

COMPARISON OF VERY HIGH EFFICIENCY DOAS WITH WASHINGTON STATE ENERGY CODE DOAS REQUIREMENT



	VERY HIGH EFFICIENCY DOAS	WASHINGTON STATE ENERGY CODE—2018 (WSEC) FOR DOAS	KEY TAKEAWAY
Definition	An alternative HVAC system for commercial buildings that use a very high efficiency heating/cooling system and a very high efficiency HRV/ERV to deliver heating and cooling air separately from ventilation air so that the control and energy impacts of each can be managed optimally, resulting in significantly reduced whole-building energy consumption.	An HVAC system that delivers 100% outside air without requiring operation of the heating/cooling system fans for ventilation air delivery. Heating/cooling systems and fans must cycle off when there is no call for heating or cooling in zone. Systems must include ERV complying with minimum energy recovery and fan power limitation. The ERV must have a 60 percent minimum sensible recovery or 50 percent enthalpy recovery effectiveness.	Very high efficiency DOAS has more stringent requirements that lead to deepened energy efficiency as compared to WSEC-minimum installations.
Applications	New construction and HVAC system replacement (especially ideal in replacing existing RTUs in spaces with open layouts and exposed interior ductwork).	New construction and major renovations where the HVAC system is replaced.	Similar applications.
Applicable Building Types	Generally, for commercial buildings 50,000 sq. ft. or less.	WSEC requires DOAS in a wide range of commercial building types including but not limited to offices, schools (through 12 th grade), retail & department stores, theaters and general assembly, banks, casinos, libraries, places of religious worship, and many more	WSEC requires DOAS in many commercial buildings, and very high efficiency DOAS is an excellent solution in many small-to-medium commercial building applications.
Heat Recovery at Rated Conditions	Minimum Sensible Recovery Efficiency (SRE) of HRV/ERV: 82% sensible effectiveness at 75% of nominal full airflow (HRV/ERV can either be selected from a compliant product list or meet the 82% SRE using AHRI 1060-2018 certified software at design conditions).	C403.3.5.1 requires minimum energy (enthalpy) recovery effectiveness of 50% or sensible recovery effectiveness of 60%. C406.7 (High Performance DOAS Option) requires minimum sensible heat recovery effectiveness of 80%.	Very high efficiency DOAS requires higher sensible recovery effectiveness and provides a prescriptive or design condition path while WSEC is more vague in its requirement.
Fan Efficacy at Rated Conditions	Minimum fan efficacy: PHI certified, or 1.3 cfm/watt at 0.5" w.g. at 75% of nominal full airflow.	C403.3.5.1 Energy recovery ventilation with DOAS requires systems less than 5hp use no more than 1 watt/cfm (minimum 1.0 cfm/watt). Fan power for systems greater than 5hp are covered by section C403.8.1. C406.7 (High Performance DOAS Option) requires combined fan power less than 0.5 watt/cfm of outdoor air (2 cfm/watt), with no static pressure requirement.	Very high efficiency DOAS fan efficacy requirement is more clearly defined and slightly more stringent than the requirements of WSEC Section C403.3.5.1. The WSEC High Performance DOAS option for additional energy efficiency credit includes required fan efficacy higher than very high efficiency DOAS.

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Heating/ Cooling System Efficiency	<p>Heating and cooling equipment must use electric heat pump technology and meet the current ENERGY STAR® minimum efficiency requirements, or meet requirements in Appendix B.</p> <p>As an example, VRF and air-source heat pumps must meet the following minimum Energy-Star efficiencies¹:</p> <ul style="list-style-type: none"> ➤ <65 kBtu/h: 16.0 SEER / 9.5 HSPF ➤ >=65 & <135 kBtu/h: 17.4 IEER / 3.4 COP ➤ >=135 & < 240 kBtu/h: 16.4 IEER / 3.3 COP ➤ >= 240 kBtu/h: 16.2 IEER / 3.2 COP 	<p>Many different types of gas and electric space heating and cooling system equipment are allowed and must meet the minimum efficiency requirements in Section C403.3.2</p> <p>VRF and air-source heat pumps must comply with the minimum efficiency requirements of Table C403.3.2(1)C²:</p> <ul style="list-style-type: none"> ➤ <65 kBtu/h: 13.0 SEER / 7.7 HSPF ➤ >=65 & <135 kBtu/h: 14.6 IEER/ 3.3 COP @ 47°F / 2.25 COP @ 17°F ➤ >=135 & <240 kBtu/h: 13.9 IEER / 3.2 COP @47°F / 2.05 COP @ 17°F ➤ >=240 kBtu/h: 12.7 IEER / 3.2 COP @ 47°F / 2.05 COP @ 17°F 	<p>Very high efficiency DOAS requires electric heat pump systems while WSEC allows a wider range of technologies.</p> <p>Additionally, the minimum efficiency requirements for very high efficiency DOAS are in general higher than what WSEC requires. WSEC includes low-temperature heating efficiency requirements for VRF systems, which VHE DOAS will adopt with the Energy Star Version 4 update January 1, 2023.</p>
	Decoupled System Design	<p>Ventilation and heating/cooling system must be controlled separately with independent ducting and zoning. Ventilation air must be delivered directly to the occupied space or downstream of the terminal heating/cooling coils.</p>	<p>C403.3.5 requires ventilation air to be “delivered directly to the occupied space or downstream of the terminal heating and/or cooling coil.” Additionally, it requires the heating and cooling fans to “shut off when there is no call for heating or cooling in the zone.”</p>
Peak Heating and Cooling Loads and Equipment Sizing	<p>Very high efficiency DOAS requires that the capacity of the heating/cooling system is supported by load calculations with no more than a 20% safety factor. Suggests best practice is to use no more than a 10% safety factor.</p>	<p>C403.1.2 requires that design loads for HVAC systems must be calculated in accordance with ANSI/ASHRAE/ACCA Standard 183 or with an approved “computational procedure”.</p> <p>C403.3 requires that the smallest available equipment size that exceeds the peak loads calculated must be selected.</p>	<p>Both very high efficiency DOAS and WSEC require systems are sized based on peak heating and cooling load calculations. Very high efficiency DOAS explicitly limits the amount of oversizing used. Over-sizing is common in DOAS systems as the impact of heat recovery is often overlooked in sizing heating/cooling systems. Over-sizing leads to higher overall HVAC energy usage and higher first cost.</p>

¹VRF and heat pump efficiencies will be updated to ENERGY STAR V4 cold climate heat pump requirements (Table 4) as of 1/1/2023.

²Required cooling efficiency is 0.2 IEER lower for VRF equipment with refrigerant heat recovery capability.

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HRV/ERV Defrost Control	Where climate conditions warrant, HRV/ERV heat recovery defrost is required. Recirculating return air is prohibited, and if electric resistance is used, it must be modulating.	No requirements around HRV/ERV defrost or recirculation.	To reduce unnecessary use of defrost and maintain indoor air quality, very high efficiency DOAS is more stringent than WSEC.
Crossflow Leakage	Crossflow leakage: less than 3%.	No requirements for crossflow leakage.	Crossflow leakage limitation is a key difference in very high efficiency DOAS, which can be particularly impactful for enthalpy wheels.