

DOAS Clarifications/Updates

- 1) Fan Energy Savings
- 2) Heating Energy Savings
- 3) Elimination of reheating

Key DOAS Design Features

- 1) Separate the ventilation from heating and cooling equipment
- 2) Provide ventilation with Energy/Heat Recovery Ventilator
- 3) Cycle zonal heating and cooling equipment off
- 4) Size equipment to the loads

EM055-2018 – Ventilation with Energy Recovery

Eliminate Ventilation Over-sizing Exception for Energy Recovery Systems

- Code currently has no limits to ventilation system sizing if using Energy Recovery.
- Exceptions already exist for particulate or VOC dilution, economizer, night flushing, dehumidification, pressurization, exhaust make-up, or other process air delivery.
- Force all projects to perform ventilation load calculations and size ventilation to 100-150% of UMC.
- Save fan and conditioning energy
- Reduce capital cost

C403.2.2 Ventilation. Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall be configured to provide no greater than 150 percent of the minimum outdoor air required by Chapter 4 of the International Mechanical Code or other applicable code or standard, whichever is greater.

Exceptions:

1. The mechanical system may supply outdoor air at rates higher than the limit above when it is used for particulate or VOC dilution, economizer, night flushing, dehumidification, pressurization, exhaust make-up, or other process air delivery. Outdoor air shall be reduced to the minimum ventilation rates when not required for the preceding uses.
2. Air systems supplying Group R-1, R-2 or I-2 occupancies.
3. Alterations that replace less than half of the total heating and cooling capacity of the system.
4. ~~Systems with energy recovery complying with the requirements of Section C403.7.7.1.~~

EM062-2018 – DOAS Occupancy Types

Link DOAS requirement to Code-Referenced Occupancy Classifications.

- Current language references occupancy types with no link to code defined spaces.
- Proposal is to link to IBC Occupancy Classifications.
- Provides better clarity and consistency across codes.
- Expands requirements to other occupancies well-suited to DOAS – notably assembly.

Table 403.3.5 - Occupancy Classifications Requiring DOAS

Occupancy Classification ^a	Inclusions	Exempted
A-1	All occupancies not specifically exempted	Television and Radio studios
A-2	Casinos (gaming area)	All other A-2 occupancies
A-3	Lecture halls, community halls, exhibition halls, Gymnasiums, Courtrooms, Libraries, Places of Religious Worship	All other A-3 occupancies
A-4, A-5		All occupancies excluded
B	All occupancies not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities.
F, H, I, R, S, U		All occupancies excluded
E, M	All occupancies included	

Case Study of DOAS in Assembly – Skokomish Community Center

- 20,200SF – Community Center near Shelton with Gym, meeting, dining, kitchen
 - DOAS with ERVs. Heat/cool with VRF.
 - Skokomish EUI = 34kBtu/SF/yr
 - Skokomish HVAC budget = \$20/SF
 - Seattle Benchmarking Data – Community Center median EUI = 69kBtu/SF/yr
 - Typical Community Center HVAC budget = \$15/SF
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- Benefit/Cost Ratio = 2.0
 - Simple Payback = 6 yrs.



EM063-2018 – DOAS Air Delivery

Allow heating and cooling of DOAS air in simple single zone systems.

Prevent REHEATING of air in multizone systems

- Responds to questions raised by 2015 State Building Code Interpretation 18.
- Prevents DOAS from being configured as VAV with reheat.

C403.3.5 Dedicated outdoor air systems (DOAS). For office, retail, education, libraries and fire stations, outdoor air shall be provided to each occupied space by a dedicated outdoor air system (DOAS) which delivers 100 percent outdoor air without requiring operation of the heating and cooling system fans for ventilation air delivery. For multizone DOAS the supply air shall be delivered directly to the space or downstream of the zonal heating and/or cooling coils.

Exceptions:

- 1) Occupied spaces that are not ventilated by a mechanical ventilation system and are only ventilated by a natural ventilation system per Section 402 of the *International Mechanical Code*.
- 2) High efficiency variable air volume (VAV) systems complying with Section C403.6.10. This exception shall not be used as a substitution for a DOAS per Section C406.6 or as a modification to the requirements for the Standard Reference Design per Section C407.

EM065-2018 – DOAS Energy Recovery

Clarify code by putting all DOAS equipment requirements in one place. Tie minimum efficiency of energy recovery to ASHRAE 90.1-referenced definition.

- Removes confusing references to other code sections that only partially apply and have led to multiple possible interpretations.
- Adds definition of Sensible Recovery Effectiveness from AHRI Standard referenced by ASHRAE 90.1.
- 60% Sensible Recovery Effectiveness is no more stringent than current 50% enthalpy requirements.
- Unnecessary to make fan power limit any more complex than 1W/CFM. There are many products on the market in the <5HP range that can meet this requirement.

C403.3.5.1 Energy recovery ventilation with DOAS.

The DOAS shall include *energy recovery ventilation*. The energy recovery system shall have a 60% minimum Sensible Recovery Effectiveness or Sensible Recovery Efficiency. For DOAS with fans < 5hp, total combined fan power shall not exceed 1W/CFM of outside air. For DOAS with fans ≥ 5hp refer to fan power limitations of Section C403.8.1. This fan power restriction applies to each dedicated outside air unit in the permitted project, but does not include the fan power associated with the zonal heating/cooling equipment. that complies with the minimum energy recovery efficiency and energy recovery bypass requirements, where applicable, of Section C403.5.1.

Exceptions:

1. Occupied spaces ~~under the threshold of Section C403.7.7.1~~ with all of the following characteristics; complying with C403.7.7.1, served by equipment less than 5000 CFM, with an average occupant load greater than 25 people per 1000 square feet (93m²) of floor area (as established in Table 403.3.1.1 of the *International Mechanical Code*) that include demand control ventilation configured to reduce outdoor air by at least 50% below design minimum ventilation rates when the actual occupancy of the space served by the system is less than the design occupancy.
2. Systems installed for the sole purpose of providing makeup air for systems exhausting toxic, flammable, paint, or corrosive fumes or dust, dryer exhaust, or commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Added Definition

Sensible Recovery Effectiveness: Change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and return air dry-bulb temperatures, expressed as a percentage , governed by AHRI Standard 1060.

EM066-2018 – DOAS Supply Air Heating

Limits use of DOAS as heating device to tempering only.

- Provide for full decoupling of ventilation from heating/cooling.
- Heating with DOAS air requires running ventilation for warm-up or after-hours heating.
- Heating/Cooling coils add pressure drop to ventilation system that must run during occupied hours.

C403.3.5.4 Heating of DOAS supply air.

If heating coils are added to DOAS supply air stream, supply air shall not be delivered greater than 5F above space temperature setpoint.

EM080-2018 – DOAS Revise Economizer Exception

Only exempt ductless heating and cooling equipment paired with DOAS systems from economizer requirements.

- Ducted heating and cooling equipment can relatively easily include cost effective economizers.
- It is not clear what the definition of an economizer is for radiant or other ductless heating/cooling equipment.

C403.5 Economizers. Air economizers shall be provided on all new systems including those serving computer server rooms, electronic equipment, radio equipment, and telephone switchgear. Economizers shall comply with Sections C403.5.1 through C403.5.5.

Exception: Economizers are not required for the systems listed below:

- 1) Non-ducted HVAC Systems complying with Section C403.3.5 Dedicated outdoor air systems (DOAS) serving only spaces with year-round cooling loads from lights and equipment of less than 5 watts per square foot.

(All other exceptions remain unchanged)