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Construction and Rating of Equipment for Drying Farm Crops



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Construction and Rating of Equipment for Drying Farm Crops

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1 Purpose

1.1 This Standard is intended to promote uniformity and consistency in the terms used to describe, rate and evaluate crop dryers, dryer components, and crop dryer operation.

1.2 This Standard is intended to promote efficiency and safety in the design, construction, and use of heated-air crop dryers.

1.3 This Standard gives minimum requirements. Where local codes are more stringent, they should be followed.

2 Scope

2.1 This Standard refers to equipment in which heated air or artificially generated radiation is used to reduce the moisture content of grain, hay, and other farm crops. These units, hereinafter referred to as dryers, include the batch type units, continuous-flow type units, heated-air units and supplemental-heat units and fans.

2.2 Within the scope of this Standard a dryer shall be understood to include the grain-holding compartment in which the product is confined while being dried, together with its source of heat or radiation, fuel supply, fuel transmission system, burner, vaporizer, heat exchanger, air moving device (AMD), control system, power source, materials handling system, and AMD tube or other discharge ducts which are integral parts of the basic dryer.

3 Compliance definitions

3.1 Compliance definitions. The accepted definitions of “shall,” “should,” and “approved,” as included in this Standard, are:

3.1.1 “Shall” is intended to indicate requirements.

3.1.2 “Should” is intended to indicate recommendations, or that which is advised but not required.

3.1.3 “Approved” or “approval” refers to listing by a nationally recognized testing laboratory or agency.

4 General construction

4.1 General. Dryers and related equipment shall be built with regard to the hazard inherent in the equipment operating at elevated temperatures, the hazard occasioned by overheating the product, the hazard of open flames, the hazard in incomplete combustion of direct-fired devices, the hazard to the operator from mechanical equipment and high temperatures, and with regard to the promotion of safety and reliable operation over the expected life of the equipment.

4.1.1 Combustible materials shall not be used in the construction of dryers where that material will be subjected to sustained temperatures in excess of 74°C (165°F).

4.1.2 Dryers designed for outdoor use shall be so constructed or anchored that they will safely withstand wind pressures or snow loads to which they may be normally subjected.

4.1.3 Dryers shall be equipped with appropriate safety shields, guards, and screens. Intake openings for drying air shall be equipped with not greater than 13 mm (0.5 in.) screen openings which shall be readily accessible for cleaning.

4.1.4 Dryers of the direct-fired type shall have combustion-air intake openings so located that foreign material is not likely to enter the combustion chamber. Where that is not practical, such openings shall be provided with a screen. Where foreign material is likely to enter the primary air to the burner, this intake should be screened. Such screens shall be readily accessible for cleaning.

4.1.5 All dryers designed to recirculate a portion of the exhaust air shall employ an approved means of removing combustible material from the air in the recirculation duct. In a direct-fired dryer using fuel oil or solid fuels, a target plate or other effective means shall be used to minimize the possibility of burning materials entering the drying chamber.

4.1.6 Interior surfaces of all dryers shall be designed to facilitate cleaning.

4.1.7 Access doors or openings shall be provided to permit inspection, cleaning, maintenance, and the effective use of extinguishers or hose streams in all parts of the dryer and connecting spouts or conveyors. All access doors which permit personnel entry shall be provided with hardware which will permit manual opening without tools from either side of access doors, except for access openings in spray dryers and cyclone-type dryers where the use of inside hardware will interfere with the proper operation of the dryer.

4.1.8 All wiring shall comply with National Fire Protection Association Standard NFPA No. 70, National Electrical Code (American National Standard, C-1, National Electrical Code). Electric motors shall be installed so that adequate ventilation is provided, in accordance with NFPA No. 70, National Electrical Code.

