



PAINT CURING AND MOISTURE DRYING OVENS

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PAINT CURING AND MOISTURE DRYING OVENS

1.0 SCOPE

- 1.1 This Standard refers to the National Fire Protection Association (NFPA-86A) designation of Class "A" Ovens and Furnaces, and shall be applicable to new installations and extensions to existing equipment covered by this classification.
- 1.2 Within the scope of this Standard, an oven shall be any heated enclosure operating at approximately atmospheric pressure, used for the processing of materials containing solvent and/or water at temperatures below 1,400°F (760°C).

2.0 DEFINITIONS

- 2.1 For the purpose of this Standard, "Batch Ovens" are ovens into which all the work charge is introduced at one time, so that the evaporation of volatiles within the oven is not at a constant rate.
- 2.2 "Continuous Ovens" are ovens into which the work charge is more or less continuously introduced, as by a conveyor, and evaporation of volatiles within the oven approaches a constant rate.

3.0 GENERAL

- 3.1 The following information should be furnished to bidders by the issuing Division:
 - (a) Applicable Ford Motor Company Process Standards.
 - (b) Maximum oven temperature and cycle time if not covered by Process Specification.
 - (c) Part name and number with part print if possible.
 - (d) Material of part and how made, such as sheet metal, forging, or casting.
 - (e) Production requirement per hour.
 - (f) Weight of part or parts per hour.
 - (g) Brief description of method of application of surface finish, method of handling, and flow of parts.
 - (h) Weight of conveyor and hooks or dollies (hourly basis), absorbing heat while in the oven (continuous ovens). Weight of trucks, cars or frames used to support parts while in the oven (batch ovens). Related drawings if pertinent to equipment design.

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3.0 GENERAL (continued)

- (i) Conveyor speed in feet (meters) per minute (continuous ovens).
 - (j) Characteristics of Plant Services available at the proposed oven location, such as voltage, phase, and frequency of electric power, kind of fuel, heat content, pressure in gas, steam, water and compressed air distributing mains, etc.
 - (k) Maximum quantity of flammable volatiles introduced into the oven, expressed in gallons (liters) per minute for continuous ovens and in gallons (liters) per batch for batch ovens.
 - (l) The auto-ignition temperature of the material to be dried or baked, and the closed cup flash point of the volatile to be evaporated.
- 3.2 All provisions of Industrial Equipment Standards No. BX1 "General Conditions," shall apply.
- 3.3 All sheet metal gauges referred to throughout these Standards shall be understood to be U.S. Standard.

4.0 SAFETY DESIGN DATA FORM FOR SOLVENT ATMOSPHERE OVENS

- 4.1 A suitable, clearly worded and prominently displayed oven safety design data form or manufacturer's nameplate shall be provided by the builder of each oven stating the safe operating conditions for which the oven was designed and built as stated in NFPA-86A. Refer to sample form in Appendix Section 18.

5.0 LOCATION

- 5.1 In general, ovens should not be located in closely confined or restricted places. They should be located at or above floor level.
- 5.2 Building columns, girders, trusses and beams shall not pass through an oven structure (exceptions must comply with NFPA 86A).
- 5.3 Ovens shall be well separated from valuable stock, important power equipment, machinery and sprinkler risers.
- 5.4 Ovens shall not adjoin lockers, lunch rooms, nor obstruct passage to exits.
- 5.5 Heaters shall be located so that vapors from spraying, flow coating, dipping areas and storage and mixing rooms cannot flow by gravity to them. The flow of ventilating air from paint rooms, or other places where flammable vapors are released, shall be away from the oven or heater.

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- 5.6 Hatches, doors or loose panels used as explosion vents shall be so located that in the event of an explosion the vent covers will not damage pipe lines, conduit, sprinkler lines, or other vital installations, or endanger personnel.

6.0 CONSTRUCTION

Continuous Indoor Ovens (Outdoor ovens to conform to additional requirements described in Section 17 of this Standard) shall be tunnel type with silhouetted air seals at the entrance and exit ends. Construction shall be in conformance with standards set forth by the NFPA-#86A, Ford Motor Company Standard BH5X-2, data form 2634, and reference sketches Section 18. (Asbestos shall not be used.)

