**Building Science Education Solution Center – Smart Thermostats and Dual Fuel Control**

Proficiency Level 2: Understand

**Learning Objective 2.1:**

* Understand why smart thermostat control is important for heat pumps.

**Lecture Notes 2.1:**

Resource: <https://www.energy.gov/energysaver/programmable-thermostats>

Programmable thermostats can save energy by reducing the temperature when the occupants are away or asleep. During cooler times of the year, the home is maintained at a lower temperature and loses less heat and overall requires less energy to heat the home.

Conventional programmable thermostats are generally not recommended for heat pumps because sudden setpoint changes or large thermostat setbacks create artificially high heating demands on the unit.. While a fossil fuel-based system would simply respond to this sudden demand in heating by burning more fuel, heat pumps switch to an inefficient supplemental heat mode and can consume more energy.

This inefficient operating pattern can be avoided by changing thermostat settings to utilize only small or gradual setbacks and setups. Some companies sell specially designed smart thermostats for heat pumps, which make setting back the thermostat cost-effective. These thermostats typically use special algorithms to minimize the use of inefficient supplemental heat systems.

**Problem Set 2.1:**

Heat pumps need special thermostat control to accomplish temperature setbacks because:

1. Parts are easily damaged by thermostat setbacks.
2. Sudden changes in heating loads cause heat pumps to operate less efficiently.
3. Heat pumps cannot communicate with conventional programmable thermostats.

**Learning Objective 2.2:**

* Understand when different components of dual fuel systems should operate.

**Lecture Notes 2.2:**

Dual fuel systems use both electric and gas heating. This lesson specifically applies to systems that use electric air-source heat pumps and natural gas heating.

Similar to managing when the supplemental heat is engaged in a heat pump system, dual fuel systems need special control to ensure optimal efficiency. Heat pumps operate at high efficiencies, but do lose efficiency and capacity at lower outdoor temperatures and higher heating loads. At moderate heating loads, the heat pump should operate to utilize the high efficiency of the system. At higher loads, the natural gas system can be enabled. Depending on the system, user needs, and fuel prices, the heat pump can be disabled at higher loads, or the gas system can simply supplement the heat pump.

The two main methods for controlling the supplemental or backup heat and giving primacy to the heat pump when economical in a dual fuel system are the balance point method and the droop method.

1. **Balance Point Method**: The balance point is programmed in the controls for automatic changeover at 5°F to 35°F depending on system capabilities. To determine the balance point, first the load line is determined through load calculations. Next the heat pump capacity is determined from the Northeast Energy Efficiency Partnerships (NEEP) cold-climate Air Source Heat Pump (ccASHP) database or the manufacturer’s extended performance data. The point at which they cross over is the balance point, where the heat pump can no longer provide enough heat to maintain comfort. The heat pump will operate on its own until the outdoor air temperature drops below the balance point, when it will then switch to the backup system instead. This way only one system is on at a time, while actively switching between systems based on the outdoor air temperature.
2. **The Droop Method**: Also known as simultaneous operation, sets the backup system’s heating setpoint 3°F colder than the heat pump system’s setpoint. Many systems offer control over balance-point and backup activation though thermostat control or from programing the unit “board.” In this method, both systems are active, with the heat pump constantly providing heat in the space. When the heat pump by itself cannot maintain the set indoor air temperature, the backup system is activated to run along with the heat pump simultaneously. This activation generally occurs at the same outdoor temperature used for the balance point method.

**Problem Set 2.2:**

The \_\_\_\_\_ method is a dual fuel control method that programs an automatic changeover between heat pump operation and gas heating based on building load calculations and equipment performance data.