4.1.9 Clearance requirements and means of venting furnaces shall be in accordance with standard practice.

NOTE: For provisions on clearances in venting, refer to: National Board of Fire Underwriters, National Building Code; National Fire Protection Association, NFPA No. 90-A, Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type; NFPA No. 211, Chimneys, Flues and Vents; Underwriters Laboratories, Inc. UL-731, Oil Fired Heaters, and UL-795, Commercial Industrial Gas Heating Equipment.

4.1.10 Provisions for expansion or contraction shall be provided if necessary to prevent damage.

4.1.11 Outside surface temperatures of dryer housing should be maintained at less than 93°C (200°F) where adjacent to combustible material. Where insulating material is used, it shall be so installed that it will not absorb moisture.

4.2 Noise level. Consideration should be given to design factors influencing noise emissions and every effort should be made to keep noise levels at a minimum.

4.2.1 Each manufacturer shall have available the sound power level rating in decibels and shall make available octave sound power levels on request.

4.2.2 The sound power level rating shall be obtained from octave sound power levels measured in accordance with Air Moving and Conditioning Association Standard AMCA 300-67, Test Code for Sound Rating Air Moving Devices.

4.3 Pollutant emission level. Consideration should be given to design factors influencing particulate emissions and every effort should be made to keep particulate emission levels at a minimum. Each manufacturer shall have available the particulate emission level rating as soon as reliable test standards are developed.

5 Heat-producing devices

5.1 General clearance requirements and means of venting furnaces shall be in accordance with standard practice.

NOTE: For provisions on clearances in venting, refer to: The National Board of Fire Underwriters, National Building Code; National Fire Protection Association NFPA No. 90-A, Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type; NFPA No. 211, Chimneys, Flues and Vents; Underwriters Laboratories, Inc., UL-731, Oil Fired Heaters, and UL-795, Commercial Industrial Gas Heating Equipment.

5.2 Gas-fired devices

5.2.1 Gas burners shall be designed so that the normal function of the automatic gas-control valves cannot be manually bypassed.

5.2.2 Gas burners and associated mixing equipment shall be suitable for the service intended as follows:

5.2.2.1 For heat content of the gas used.

5.2.2.2 For the operating pressures listed on nameplate.

5.2.2.3 Capable of maintaining flame stability throughout the turn-down range.

5.2.2.4 Designed with the required safety interlocks.

5.2.3 Approved methods of ignition shall be employed.

5.2.4 Electrical operation of the valves shall be of common characteristics of cycle, frequency and voltage.

5.2.5 Gas-fired infrared generators may be used. Adequate clearances shall be provided to assure safe surface temperatures for the product being dried.

5.2.6 Methods of ignition of gas-fired devices

5.2.6.1 Pilots

5.2.6.1.1 Continuous and interruptible gas pilots

5.2.6.1.1.1 If a continuous or interruptible pilot is employed, it shall be suitably interlocked to insure a pre-purge of at least 15 seconds or 4 complete air changes of the plenum chamber and duct prior to an ignition attempt of the pilot.

5.2.6.1.1.2 Trial for ignition shall not exceed 90 seconds.

5.2.6.1.1.3 The construction of all safety pilots shall be such that in the event of breakage or failure of the flame sensing device they shall fail safe.

5.2.6.1.1.4 The input to the pilot(s) shall not exceed 21.10 MJ/h (20 000 BTU/h) or 3% of the maximum input to the main burner as fired, whichever is greater.

5.2.6.1.1.5 Pilot burners not automatically lighted shall be fixed in place so that they can be safety lighted manually.

5.2.6.1.1.6 Main flame supervision is mandatory where any part of the main burner is more than 0.91 m (3 ft) from the point of supervision of the pilot along the path of flame travel or run. Main flame supervision shall also be required if the main flame cannot be observed from the point of manual start up. The main flame supervision is necessary with any burner that can supply gas through a channel or part that is not immediately adjacent to a proved pilot.

5.2.6.1.1.7 The pilot shall be proved before gas is admitted to the main burner.

5.2.6.1.1.8 Flame response timing shall not exceed 90 seconds.

5.2.6.1.2 **Standing pilot.** Pilot supervision is mandatory.