6.1 Oven Side Walls and Roofs

- 6.1.1 Oven side walls and roofs shall be constructed of insulated interlocking (except explosion vents) sheet metal panels 6" (152.4 mm) thick (minimum) and 30" (762.0 mm) wide (maximum) properly supported by structural steel framing of adequate strength to support panels and work conveyor fully loaded, when required. Panels shall be fabricated of 20 gauge (0.9 mm) black or aluminized steel preferred and 4 lb. (1.8 kg) density mineral fiber product with a minimum 6" (152.4 mm) of insulation (not applicable to extensions of ovens built to prior standards unless directed by issuing Division). All joints between panels shall be vaportight (see Figure 1, Section 18) and packed with the same density of insulation as that within the panels. High temperature oven cement shall be applied to all oven joints when assembling panels.

- 6.1.2 Assembled oven panels shall be able to support a loading of 60 lbs. per sq. ft. (2.87 kPa) with a maximum deflection of 0.6" (15.24 mm) when spanning 10 ft. (3.05 m) end to end, and shall have a maximum overall coefficient of heat transmission (U) of 0.067 BTU/sq. ft. per hour per degree F temperature difference ($.38W/m^2 \cdot ^\circ C$).

6.2 Floors

- 6.2.1 The floors of continuous ovens with floor conveyors shall be insulated according to one of the following methods:
- (a) Four inch (101.6 mm) thick stove block covered with dust tight steel plate of 11 gauge (3.04 mm) minimum thickness. Stove block insulation shall not be used in moisture dry-off ovens nor in ovens using humidifying accessories.
 - (b) Standard 6" (152.4 mm) oven panels as described in Section 6.1.1 except with 14 gauge (1.9 mm) sheet steel forming the uppermost side of the panel.

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6.2.1 (continued)

- (c) Four inches (101.6 mm) of vermiculite cement (one 80 lb. (36 kg) bag Portland cement to 60 pounds (27.2 kg) vermiculite), poured flush with the tops of steel plate channels spaced 16 inches (.41 m) apart. 20 gauge (0.9 mm) sheet steel shall cover the whole oven floor with the sheets tackwelded smooth to channels.

6.2.2 The floors of continuous ovens with overhead conveyors shall be insulated according to one of the following methods:

- (a) Four inch thick stove block laid directly upon the building floor and covered with 18 gauge (1.2 mm) sheet steel having four inches (101.6 mm) of one edge bent at right angles and projecting downward between the courses of stove block and the opposite edges and sides lapping over the adjacent cover sheets and tackwelded smoothly to them.
- (b) Panels as described in Section 6.1.1 except with No. 14 gauge (1.9 mm) sheet steel forming the uppermost side of the panel when in place.

6.2.3 The floors of all batch type ovens may be insulated according to one of the methods outlined in Sections 6.2.1 or 6.2.2.

6.2.4 The insulating material shall be placed on the prepared surface and covered with sheet steel as described above, whose joints are dust tight, either welded or lock seam construction. The insulating material shall resist crushing if subjected to 200 pounds per square foot (9.57 kPa) live load (for maintenance purposes).

6.2.5 Oven floor insulation can be omitted in ovens utilized in final car paint repair or water dry off systems if the concrete floor is judged adequate by the issuing Division.

6.3 Structural Supports

6.3.1 Oven structural supports and conveyors shall be designed with adequate factors of safety at the maximum temperature of the oven.

- 6.3.1.1 The preferred method is to use Cor-Ten structural steel ("T" or back-to-back angles) framing on maximum center-to-center distance of 10 ft. (3.05 m) with proper provisions for thermal expansion. Roof steel shall be installed with standing edge joint within panel so as to provide an inside surface as smooth as possible. Structural steel framing shall be of adequate strength to support panels and work conveyor fully

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6.3.1.1 (continued)

loaded, where required. Adequate cross-bracing exterior of the panels shall be provided to produce a rigid structure.

6.4 Access Doors

6.4.1 Access doors designated "Authorized Employees Only," shall be provided on all continuous ovens. The doors shall be no more than 50 ft. (15.24 m) apart staggered on opposite sides of the oven, constructed similar to wall panels with wedge type closure and be equipped with 18" (.46 m) Richards Wilcox strap hinges with steel pintle #03-3, heavy duty handle, and two #3 "Brixon" explosion latches, or approved equal. Doors shall be properly gasketed to be airtight with a minimum of two doors provided, regardless of oven length. Opening for doors shall be 2'-2" (.66 m) wide x 5' (1.52 m) high (minimum).

6.4.2 An explosion relief access door shall be installed in the heater housing directly downstream of the burner. If an access door is located upstream of the burner, it shall also be an explosion relief type.

