

SAFETY CONTROL REQUIREMENTS FOR OVENS AND FURNACES

SAFETY CONTROL REQUIREMENTS

The NATIONAL FIRE PROTECTION ASSOCIATION is organized “to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects, and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire.”

The NFPA standards are developed by committees of people selected for their technical competence and interest. The objective of the standards is to reduce the loss potential in terms of life, property and production. The NFPA standards are only advisory publications. However, they are widely referenced by public jurisdictional authorities, testing agencies and insurer organizations.

The 2007 edition of NFPA 86 continues to bring the standard into compliance with the for Industrial Furnaces Using a Special Processing Atmosphere, and NFPA 86D, Standard for Industrial Furnaces Using Vacuum as an Atmosphere, into NFPA 86. This new, combined document provided one standard for ovens and furnaces of all types. In addition, the standard was revised to comply with the Manual of Style for NFPA Technical Committee Documents. Chapter 2 now contains all referenced publications, and Chapter 3 contains all definitions. The 2007 edition of NFPA 86 continues to bring the standard into compliance with the Manual of Style for NFPA Technical Committee Documents and to update requirements where needed, as follows:

- (1) Requirements for logic systems and programmable logic controller–based systems were provided to replace a requirement that programmable logic controllers be specifically listed for combustion safety service. Listed controllers are no longer available.
- (2) Unenforceable text was either revised to be enforceable, deleted, or relocated to Annex A.
- (3) Where appropriate, repetitive text was replaced by a table.
- (4) Coverage of operations and maintenance requirements throughout the standard were relocated from former Chapter 14, Inspection, Testing and Maintenance. The chapter was renamed Commissioning, Operations, Maintenance, Inspection, and Testing and relocated to Chapter 7.

APPROVAL PROCEDURE

NFPA does not review, inspect, or approve equipment, plans or installations and therefore has no procedure for doing so. In instances where it is necessary to meet NFPA standards, the authority having jurisdiction will have established a procedure for the review and approval of systems. Contact the appropriate authority early in the planning stage of a project to ensure that all submissions and inspection schedules can be maintained.

NATIONAL FIRE PROTECTION ASSOCIATION-86



Table 1. SUMMARY OF REQUIREMENTS

(This publication is intended only as a convenient reference to general combustion control requirements of NFPA 86. For information regarding other requirements such as ventilation, oxygen enhancement, etc., refer to the NFPA Standard directly.)

NFPA 86: Ovens and Furnaces, Classes A, B, C and D[Ⓞ]				
System Control Specifications	Gas-fired	Oil-fired	Associated Standard Paragraph	Recommended Controls
INTERLOCK/LIMITS				
Operating Controller Temperature	Required	Required	NFPA 86: 8.17	L4006A, L4008A
High Limits Temperature	Required	Required	NFPA 86: 8.16	L4006E
High Fuel Gas Pressure	②		NFPA 86: 8.8.2	C6097B, C437D
Low Fuel Gas Pressure	Required		NFPA 86: 8.8.1	C6097A, C437E
High Oil Pressure		②	NFPA 86: 8.8.2	L404T
Low Oil Pressure		Required	NFPA 86: 8.8.1	L404V
High Oil Temperature			NFPA 86: 8.11	
Low Oil Temperature		Required	NFPA 86: 8.11	
Manual Supervisory Cook				
Atomizing Media		Required	NFPA 86: 8.10	
Rotating Cup Drive				
Valve Seal Overtravel Interlock (POC)	⑦		NFPA 86: 8.7, (VPS 8.7.2), ref. 3.3.64.6	V4055D, EN5055C, E
High Fire Switch				Integral to M9484D, E, F; M9494D
Low Fire Switch	③		NFPA 86: 3.3.33	Integral to M9484D, E, F; M9494D
Low Liquid Cutoff	④		NFPA 86: 13.2.6.8	
Supervise Purge Air (pre ignition airflow)			NFPA 86: 8.4.1	C6097, C437
Proven Combustion Air	Required	Required	NFPA 86: 8.6	C6097, C437
Ventilation Fan Interlock	⑬	⑬	NFPA 86: 8.5	
Oxygen Enhancement O ₂ Interlocks	⑭	⑭	NFPA 86: 6.4, 10.2	
Valve Proving System	Optional		NFPA 86: 3.3.74; 7.5.9; 8.7.2; 8.7.2.2	
PILOT VALVE TRAIN ^⑤				
Approved Safety Shutoff Valve(s)	One or two required ^⑥	One or two required ^⑥	NFPA 86: 8.7	V4046C/V8046C
Manual Shutoff Valve(s)	Required	Required	NFPA 86: 6.2.5.1 (gas); 6.3.5.1 (oil)	
Normally Open Vent Valve				
Leak Test Valve	Required	Required	NFPA 86: Annex A7.5.9	
Pressure Regulator	Required	Required	NFPA 86: 6.2.7	

