Wet Dog Glass Studio Equipment Installation GuidelinesRev 02/25

Wet Dog Glass Heating Equipment must be installed by qualified personnel in accordance with NFPA 86 Standard for Ovens and Furnaces and NFPA 79 Electrical Standard for Industrial Machinery as applicable.

For Gas-fired Equipment:

- Install gas supply piping in accordance with NFPA 86 Standard for Ovens and Furnaces.
- Install electrical service to the equipment in accordance with NFPA 79 Electrical Standard for Industrial Machinery.
- Ventilation must be provided in order that the accumulation of heat and/or biproducts of combustion is avoided within the workspace.

For Electrically Heated Equipment:

- Install electrical service to the equipment in accordance with NFPA 79 Electrical Standard for Industrial Machinery.
- Ventilation must be provided in order that the accumulation of heat and/or any off-gassing of work product (such as when curing certain types of molds) is avoided within the workspace. Off-gassing is typically not a concern in glassblowing studios unless there is also a warm glass operation such as kiln-casting is performed.

Ventilation:

- Ventilation systems should be designed and installed in accordance with NFPA 86 and NFPA 91 and with several considerations in mind. Note: For the purpose and intent of this document, the terms “hood plenum”, “hood enclosure”, and “equipment room” are used interchangeably.
    - Evacuating products of combustion and/or vapors or fumes off-gassing from heat processing of mold materials or otherwise.
        - For gas fired equipment, the bare minimum exhaust rate--<u>without taking temperature into consideration</u>--would be 83.3 CFM per 100,000 Btu to exhaust combustion byproducts.
        - For electrically heated equipment such as casting ovens, a hood or local exhaust system should be considered with a minimum of 50 CFM per kW. Direct downdraft systems can also be installed directly onto the kilns. Orton Ventmaster is an example of such a system.
    - Air quality in the workspace:
        - Air should be changed at least 4-8 times per hour in the workspace. Hotter climates will require more air changes per hour (ACH).
        - Air should be supplied into and exhausted from the workspace so that it flows past the occupants in the space. Hence, the glassblowers and any audience sections within the space will have air directed to flow past them. At minimum, 10 cfm fresh air should be supplied per audience member and 30 cfm per glassworker.

- Pressure balance across spaces within the building should be maintained.
  - Make up air should be balanced against exhaust, so that a slight pressure differential (~0.25 in. w.c.) exists across the plenum openings.
  - Make up air can be supplied to both the workspace and the equipment room (hood plenum) in order to achieve this condition while still meeting all other criteria given herein. In this way, it's possible to condition a space without extracting too much of the conditioned air (if it's being conditioned) from the space through the openings in the face of the hood plenum.
  - Upon startup of ventilation system, contractor must make adjustments where possible, ie. VFDs, louvers, etc., to balance the system as described above.
- Temperature of exhaust at the discharge should not exceed the temperature rating of the exhaust system components. As a rough calculation, it requires 98 units of 95F ambient air to cool 1 unit of 1,700F exhaust to a discharge temperature of 120F. 1,700F is the typical exhaust temperature of a recuperated furnace melting glass at 2,400F chamber temperature.
- Maximum temperature of the working space around the equipment within the hood plenum should be no greater than 100F to prevent damage to components, and ideally it will not exceed 95F. Some climates and seasons may not allow cooling to this degree without conditioning.
- Heat emitted from electric equipment not located under a hood, such as annealing ovens, can be mediated by a ventilation rate of 63 CFM per kW given a supply air at 70F and resulting 120F. Conditioned air can also combat this heat. Consult HVAC specialist for this approach.
- Heat emitted from gas equipment can be mediated by a ventilation rate of 600 CFM per 100,000 BTU/hr given a supply air at 70F and hood discharge of 120F. The hotter the supply air, the greater the volume required. For example, 1500 CFM per 100,000 BTU/hr is required for supply air of 100F and hood discharge of 120F.
- Equipment room should be provided with at least 20-30 ACH, with attention to flow of supply air over the electronic temperature and safety control systems installed on the equipment.
- Face velocity of hoods or hood plenums should be 50-100 fpm (feet per minute). Openings in hood plenum walls can be baffled down to achieve the target velocity with the given air flow volume as long as all other ventilation concerns are met or exceeded.
- Small "awnings" can be installed above glory holes as necessary to capture heat projected outward from the opening. Awnings should extend 18 to 20" out from the cold face of the hood plenum wall at least 72" above finished floor.

  - While most of the supply air can be provided directly into the plenum, some of the heat from the equipment will be directed out into the studio space. To alleviate this, a portion of the supply air should be ducted into the studio space ~5' from the plenum wall and directed downward. This provides an air curtain effect, helping move heat from directly in front of the plenum wall back into the hood enclosure. The amount of supply in either location will be determined by the face velocity calculations but should be approximately 75% directly into the plenum and 25% in front of the plenum.

- Appropriate air volume must be supplied for complete combustion of fuel gas. Passive air inlets to the space should be sized at 1 square inch (6.45 cm^2) of open area for every 4,000 Btu/hr. Forced air should be supplied at 18.4 CFM (0.52 CMM) per 100kBtu/hr. This volume is typically covered sufficiently by the general space ventilation requirements.

- Interlocks to consider as required by (AHJ) authority having jurisdiction:
  - Duct pressure switches or air flow switches can be installed in ductwork or in air flow paths as appropriate to prove ventilation air is flowing.
  - CO monitors can be interlocked into the system to shut down gas fired equipment if CO level rises above given threshold.
  - Adjustable air inlet or outlet louvers may be interlocked into the system to shut down gas fired equipment if the louvers are not proven to be in the open position.

- Efficiency and adjustability:
  - Exhaust fans and blowers can be coupled with VFDs (Variable Frequency Drives) in order to adjust their output level, which can help in balancing the system as well as saving energy when less volume is needed.
  - Temperature sensors can be installed in the hood plenum, workspace, or ductwork to influence ventilation volume via signal to VFDs.

- Noise level:
  - Glass studios often serve as classrooms or audience spaces and are therefore best served by exhaust systems operating below 70 dB. While often difficult to achieve, 60-65 dB or lower should be used as target decibel levels, especially where classes or demonstrations are held.

Please refer to the Receiving and Installation section of the Wet Dog Glass Equipment Manual for additional general information.