6.5 Explosion Vents

6.5.1 All ovens containing flammable air-gas mixtures shall be provided with unobstructed vents for freely relieving internal explosion pressures. The explosion relief ratio should be 1 square foot of relief area to 15 cubic feet of oven volume. The metric equivalent is 1 square meter of relief area to 4.57 cubic meters of oven volume. The areas of permanent openings and access openings provided with doors having approved explosion latches, as described in Section 6.4.1, can be considered as relief venting area.

6.5.2 Guards shall be installed in front of doors where necessary, to prevent obstruction by stock or portable equipment.

6.5.3 Sidewall panels held in place by friction clips may be used as explosion relief vents. These panels shall have strength, rigidity, and insulating value equal to the requirements of Sections 6.1.1 and 6.1.2 of this Standard, and shall be restrained by barriers from more than 2 ft. (0.6 m) movement for personnel protection.

6.5.4 If all panels are permanently fastened, loose or hinged explosion hatches of the area specified in Section 6.5.1 shall be provided in the roof of the oven. Hatches shall be of light construction, readily breakable as described in NFPA 86A.



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PAINT CURING AND MOISTURE DRYING OVENS**6.6 Static Electricity**

- 6.6.1 The metal frames of ovens shall be electrically grounded throughout for the safe removal of static electric charges.

7.0 SOURCE OF HEAT**7.1 Types of heat sources shall be as follows:**

- (a) Fuel gas (manufactured gas, natural gas, propane, butane) burned in external direct or indirect fired heaters.
- (b) Electrical infrared radiating sources within the oven chamber.
- (c) Electrical resistance elements installed in the oven chamber or circulating ducts.
- (d) Fuel oil burned in external indirect fired heaters.
- (e) Circulating mediums - steam, water, oil or other liquids.
- (f) Combinations of the above.

- 7.2 The above sequence shall be considered the order of Ford Motor Company preference unless fuel availability dictates otherwise.

8.0 OVEN HEATING SYSTEMS**8.1 General**

- 8.1.1 For the purpose of this Standard the term "Oven Heating Systems" shall include the heating source, (such as gas and oil burners, infrared radiators, steam radiating systems and associated housings) circulating fans and ducts to convey heat to the oven.

8.2 Zones

- 8.2.1 Oven shall be divided into heating zones equipped with approved direct gas-fired combustion units unless otherwise specified. Maximum allowable zone length shall be 80 ft. (24.2 m).

8.3 Heaters

- 8.3.1 The heaters shall be circular shell, pull-through type, with air and heat mixing baffles and dampers; with recirculating fan, heater, filter box, prepiped gas train, and burner completely built-up into an integral unit. Units will be provided with catalyst or provision for future addition of catalyst as directed by issuing Division. Units will be similar in design to the Gladd Industries, type PBWG, "MFCCGO," NCG or Ford approved equal.

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- 8.3.2 Heater fans shall be Class III as described in heater package, unless stated otherwise in detailed equipment specification.
- 8.3.3 All make-up and combustion air shall be filtered and necessary dampers and blast gates shall be provided to control same.
- 8.3.4 Fuel shall be natural gas with heat content of approximately 1,000 BTU per cubic foot (37,259 kJ/m³) and supply pressure of approximately 15 PSIG (103 kPa), unless otherwise specified. (Refer to 7.1 and 7.2)
- 8.3.5 Heater capacity shall be 10% greater than actual design requirements for the specified operating temperatures and circulated air volumes.
- 8.3.6 Thermal head of 150° F (66° C) shall be used for ovens, such as prime paint, moisture dry-off, flo-coat and E-coat. Thermal head of 100° F (37.7° C), unless specified otherwise, shall be limited to enamel ovens of 300° F (149° C) or less.
- 8.3.7 Heater capacity shall be based on fully-loaded and running conveyors (live load), radiation and exhaust load.
- 8.3.8 Heaters for the last zone of a multiple zone oven shall be sized for 1,000,000 BTU/hr (1,054,800 kJ) minimum.
- 8.3.9 Gas vent piping shall be installed as per NFPA 86A and Ford Motor Company Standard BH5X-2. Heaters shall be individually vented.
- 8.3.10 The source of heat may be located either inside or outside the oven. External or remote fuel fired heaters may be:
- (a) Direct, where products of combustion enter the oven, and contact the work in process, or
 - (b) Indirect, where combustion products do not mix with recirculated air and do not contact the work in process.
- 8.3.11 Heat may be transferred to the work in process by radiation, convection or a combination of both.
- 8.3.12 Fuel fired heaters, classified in Section 8.3.10(a) as direct, may be used in most paint drying applications, all water dry-off ovens, and other ovens where the products of combustion have no adverse effect upon materials being processed. Otherwise, indirect heaters described in Section 8.3.10(b) shall be used.
- 8.3.13 Ceramic tipped gas and oil burners shall not be used as components of direct fired oven heaters.

