.4]	Annex content for the new requirement at 10.4

Submitter Information Verification

Submitter Full Name: Richard Martin
Organization: Martin Thermal Engineering Inc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 25 12:45:59 EST 2023
Committee: OVE-AAA

Committee Statement

Resolution: FR-40-NFPA 86-2024

Statement: This revision more explicitly codifies how solvent ovens and oxidizer systems can work together for enhanced safety from explosions. The adopted content introduces explicit requirements for diverting the fume stream of volatile organic compounds to atmosphere and for re-introducing it to the oxidizer system.

Diverter valves that emit uncontrolled VOC to the atmosphere are not considered environmentally friendly. The adopted annex section is to assist equipment designers in expressing that the exhaust gas diverter valve is preferred in an environmental sense, and that good faith efforts to minimize such emissions should be utilized as a better alternative to a "one-size-fits-all" mindset that puts less focus on worker safety and mitigation of explosions.

Public Input No. 16-NFPA 86-2023 [New Section after A.11.6.3.1]

A.11.6.3.2

Pollution control devices such as oxidizer systems (Chapter 10) can accumulate oxidation products that solidify and adhere to surfaces, including walls and ceramic media. When the gases being oxidized include compounds that contain silicon atoms (e.g. silane) or phosphorus atoms (e.g. phosphine) the accumulation of solid oxides (e.g. silicon dioxide and phosphorus pentoxide) can occur steadily over rather short periods of time (weeks rather than years), and the accumulated solids can reduce the furnace diameter (if open) or the interstitial porosity (if packed).

An inventory calculation should be performed to estimate the rate at which such solids will collect and reduce flow area. The oxidizer system should be maintained and/or the bed material should be replaced before safety ventilation is reduced to an unsafe level. Relying on measurement of a sufficiently high pressure differential across the oxidizer's porous bed is not a satisfactory replacement for anticipatory inspection and/or maintenance.

Statement of Problem and Substantiation for Public Input

This annex material points out the need for predictive maintenance above and beyond routine maintenance, when an oxidizer system can accumulate solids and reduce safety ventilation to an unacceptably low level.

Submitter Information Verification

Submitter Full Name:	Richard Martin
Organization:	Martin Thermal Engineering Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Feb 23 07:57:22 EST 2023
Committee:	OVE-AAA

Committee Statement

Resolution: Although there is useful information proposed that identifies the differential pressures across a oxidizer bed, the revision would be contrary to the user's experience and direction from oxidizer suppliers.

Public Input No. 59-NFPA 86-2024 [Section No. O.1.2.10]

O.1.2.10 FM Publications.

FM Global, 270 Central Avenue, P.O. Box 7500, Johnston, RI 02919.

FM Approval 7400, *Approval Standard for Liquid and Gas Safety Shutoff Valves*, 2016.

FM Global Property Loss Prevention Data Sheet 1-44, *Damage-Limiting Construction* , 2023

FM Global Property Loss Prevention Data Sheet 6-13, "Waste Fuel Fired Facilities," updated January 2021.

FM Global Property Loss Prevention Data Sheet 6-17, "Rotary Kilns and Dryers," updated July 2021.

Statement of Problem and Substantiation for Public Input

Additional information reference used in new annex material.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 46-NFPA 86-2024 [Section No. 5.3]	Updated informational reference
Public Input No. 57-NFPA 86-2024 [New Section after A.5.3.2]	Updated informational reference

Submitter Information Verification

Submitter Full Name: Geoffrey Raifsnider
Organization: Global Finishing Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 03 16:18:50 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-39-NFPA 86-2024
Statement: Annex references have been updated to their current editions.

Public Input No. 44-NFPA 86-2024 [Section No. O.1.2.17]

O.1.2.17 UL Publications.

Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

Bulletin of Research No. 43, “The Lower Limit of Flammability and the Autogenous Ignition Temperature of Certain Common Solvent Vapors Encountered in Ovens,” January 1950.

UL 353, *Limit Controls*, 1994, revised 2011.

UL 429, *Electrically Operated Valves for Gas Appliances*, 2023, revised 2021.

Statement of Problem and Substantiation for Public Input

Update reference to most current edition.

Submitter Information Verification

Submitter Full Name: Kelly Nicolello
Organization: UL Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Sat Jun 01 12:49:46 EDT 2024
Committee: OVE-AAA

Committee Statement

Resolution: FR-39-NFPA 86-2024
Statement: Annex references have been updated to their current editions.