NFPA 86: Ovens and Furnaces, Classes A, B, C and D ^⓪				
System Control Specifications	Gas-fired	Oil-fired	Associated Standard Paragraph	Recommended Controls
MAIN VALVE TRAIN				
Approved Safety Shutoff Valve(s)	One or two required [ⓐ]	One or two required [ⓐ]	NFPA 86: 8.7	V4055/V5055/V5097 (gas only)
Firing Rate Valve	Optional	Optional	NFPA 86: 6.2.8 (gas); 6.3.6 (oil)	V9055/V5055B/V5097B (gas only) V51E/M9484 (gas only)
Manually Operated Leak Test Valve(s)	[ⓐ]	[ⓐ]	NFPA 86: Annex A7.5.9	
Manual Shutoff Valve(s)	Required	Required	NFPA 86: 6.2.5.1 (gas); 6.3.5.1 (oil)	
Normally Open Valve Vent				
Pressure Regulator	Required	Required	NFPA86: 6.2.7	
AUXILIARY EQUIPMENT				
Auxiliary Equipment	Required	Required	NFPA 86: 5.5	
Oxygen Enhanced Combustion	Optional	Optional	NFPA 86: 6.4	
Ventilation	Optional	Optional	NFPA 86: 8.5	
Alarms	Required [ⓐ]	Required [ⓐ]	NFPA 86: examples - 10.1.8.8; 12.1.3.6; 12.3.4.1	
Combustibles/O ₂ Analyzer				
N.O.x Analyzer				
Draft Control System				
APPROVED SAFETY CONTROL SPECIFICATIONS				
Prepurge	Required	Required	NFPA 86: 8.4	
Prepurge Timing	Required [ⓐ]	Required [ⓐ]	NFPA 86: 8.4	
Prepurge Air Changes	4	4	NFPA 86: 8.4	
High Fire Purge Proving Circuit				
Low Fire Start Circuit	[ⓐ] [ⓐ]	[ⓐ] [ⓐ]	NFPA 86: 3.3.33	
Continuous Pilot	Optional	Optional	NFPA 86: 3.3.48.2	
Intermittent Pilot	Optional	Optional	NFPA 86: 3.3.48.3	
Interrupted Pilot	Optional	Optional	NFPA 86: 3.3.48.4	
Direct Ignition	Optional	Optional	NFPA 86: 8.15	
Proved Pilot	Required	Required	NFPA 86: 3.3.48.5	
Pilot Flame Establishing Period (PFEP)	15 seconds maximum	15 seconds maximum	NFPA 86: 3.3.49; 6.2.10.4; 8.9; 8.4.2; 6.2.11	
Main Flame Establishing Period (MFEP)	15 seconds maximum	15 seconds maximum	NFPA 86: 6.2.10.4; 6.2.11; 6.3.8.4; 8.4.2; 8.9	
Supervise Main Flame	Required	Required	NFPA 86: 8.9	

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NFPA 86: Ovens and Furnaces, Classes A, B, C and D ^⓪				
System Control Specifications	Gas-fired	Oil-fired	Associated Standard Paragraph	Recommended Controls
Flame Failure Response Time (FFRT)	4 seconds maximum	4 seconds maximum	NFPA 86: 8.9	
Action on Flame Failure	Safety shutdown (lockout)	Safety shutdown (lockout)	NFPA 86: 8.2	
Action On Limit Opening	Safety shutdown (lockout)	Safety shutdown (lockout)	NFPA 86: 8.3.1.2; 8.3.2.1	
Post Purge				
Recommended Approved Safety Control ⁽⁵⁾	R7795, R7140 RM7895.6,7,8 RM7840 RM7800 RM7838B, C	R7795, R7140 RM7895.6,7,8 RM7840 RM7800 RM7838B, C		

Footnotes:

- ① Class A - 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.
 Class B - An oven or furnace that has heat utilization equipment wherein there are no flammable volatiles or combustible materials being heated.
 Class C - 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.
 Class D - An oven or furnace that is a pressure vessel that operates under vacuum for all or part of the process cycle.
- ② Whenever the normal fuel pressure to the pressure regulator immediately upstream from the safety shutoff valve exceeds the design limits of the burner system, a high pressure switch shall be provided and interlocked with the burner system's safety shutoff valve.
- ③ If any specific input, or limited range of inputs is required for safe ignition, the fuel control valve shall be properly positioned and interlocked prior to each and every attempt at ignition.
- ④ On circulating liquid systems, limit switches in addition to the low liquid cutoff shall be provided to shut off the heater automatically if liquid temperature is excessive and if circulation rate is low.
- ⑤ If pilot is used.
- ⑥ When main or pilot fuel gas burner system capacity exceeds 400,000 Btu/h, two safety shutoff valves (piped in series) shall be used. If main or pilot gas burner capacity is 400,000 Btu/h or less, a single safety shutoff valve may be used in place of the double safety shutoff valves
 Exception: With a radiant tube-fired burner system, a single safety shutoff valve may be used.
- ⑦ Position indication shall be provided for safety shutoff valves to main burners in excess of 150,000 Btu/h.
- ⑧ Two safety shutoff valves should be provided under any one of the following conditions: (a) when the pressure is greater than 125 psi; (b) whenever the fuel oil pump operates without main oil burner firing, regardless of the pressure; (c) with combination gas/oil burners when the fuel oil pump operates during the fuel gas burner operation.
- ⑨ A permanent and ready means for making tightness checks of all main burner fuel gas safety shutoff valves shall be provided.
- ⑩ An audible and/or visible alarm shall be provided in the safety circuit to give warning of unsafe conditions or interruption of the safety circuit
- ⑪ At least four standard cu ft of fresh air per cu ft of oven volume shall be introduced during the purge cycle.
- ⑫ For burners that cannot be safely ignited at all firing rates encountered, positive provision shall be made to reduce the burner firing rates during light-off to a level that will assure a smooth and reliable ignition of the main flame (forced low-fire start).
- ⑬ Required when used.
- ⑭ Required when oxygen-enhanced combustion is used.
- ⑮ Select proper safety control on basis of system requirements.

SUPPLY VOLTAGE REQUIREMENTS

NFPA 86: 4-13 Electrical Power; 8.3.22

"Safety control circuits shall be DC or single phase AC, 250 volt maximum, one side grounded, with all breaking contacts in the ungrounded, fuse (or circuit breaker) protected line."

REFERENCE-NFPA 86: Ovens and Furnaces 2009 Edition.

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