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8.3.14 Electric heating elements of the calrod or quartz tube type may be used for infrared radiation in the oven chamber only. Edge wound and finned type electrical resistance heaters may be used in the circulating ducts or burner chamber as convection heating elements.

8.3.15 Radiation surfaces shall be guarded to prevent their coming close to or in contact with combustible materials in the oven. Steam coils, electric heating elements, or open flames shall not be located where paint drippage or combustible material can accumulate.

8.3.16 Combustion air blowers, when utilized, shall be equipped with an intake filter capable of retaining air-borne solids that would adversely affect the normal performance of the combustion system. Filter shall be easily removed for cleaning and shall be listed by Underwriters' Laboratories, Incorporated, as Class 1, Class 2, or equivalent. (Section 16.3.)

8.4 Combustible Materials

8.4.1 Ovens processing combustible materials such as wood, paper and fibers, should preferably be heated by convection, using external heating units and heated air recirculating system.

8.5 Catalytic Burners

Catalytic burners may be used to:

- a. Provide air pollution control for the oven exhaust.
- b. Provide partial reduction of exhaust constituents.
- c. Achieve energy savings by releasing latent solvent energy in the exhaust or recirculation system for return to the oven chamber.

8.5.1 When using a catalytic burner, controls must be provided to control the temperature and pressure change across the catalyst bed. See Controls Section 14.2.5.

8.6 Gas and Electric Meters

8.6.1 A line-mounted, positive displacement gas meter, Roots Rotary Series 125 temperature and pressure compensated or Ford approved equal, shall be furnished and installed in the gas branch supplying the oven.

8.6.2 An electric meter shall be furnished for each oven. It will be a 3-phase, 480 volt, GE Type DS-60 series Sangamo or Ford approved equal.

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9.0 STACKS

- 9.1 All exhaust stacks shall be sized to produce an exhaust gas exit velocity of 2,300 ft. per minute (701.5 m/min.) at stack gas conditions, self-draining, self-supporting, free-standing, and normally extend 15' (4.572 m) above the building roof, or in accordance with the following conditions:

Stack Diameter	Height	Method of Support
16"Ø (406.4 mm) and less	Up to 18' (5.486 m)	Self supporting
16"Ø (406.4 mm) and less	Over 18' (5.486 m)	Guy Wires Required
17"Ø (431.8 mm) and larger	Up to 20' (6.096 m)	Self supporting
17"Ø (431.8 mm) and larger	Over 20' (6.096 m)	Guy Wires Required

- 9.1.1 Stacks shall be fabricated of 16 gauge (1.5 mm) (minimum) welded steel sheets, and be provided with vertical discharge type rain protectors or approved equal, roof flashing and a raised type access door approximately 5' (1.52 m) above roof line.
- 9.1.2 Stacks shall be equipped with 18" (457.2 mm) x 18" (457.2 mm) raised, watertight access doors opposite each sprinkler head (see Section 16.2). Stacks shall be capable of withstanding wind velocities of 100 miles (160.9 km) per hour, unless otherwise specified, and be supported from building steel in such a manner that fans may be easily removed for maintenance purposes.
- 9.1.3 All exhaust stacks within a radius of 50 ft. (15.24 m) of fresh air intakes shall extend 10 ft. (3.05 m) above such air intakes.
- 9.1.4 Contractor shall furnish and install roof opening framing, stack sleeves, plates, etc., unless otherwise specified.

10.0 AIR SEALS

10.1 General

Air seals, when required by issuing Division, shall be constructed of panels similar to oven proper at each end of all ovens other than batch ovens, and fall into the following categories:

- Bottom entry or exit (overhead ovens)
- Horizontal entry or exit, recirculating
- Horizontal exit, accelerated cooling

10.2 Dimensions

- 10.2.1 The air seal shall be of the same outside dimensions as the oven proper except for length. The air seal shall have tunnel type chamber with an inner and outer housing. The inner housing shall have a