

Chapter 7: Heating and Cooling Systems

Design Conditions

The Washington State Energy Code sets the following conditions for heating system design and equipment sizing:

- [302.2.1] • Indoor Design Temperature: 70°F heating - 78°F cooling.
- [302.1] • Outdoor Design Temperature: Based on local weather data taken from Puget Sound Chapter of ASHRAE publication “Recommended Outdoor Design Temperatures for Washington State.”
www.pugetsoundashrae.org/interest.htm
- Recommended Air Infiltration Rate for equipment sizing: 0.6 air changes/ hour.

Design Heat Load (DHL) Calculation

- [503.2.1] Heating and cooling design loads for the purpose of sizing the heating and/or cooling equipment must be calculated in accordance with accepted engineering practice, including infiltration and ventilation.

- [503.2.2] **System Sizing Limit.** The Code limit is set at 150% of designed heating or cooling load. Exceptions are made for:
 - Equipment providing both heating and cooling in one packaged unit; compliance need only be demonstrated for the heating or cooling system size.
 - Gas or oil heating equipment with a total rated output less than 40,000 Btu/hr. are exempt from the sizing limit. Gas or oil heating equipment that exceeds 40,000 Btu/hr. may be 250% of the DHL if the annual fuel utilization efficiency (AFUE) is 90% or greater.

Alternate methods to calculate HVAC system sizes are:

- Air Conditioning Contractors of America (ACCA) Manual J; or
- Prescriptive Path and Component Performance Worksheets located at www.energy.wsu.edu/code/

Electric Resistance Heating Systems

System efficiency. No requirement. Electric resistance heating is considered 100% fuel efficient (see Figure 7-1)

[503.8]

Controls. Thermostat, which must provide:

- Heating only 55°F to 75°F with Cooling 55°F to 85°F.
- Adjustable deadband of not less than 10°F between hot and cold.
- Manual or automatic setback.
- Zonal Control – at least one thermostat for each separate system.

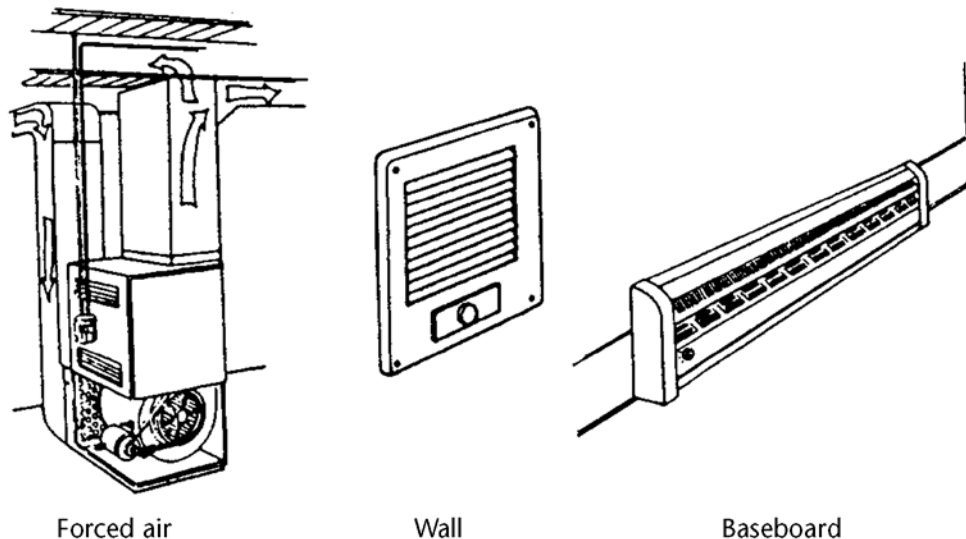


Figure 7-1

Other Fuel Heating Systems (Combustion)

[503.4]

System efficiency. Minimum 78% AFUE.

Oil, gas, or propane space heater requires intermittent ignition or must meet 1987 NAECA efficiency requirement.

Credit for increased efficiency by Systems Analysis approach.

Controls: Same as Electric Resistance.