5.2.6.2 **Direct spark ignition**

5.2.6.2.1 If direct spark ignition is employed, it shall be suitably interlocked to insure a pre-purge of at least 15 seconds or 4 complete air changes of the plenum chamber and duct, prior to an ignition attempt.

5.2.6.2.2 The high voltage ignition spark shall ignite the main flame within 4 seconds after the gas reaches the main burner(s) parts.

5.2.6.2.3 The trial for ignition of the main flame shall not exceed 90 seconds.

5.2.6.2.4 Flame failure response timing shall not exceed 90 seconds.

5.2.6.2.5 The ignition transformer shall not be energized until combustion air supply and circulating air flow is proved. Air flow sensing devices such as pressure switches, sail switches, and differential switches shall be of the approved type.

5.2.6.2.6 Main flame supervision shall be located so as to prove ignition across the entire face of the burner.

5.2.7 The gas or vapor handling components shall have a working pressure rating in accordance with the following:

5.2.7.1 For natural gas and liquid propane gas, twice the maximum available safety monitored supply pressure.

5.2.7.2 For liquid propane systems, at least 1.72 MPa (250 psi) from point of supply connection to and including the pressure regulator downstream of the vaporizer.

5.2.7.3 All components downstream from the vaporizer shall be designed to withstand the maximum vapor temperature that is encountered with the system.

5.3 Electrically heated devices. All types of heating devices that use electrical energy for heat shall comply with the following requirements:

5.3.1 Induction or dielectric heating systems which employ high-frequency electrical energy may be used for dryers.

5.3.2 Infrared heating systems may be used for dryers.

5.3.2.1 Infrared lamps shall not be used where combustible dust may be present or where accumulation of combustible dust may form on surfaces of the lamps.

5.3.2.2 Infrared lamps of suitable focal length shall be used to assure safe surface temperatures for the product being dried. Instruction concerning replacement of lamps should include necessary warning and be a part of the permanent label.

5.3.3 Resistance-type heating systems may be used for dryers.

5.3.4 All internal wiring of electrically heated devices shall conform to the requirements contained in NFPA No. 70, National Electrical Code.

5.4 LP-gas vaporizers and vaporizer-burners for direct-fired application. The vaporizer section of vaporizer-burners used for dryers shall be constructed as follows:

5.4.1 Vaporizer-burners shall have a minimum design pressure of 1.72 MPa (250 psi) with a factor of safety of 5.

5.4.2 The vaporizer section shall be protected by a hydrostatic relief valve, located where it shall not be subjected to temperatures in excess of 60°C (140°F), and with a pressure setting such as to protect the components involved but not lower than 1.72 MPa (250 psi). The relief valve discharge shall be directed upward and away from the component parts of the vaporizer burners. Fusible plugs shall not be used.

5.4.3 A means shall be provided for manually turning off the gas to main burner and pilot.

5.4.4 Vaporizing-burners shall be provided with an automatic safety device to shut off the flow of gas to the main burner and pilot in the event pilot is extinguished. See Prevention of Fire and Dust Explosions in Grain Elevators and Bulk Grain Handling Facilities, NFPA No. 61B, for ignition and combustion controls applicable to vaporizing-burners associated with grain dryers.

5.4.5 Pressure regulating and control equipment shall be so protected as not to be subject to temperatures above 60°C (140°F), unless it is designed and recommended for use by the manufacturer for a higher temperature.

5.4.6 Pressure regulating and control equipment located downstream of the vaporizing section shall be designed to withstand the maximum discharge temperature of the hot vapor.

5.4.7 The vaporizer section of vaporizer-burners shall not be provided with fusible plugs.

5.4.8 Dryers utilizing vaporizing burners shall be equipped with automatic devices both upstream and downstream of the vaporizing section. These devices shall be installed and connected to shut off in the event of excessive temperature, flame failure and if applicable, insufficient air flow.

