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# Floor heating plus condensing boiler equals 104% efficiency

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OBTAINING 104% efficiency for any heating system sounds impossible, but it is not wishful thinking according to European Efficiency ratings. The Europeans equate the sensible heat (or lower heating value) of the fuel to 100% and add the latent (hidden) heat of the fuel. In real U.S. DOE terms, that 104% translates into 96% AFUE, which means only 4% of the potential Btu value of the fuel goes up the chimney.

Since condensing boilers are expensive, usually the building owner must be convinced that the payback of such a system justifies the additional cost and must be assured that the overall efficiency can be extremely attractive if applied properly to commercial buildings.

The key to payback is to operate the boiler year round in the condensing mode. The only way to assure this is to couple the boiler to a low temperature floorheating distribution system and proper controls capable of providing ideal operating conditions.

**How do they work?**

When combustion of natural or propane gas occurs within the combustion chamber of a conventional boiler, only the lower heating value or sensible heat of the fuel is used. During combustion, however, a large amount of water vapor is generated, then driven out into the atmosphere together with the rest of the combustion flue gases.

**Unfortunately, most existing heat distribution systems operate at significantly higher return water temperatures, which makes them unsuitable to work with condensing boiler.**

To vaporize water, a certain amount of the fuel's energy is used up (approximately 11% with natural gas, 14% with propane and 6% with No. 2 heating oil) during the combustion process.

This "hidden" energy of the steam vapor is normally wasted in a conventional boiler, causing condensation problems in the boiler or chimney if the flue gasses fall below dew point temperatures. That's why a conventional boiler has to be kept at fairly high water temperatures to keep the steam vapor suspended within the hot flue gasses and carried out the chimney. Cool boiler heat exchange surfaces and chimney walls, like cold single pane windows in the winter, will condense moisture.

The condensing boiler's elaborate and oversized heat exchanger design retrieves this energy of the steam vapor - the latent heat of the fuel - by extracting the steam condensate and returning its energy back to the system heating water. Therefore, in order for the condensing boiler's heat exchanger surfaces to extract all the potential latent heat effectively, the system has to run with the lowest possible return water temperatures, preferably not exceeding 115°F. Unfortunately, most existing heat distribution systems operate at significantly higher return water temperatures, which makes them unsuitable to work with condensing boilers. The condensing boiler will rarely get into condensing mode, but operate as a conventional boiler during most of the heating season.

The only suitable type of radiation to work with condensing boilers are low temperature panel radiators operating at 130°F supply/110°F return temperatures and, of course, floorheating systems running at 110°F/95°F. Floorheating is the ideal

heat distribution system, guaranteeing 100% condensing mode operation throughout the heating season with the lowest possible return water temperatures.

A well-designed condensing boiler operating in the condensing mode will generate flue gas temperatures not more than 20°F above the system return water temperature. For instance, a commercial floorheating system with an average seasonal return water temperature of 85°F will generate flue gas temperatures of 105°F. The additional costs for the proper venting and condensate neutralization equipment needed in a condensing boiler installation has to be taken into account when comparing the overall initial boiler installation with other heat sources.

Gas-fired condensing boilers will add approximately 10% to the seasonal efficiency. It is, however, the powerful combination of floorheating, outdoor reset, constant circulation and condensing which provide an overall system efficiency building owners have only dreamed of in the past!

The following figures have been carefully documented at a commercial installation which has been in operation for the past two heating seasons.

Location of building: Waterloo, Ontario, Canada. Heat source: two Viessmann Vertomat Model VSB 13 condensing boilers (488 MBH input each). Boiler running time: stage 1 runs for 80% of the total heating season, stage 2 runs 20% of the total heating season. (To reduce the initial boiler cost investment, the second boiler stage ca be a conventional boiler.) controls: Viessmann Dekamatik outdoor reset control. Heat distribution system: commercial floor heating system. Period of heating season: 10/26/92 though 4/15/93. Degree days: 2,047. Total square footage of building: 33,000 sq. ft., with a warehouse of 26,000 sq. ft. and office of 7,000 sq. ft. Building R-Values: walls and roof both R-19. Height of building: 40 ft.

Total fuel consumption in therms of natural gas: 10,839 therms (1 therm equals 100,000 Btu) Cost per therm: U.S.$0.38. Total fuel cost for the heating season (including walkway snow melting, fresh-air heating and domestic hot water for restrooms): $4,119. Average heating cost per sq.ft./day for 92/93 Season:7/100 of a cent or $23.10 per day. Average Btuh/sq. ft.: 7.6. Temperature set back: none.

These numbers speak for themselves and have proven themselves many times over in similar floorheating/condensing boiler system applications n Europe.

Commercial floor heating, combined with condensing technology, is an ideal system to offer commercial property owners. Heating operating costs of such commercial systems in operation have proven payback periods of two to three heating seasons, with system efficiencies unheard of. It affords the building owner floor plan flexibility, ideal heat distribution comfort and associated work place productivity, increased property values, and a 21st century heating system which will meet future emission standards by cutting CO2 emissions in half. per, common-sense installation rules!

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