Combustion Heating Systems

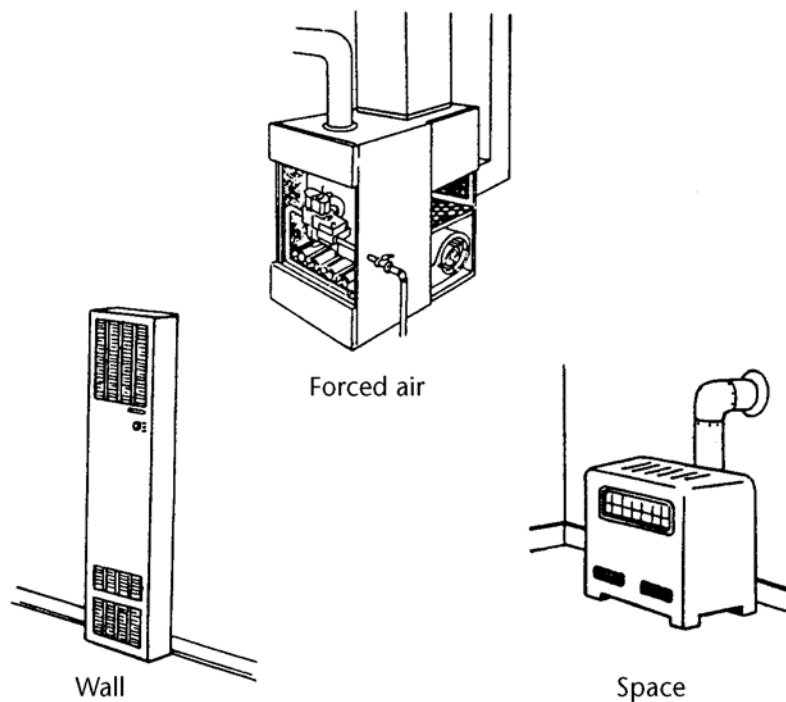


Figure 7-2

Other Fuel Heating Systems (Heat Pumps)

[503.4] **System efficiency.** Varies depending on source of heat.

Air Source

- For Split System, a minimum of 7.7 HSPF (Heating Seasonal Performance Factor). (See WSEC Table 14-1B.) (See Figure 7-3.)
- For Single Package, a minimum of 6.6 HSPF.

Ground Source

- Minimum COP (Coefficient of Performance) = 3.6 @ 50°F.

Split Package Heat Pump

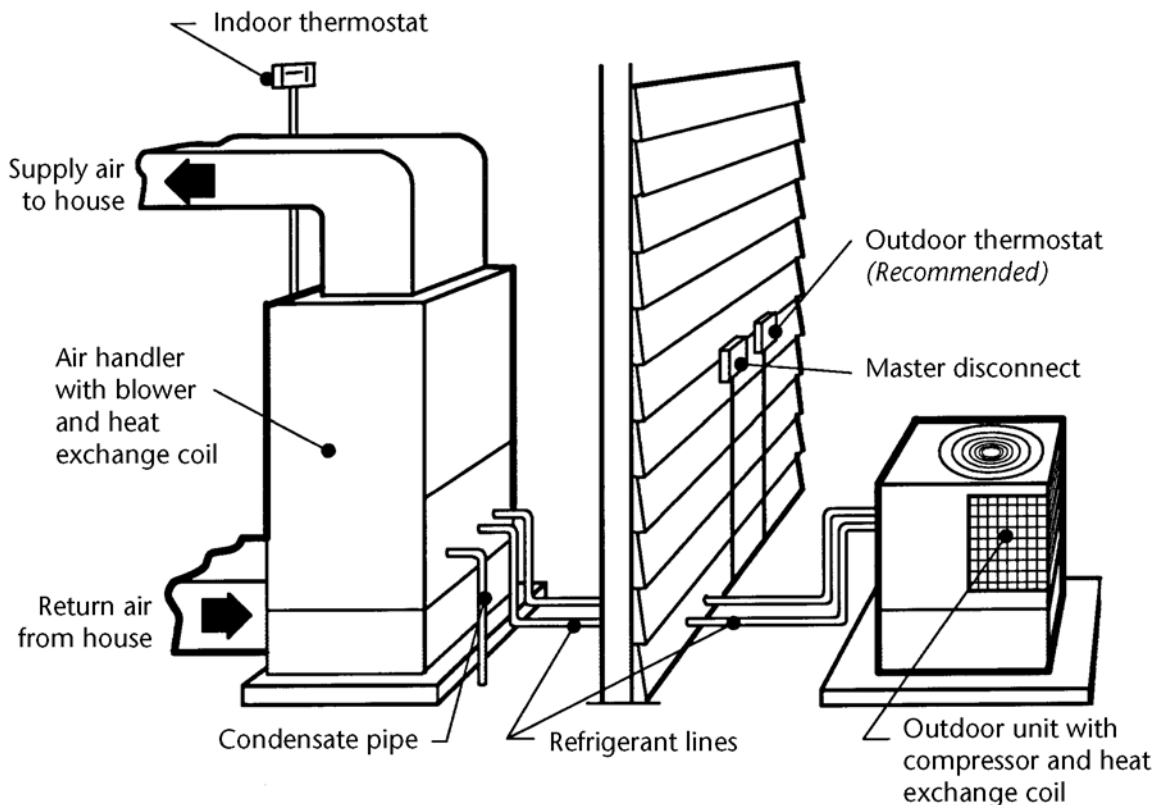


Figure 7-3

Duct Systems

[503.9]