5.4.9 Vaporizing-burners shall not raise the fuel pressure above the design pressure of the vaporizing section.

5.4.10 The vaporizing-burner or the appliance in which it is installed shall be permanently and legibly marked with the maximum burner input J/h (BTU/h) and the name or symbol of the manufacturer.

6 LP gas systems

6.1 Piping, tubing and fittings

6.1.1 Pipe. Pipe shall be wrought iron or steel (black or galvanized), brass or copper and shall comply with 6.1.1.1 through 6.1.1.4.

6.1.1.1 Wrought iron pipe. ANSI B36.10, Wrought-Steel and Wrought-Iron Pipe.

6.1.1.2 Steel pipe. ASTM A53, Specification for Welded and Seamless Steel Pipe.

6.1.1.3 Brass pipe. ASTM B43, Specification for Seamless Red Brass Pipe, Standard Sizes.

6.1.1.4 Copper pipe. ASTM B42, Specification for Seamless Copper Pipe, Standard Sizes.

6.1.2 Tubing. Tubing shall be steel, brass or copper and shall comply with 6.1.2.1 through 6.1.2.3.

6.1.2.1 Steel tubing. ASTM A539, Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines.

6.1.2.2 Brass tubing. ASTM B135, Specification for Seamless Brass Tube.

6.1.2.3 Copper tubing

6.1.2.3.1 Type K or L: ASTM B88, Specification for Seamless Copper Water Tube.

6.1.2.3.2 ASTM B280, Specification for Seamless Copper Tube for Air Conditioning and Refrigerator Field Service.

6.1.3 Pipe and tubing fittings. Fittings shall be steel, brass, copper, malleable iron or ductile (nodular) iron, and shall comply with 6.1.3.1 and 6.1.3.2.

6.1.3.1 Pipe joints in wrought iron, steel, brass or copper pipe may be screwed, welded or brazed.

6.1.3.1.1 Fitting used with liquid LP-Gas, or with vapor LP-Gas at operating pressures over 0.86 MPa (125 psi) shall be suitable for working pressure of 1.72 MPa (250 psi).

6.1.3.1.2 Fittings used with vapor LP-Gas at pressures not exceeding 0.86 MPa (125 psi) shall be suitable for a working pressure of 0.86 MPa (125 psi).

6.1.3.1.3 Soldering or brazing filler material shall have a melting point exceeding 538°C (1000°F).

6.1.3.2 Tubing joints in steel, brass or copper tubing shall be made with approved gas tubing fittings and may be flared, soldered or brazed.

6.1.3.2.1 Fittings used with liquid LP-Gas, or with vapor LP-Gas at operating pressures over 0.86 MPa (125 psi) shall be suitable for a working pressure of 1.72 MPa (250 psi).

6.1.3.2.2 Fittings for use with vapor LP-Gas at pressures not exceeding 0.86 MPa (125 psi) shall be suitable for a working pressure of 0.86 MPa (125 psi).

6.1.3.2.3 Soldering or brazing filler material shall have a melting point exceeding 538°C (1000°F).

6.1.4 Installation of piping, tubing, and fittings

6.1.4.1 LP-Gas normally is transferred into containers as a liquid, but may also be conveyed as a liquid or vapor under container or lower regulated pressure. Piping shall comply with the following:

6.1.4.1.1 Vapor LP-Gas piping with operating pressures in excess of 0.86 MPa (125 psi) and liquid LP-Gas piping shall be suitable for a working pressure of at least 1.72 MPa (250 psi).

6.1.4.1.2 Vapor LP-Gas piping subject to pressures of not more than 0.86 MPa (125 psi) shall be suitable for a working pressure of at least 0.86 MPa (125 psi).

6.1.4.2 Pipe joints may be threaded, flanged, welded or brazed using pipe and fittings complying with 6.1.1 and 6.1.3. Threaded joints, including joints threaded and back welded, shall comply with the following: