PART 1: INTRODUCTION

1.1 PURPOSE

A. System Description

1. This section pertains to the material and installation requirements for dedicated outdoor air systems (DOAS), which should include:

   a) Filters.
   b) Air-to-air energy/heat recovery wheel/core.
   c) Direct expansion, or chilled water cooling.
   d) Dehumidification through hot gas reheating, a wrap-around coil, or a hot water/steam coil (systems that have a fossil fuel component should be avoided, if possible).
   e) Heat pump with a backup, a gas-fired furnace, or a hot water/steam coil (systems that have a fossil fuel component should be avoided, if possible).
   f) Supply and exhaust fans.

2. This section covers applications in buildings used for new construction and renovations (whole or partial).

3. This section covers all dedicated outdoor air system components except for the air-to-air energy/heat recovery system. For more information on the recovery system, refer to standard 23 72 00 Air-To-Air Energy Recovery Equipment.

4. DOAS should be considered as part of variable refrigerant volume (VRV), fan coil, or chilled beam systems to supply the required outdoor ventilation air to indoor spaces.

5. This standard is not meant to apply to 100% outdoor air handling units serving laboratory uses or spaces with hazardous exhaust.

PART 2: GENERAL DESIGN REQUIREMENTS

2.1 GENERAL

A. System Architecture

1. The dedicated outdoor air system shall provide tempered, neutral, 100% outdoor air to the associated indoor spaces.

2. DOAS shall be variable capacity on:

   a) The airside in a type of variable air volume (VAV).

   b) The heating, cooling, and dehumidification coils (inverter compressors, modulating valves).

3. An air discharge dewpoint in dehumidification mode shall not exceed 55°F.

4. The discharge air temperature shall be designed according to the ductwork distribution system.

   a) Direct to the room (VRV, fan coil, and passive chilled beam systems). The discharge air

temperature shall be controlled to help cooling/heating the associated spaces maintain the desired temperature setpoint and shall be reset based on an average thermostat voting values. When the thermostats' voting values are satisfied, the unit shall provide a neutralized air temperature (70ºF heating, 75ºF cooling).

b) Discharge to the return plenum of indoor units (VRV, fan coil, and passive chilled beam systems) will be checked by the designer using the manufacturer's guidelines to confirm the allowable mixing air temperature and set the discharge air temperature accordingly.

c) Discharge to the active chilled beam unit's air dewpoint shall not be more than 55ºF, and dry bulb air temperature should be between 50ºF to 65ºF.

d) Outdoor air delivery method, whether direct to space or ducted through terminal heating and cooling devices, should be consistent throughout the space/building.

5. Demand-controlled ventilation: The airflow shall be controlled to maintain the CO_2 level globally on the exhaust air duct, or per space when VAV boxes are utilized. The minimum flow shall not be less than the ventilation required by the space square footage in accordance with the applicable codes.

B. DESIGN

1. The design engineer shall include the following items for the design.

a) Outdoor DOAS on a roof shall be located:

i) Above public areas (corridors, toilets, storages, etc.) where acoustic disturbance is minimal.

ii) On a seismic/wind roof curb that is sufficiently high for snow, the roof curb shall be equipped with acoustical layers to eliminate the radiated noise.

iii) 25-feet away from any fossil fuel burning flue discharge and 10-feet away from any nonhazardous building exhaust or vent.

b) Indoor DOAS shall be located in a mechanical room with:

i) All required maintenance clearance.

ii) At least three-foot-wide and six-foot, ten-inch-high (3'x 6'10") means of access.

iii) Concrete pad, railings, and vibration isolating springs.

c) Calculating the required outdoor air ventilation shall be done in accordance with the adopted version of the International Mechanical Code (IMC) and ASHRAE 62.

d) The DOAS system shall not be selected for equal supply and exhaust air flow. The exhaust volume shall take into account building pressurization, and the volume of supply air that is not retuned back to the centralized DOAS unit. The mechanical schedule shall reflect performance data that is based on actual operating airflow, and not equal airflow.

e) Air velocity in the unit shall not exceed 450 FPM to avoid condensate carryover.

f) The unit's efficiency shall be in accordance with the adopted version of the International Energy Conservation Code (IECC) and ASHRAE 90.1.

g) DOAS direct expansion (DX) systems shall be AHRI 920 compliant.

h) When using a heat pump as a means of heating, backup heating shall be utilized and operate when the heat pump reaches its limit on low ambient temperature. Electric resistance, as a means of backup/supplemental heating, shall only be used with approval from Yale Engineering.

i) The designer shall include modulating control methods to prevent frosting of the energy/heat recovery wheel/core.

j) When using hot water for heating and/or dehumidification, the designer shall include a means of freezing protection (freeze stat, circulating pump, propylene glycol, etc.).

k) The DOAS manufacturer shall provide a five-year warranty after substantial completion.

l) Supply and exhaust fan working points shall not be located on the unstable portion of the fan curves.

m) Supply and exhaust fan motor horsepower shall be at least one- and one-half times (1.5) more than the break horsepower.

n) Supply and exhaust fan motors shall be premium efficiency induction motors with a shaft grounding variable frequency drive (VFD). For systems with multiple supply and exhaust motors, each motor shall have a separate VFD. Electronically commutated motors are generally only allowed for two horsepower motors or less.

o) The manufacturer shall provide an outdoor air monitor.

p) Regardless of operational availability conditions and system cubic feet per minute demand for the heating and cooling mode, the unit shall be capable of achieving the design discharge air conditions for normal, unloading, and defrost modes.

q) Frost control strategies shall not include the interruption of mechanical ventilation during occupied hours.

r) For winter conditions, terminal-level equipment shall be designed to maintain a minimum space temperature of 68°F, during occupied and unoccupied periods.

s) For summer conditions, terminal-level equipment shall be designed to maintain a maximum space temperature of 76°F db, during occupied and unoccupied periods.

t) For summer conditions, terminal-level equipment shall be designed to maintain a maximum space relative humidity of 60 percent, during occupied and unoccupied periods.

C. CONSTRUCTION

1. The contractor/design engineer shall include the following items for construction.

a) The contractor shall have a minimum of three (3) years' experience in installing this type of equipment.

b) The contractor shall provide a basis of design (BOD) bid as specified and with specified products. If the contractor wishes to propose alternate products to the BOD products, they shall provide a separate, and complete, bid detailing the alternate products and the associated adjustment of price to support the change from the initial BOD products. The contractor bids the alternate product(s) with full knowledge that the proposed product(s) may not be acceptable or approved. In no event shall the contractor be entitled to additional compensation to supply such specified products, options, sequences, or intents. All additional cost, to any party, because of any product submitted on or supplied other than that of the original specified products shall be the responsibility of the contractor without recourse.

c) Supply and exhaust ductwork shall be connected to the unit with a flexible connection.

d) The mechanical designer shall coordinate with the acoustical engineer to decide if a duct sound attenuator, duct sound wrapping, or other approved attenuating means is required to maintain the required noise criteria in the spaces served.

e) The designer shall include supply/exhaust smoke detectors as required by the adopted IMC requirements.

f) Upon job completion, the contractor will provide the owner with a copy of approved submittal; mobile service; project mechanical and control drawings; all as-built drawings, including device controls addressing map and guide; operation and maintenance manuals; troubleshooting guides; start-up and system configuration reports; and service and engineering manuals in a PDF format.

g) Provide any specialized repair tools needed for system maintenance.

h) Provide at least one spare of each critical part or component that is not readily available at a local distributor.

PART 3: MINIMUM PRODUCT REQUIREMENTS

A. All equipment and components shall be new, and the manufacturer's current model.

B. All parts and components shall be readily available in the United States of America.

C. The DOAS equipment supplier shall have a minimum of five (5) years of experience designing and installing DOAS equipment specifically for DOAS applications.

D. Acceptable manufacturers include:

1. Factory package equipment
   a) Daikin
   b) Trane
   c) AAON
   d) Valent
   e) Semco

2. Custom equipment
   a) Innovent

b) Yale-approved equivalent

E. For both packaged and custom equipment, refer to the applicable standards for unit and system component requirements. For example, filters, casing, fans, and coils.

F. Controls

1. Manufacturer packaged control of DOAS equipment shall not be allowed, unless it is reviewed with Yale Engineering, with the exception of packaged refrigeration controls.

2. The central building management system shall control all aspects of the DOAS system. Comply with the requirements of standard 23 75 00 Air Handling Equipment.

Date	Description of Change	Pages / Sections Modified	ID
11/2023	New standard for requirements for DOAS	N/A	Office of Facilities, Engineering and Operations