Ducts, plenums, and enclosures outside conditioned space must be insulated to R-8 in Climate Zone 1 and R-10 in Climate Zone 2 (R-5 in slabs or in the ground in both climate zones).

Exceptions:

- Within the HVAC equipment.
- Supply or return ducts installed in unvented crawlspaces with insulated walls.

Duct Fasteners

Ducts must be fastened in accordance with the International Mechanical Code (IMC). For small sheet metal ducts, a minimum of three screws per connection equally distributed around the duct, or equivalent is required. For flex duct, and duct board, you must follow instructions developed by the Sheet Metal & Air Conditioning Contractors National Association (SMACNA), noted in the IMC. More information can be found at:

www.smacna.org/

Duct Sealing

All supply and return ducts that may communicate air to the exterior of the building must be sealed. This includes ductwork and building cavities used to transport air.

Primary sealants approved for ducts include welds, gaskets, mastic, or mastics with embedded fabric systems. Tapes may be used if specific installation procedures provided by the manufacturer are followed.

Tapes must be installed in accordance with manufacturer's instructions, or in the case of UL 181 sealants, in accordance with the product listing. If the product does not have instructions specific to material or application it is being applied to, it does not meet the intent of the code. For example, if tape is used to seal sheet metal, instructions published by the manufacturer must include notes

on application to sheet metal. If the sheet metal needs to be cleaned, the manufacturer's instructions must provide specific instructions on cleaning. These instructions must be followed by the installer.

Building cavities used to transport air may be sealed using drywall, tape and mud. It must be installed with a continuous air barrier.

For additional information on duct sealing, see the *Builder's Field Guide's Supplement A, "Improving Forced Air Heating Systems,"* included in this guide.

Duct Insulation and Sealing

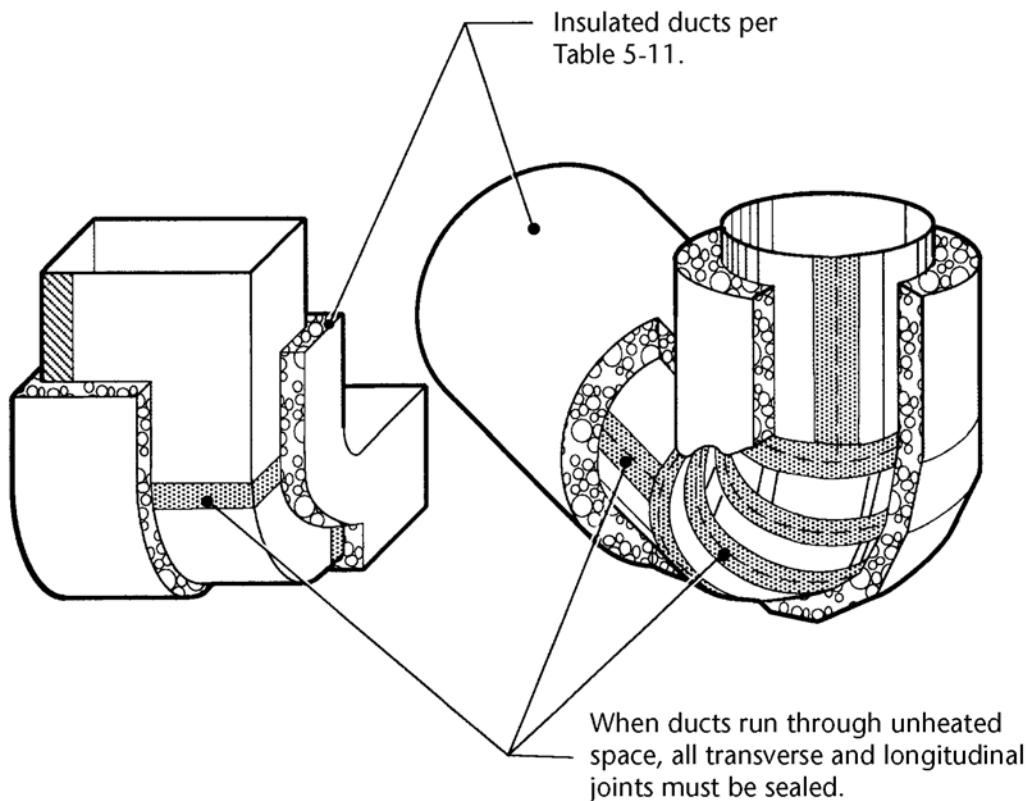


Figure 7-4

Sealing Ducts

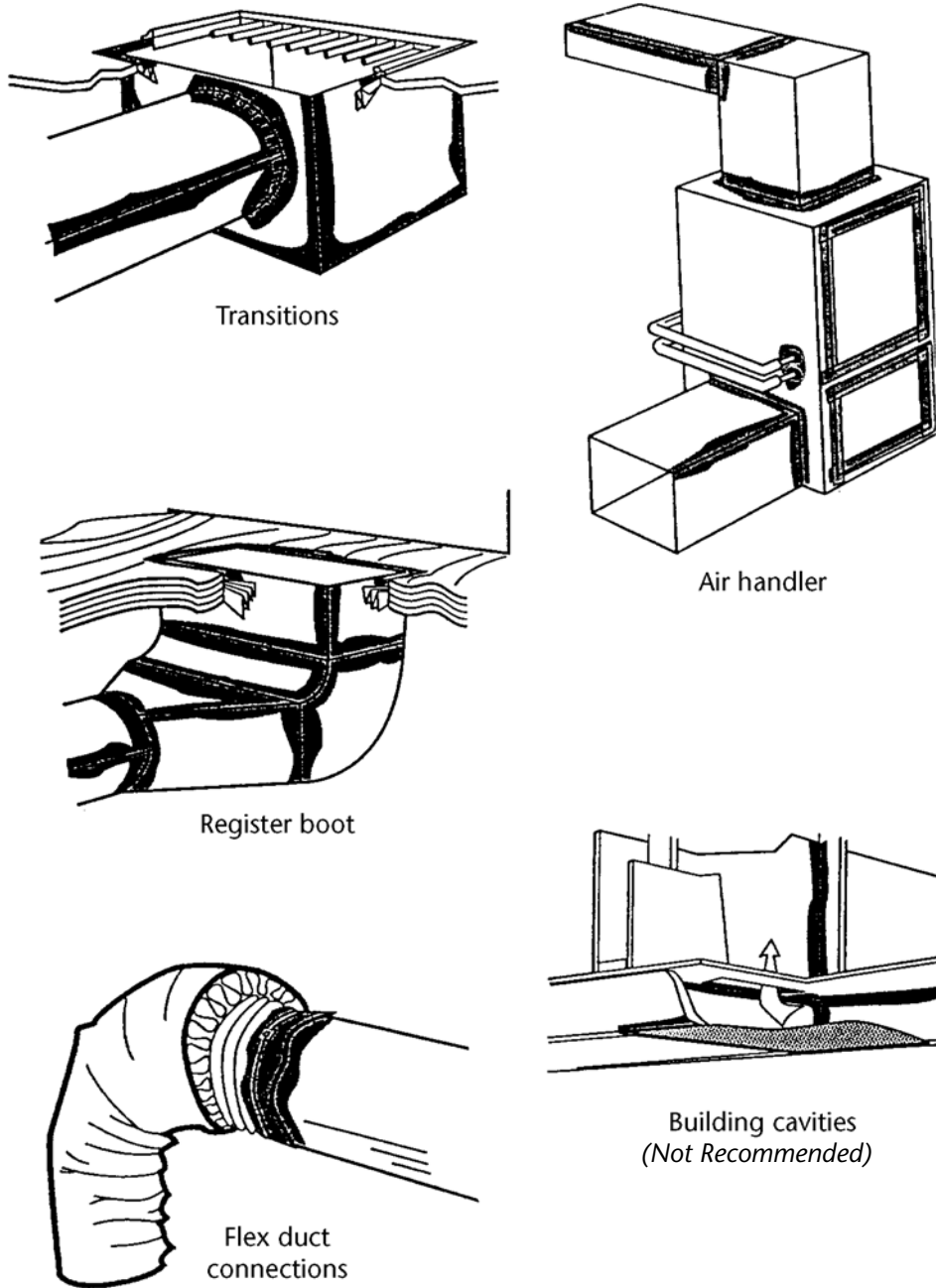


Figure 7-5