

HV22 Carbon Dioxide Sensors (Climate Zones: all)

The number and location of carbon dioxide sensors for demand-control ventilation can affect the representation of the building or zone occupancy. A minimum of one CO₂ sensor per zone is recommended for systems with greater than 500 cfm of outdoor air. Multiple sensors may be necessary if the ventilation system serves spaces with significantly different occupancy expectations. Where multiple sensors are used, the ventilation should be based on the sensor recording the highest concentration of CO₂.

Sensors used in merchandise areas with high outdoor air requirements should be installed in the return air ducts to provide an average CO₂ measurement for the zone. For sensors mounted in return air duct, adequate access for sensor calibration and field testing must be provided. The number and location of sensors should take into account the sensor manufacturer's recommendations for the particular product.

The demand ventilation controls should maintain CO₂ concentrations less than or equal to 600 ppm plus the outdoor air CO₂ concentration in all spaces with CO₂ sensors. However, the outdoor air ventilation rate should not exceed the maximum design outdoor air ventilation rate required by code regardless of CO₂ concentration.

The outdoor air CO₂ concentration can be assumed to be 400 ppm without any direct measurement, or the CO₂ concentration can be monitored using a CO₂ sensor located near the position of the outdoor air intake.

CO₂ sensors should be certified by the manufacturer to have an error of 75 ppm or less and be factory calibrated. Inaccurate CO₂ sensors can cause excessive energy consumption and poor air quality, so these need to be calibrated as recommended by the manufacturer.

HV23 Economizers (Climate Zones: ③ ④ ⑤ ⑥ ⑦ ⑧)

Economizers, when recommended, should be employed on air conditioners to help save energy by providing free cooling when ambient conditions are suitable to meet all or part of the space cooling load. Consider using enthalpy controls (versus dry-bulb temperature controls) to help ensure that unwanted moisture is not introduced into the space in hot, humid climates. Economizers are not recommended in climate zone 1. There may be some applicability in dry climate areas in climate zone 2. Periodic maintenance is important with economizers, as dysfunctional economizers can cause substantial excess energy consumption due to malfunctioning dampers and/or sensors.

References

- ASHRAE Handbook—HVAC Applications*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- ASHRAE Handbook—Fundamentals*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- ASHRAE Handbook—HVAC Systems and Equipment*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- ASHRAE. 2004. *ASHRAE Standard 62.1-2004 - Ventilation for Acceptable Indoor Air Quality*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- National Electrical Manufacturers Association, www.nema.org, Standards and Publications section.

SERVICE WATER HEATING

Good Design Practice

WH1 *Service Water Heating Types (Climate Zones: all)*

The service water heating (SWH) equipment discussed in this Guide is considered to use the same type of fuel source used for the HVAC system. This Guide does not cover systems that use oil, hot water, steam, or purchased steam for generating SWH. The Guide also does not address the use of solar or site-recovered energy (including heat pump water heaters). These systems are alternative means that may be used to achieve 30% or greater savings over ASHRAE Standard 90.1-1999 and, where used, the basic principles of this Guide would apply.

The SWH equipment included in this Guide for the HVAC options listed in HV2 are the gas-fired water heater and the electric water heater.

Both natural gas and propane fuel sources are available options for gas-fired units.

WH2 *System Description (Climate Zones: all)*

1. **Gas-fired storage water heater.** A water heater with a vertical or horizontal water storage tank. A thermostat controls the delivery of gas to the heater's burner. The heater requires a vent to exhaust the products of combustion.
2. **Gas-fired instantaneous water heater.** A water heater with minimal water storage capacity. The heater requires a vent to exhaust the products of combustion. An electronic ignition is recommended to avoid the energy losses from a standing pilot.
3. **Electric resistance storage water heater.** Water heater consisting of a vertical or horizontal storage tank with one or more immersion heating elements. Thermostats controlling heating elements may be of the immersion or surface-mounted type. For typical retail applications, small water heaters are available from 2 to 20 gal.
4. **Electric resistance instantaneous water heater.** Compact, under-cabinet, or wall-mounted types with insulated enclosure and minimal water storage capacity; a thermostat controls the heating element, which may be of the immersion or surface-mounted type. Instantaneous, point-of-use water heaters should provide water at a constant temperature regardless of input water temperature.

WH3 *Sizing (Climate Zones: all)*

The water heating system should be sized to meet the anticipated peak hot water load, typically 0.4 gal per hour per store employee in the average retail building. The hot water demand will be higher if showers or other high-volume uses exist, and these should be accounted for in sizing equipment. The supply water temperature should be no higher than 120°F to avoid injuries due to scalding.

WH4 *Equipment Efficiency (Climate Zones: all)*

Efficiency levels are provided in the Guide for gas instantaneous, gas-fired storage, and electric resistance storage water heaters. For gas-fired instantaneous water heaters, the energy factor and thermal efficiency levels correspond to commonly available instantaneous water heaters.

The gas-fired storage water heater efficiency levels correspond to condensing storage water heaters. High-efficiency, condensing gas storage water heaters (energy factor > 0.90 or thermal efficiency > 0.90) are alternatives to the use of gas-fired instantaneous water heaters.

Electric storage water heater efficiency should be calculated as $0.99 - 0.0012 \times$ water heater volume. Instantaneous electric water heaters are an acceptable alternative