**Building Science Education Solution Center – Thermostats Dual Fuel**

Proficiency Level 3: Apply

**Learning Objective 3.1:**

* Operate the terminal wiring for thermostats.

**Lecture Notes 3.1:**

All new thermostats provide color-coded wiring for their installation.

The R wire terminal connects to the 24 Vac power, and is color-coded red.

The W wire terminal connects to the heating, and it is color-coded white.

The Y wire terminal connects to the cooling, and it is color-coded yellow.

The G wire terminal connects to the fan, and it is color-coded green.

The C wire terminal is the common wire, and it is color-coded blue. Smart thermostats use the C wire and the R wire to close the circuit and charge the thermostat’s internal battery without needing to operate any of the other wires (W,Y,G) that would require the operation of the mechanical equipment.

Source: <https://www.youtube.com/watch?v=xQd6GERVzVM>

**Problem Set 3.1:**

1. What color is the wire terminal for the fan?
2. What color is the wire terminal for the heating?
3. What color is the wire terminal for the cooling?
4. What color is the wire terminal for the power?

**Learning Objective 3.2:**

* Implement the thermostat settings for the dual fuel configuration for ecobee and NEST.

**Lecture Notes 3.2:**

Source: <https://www.berkeleyelectric.coop/ecobee-installation-guide-dual-fuel>

The dual fuel system setting means to run a heat pump with gas furnace backup. Therefore, dual fuel refers to running the heating system using electricity, when the heat pump operates, and gas when the furnace operates. Dual fuel systems are usually installed in colder climates. In cold climates, the outdoor unit (i.e., heat pump) operates when the outdoor air temperatures are mild. However, when the outdoor air temperature drops below a threshold, the heat pump stops operating and the gas furnace takes over to heat the home.

Terminal wiring for ecobee for dual fuel systems:

Rc wire terminal is for power

W1 wire terminal is for the heating

Y1 wire terminal is for the cooling

G wire terminal is for the fan

C wire terminal is for the common

O/B wire terminal is used for the reversing valve. The “O” position defaults to heating mode, whereas the “B” position defaults to cooling mode.

Configuration instructions for dual fuel systems with ecobee:

Source: <https://www.youtube.com/watch?v=ffOhmfaq9Jc>

Upon the terminal wiring completion, the ecobee thermostat prompts to configure the “Compressor Minimum Outdoor Temperature” setting. The setting prompts for an outdoor temperature for which the compressor (e.g., outdoor unit/heat pump) will stop operating. In the outlined example (presentation slide #16; ecobee view #6) the minimum outdoor temperature value is set at 30F. This means that at 30F heat pump stops operating and switches over to the gas furnace backup heat to maintain occupant comfort inside the home.

After that initial setting is completed, the ecobee has an additional setting called “Aux Heat Max Outdoor Temperature” that must be configured as well by following the steps below:

Step 1: From the main screen select the “sandwich icon” menu.

Step 2: Scroll down and select “Settings.”

Step 3: Scroll down and select “Installation Settings.”

Step 4: Select “Thresholds.”

Step 5: Scroll to “Aux Heat Max Outdoor Temperature” and select a temperature between 30 and 45 F. This setting must be at least 5 F higher than the selected value under the “Compressor Minimum Outdoor Temperature.”

Terminal wiring for NEST for dual fuel systems:

Rc wire terminal is for power

W1 wire terminal is for the heating

Y1 wire terminal is for the cooling

G wire terminal is for the fan

C wire terminal is for the common

O/B wire terminal is used for the reversing valve. The “O” position defaults to heating mode, whereas the “B” position defaults to cooling mode.

“ \* ” (star sign) is used for dual fuel systems that use gas furnace to heat the home when outdoor temperatures are low.

Configuration instructions for dual fuel systems with NEST:

Source: <https://www.youtube.com/watch?v=aAluyOpVzu0&t=70s>

The following steps are used to setup the dual fuel system at a NEST thermostat.

Step 1: Activate the main menu by waving or tapping the thermostat (Slide #21, view #1).

Step 2: Rotate the outer ring of the thermostat to “Equipment” and then push the outer ring to select the setting (Slide #21, view #2).

Step 3: Ensure that the Y1, G, O/B, Rc, W1, C, and star sign are highlighted (Slide #21, view #3).

Step 4: Select “alternate heating” (Slide #22, view #4).

Step 5: Select “Pro setup” to enable additional configuration options (Slide #22, view #6).

Step 6: Select “Continue” to the prompt message “Incorrect pro Settings will cause unexpected HVAC activity or equipment damage.”

Step 7: Select “Dual Fuel” and once again ensure that the highlighted wiring is correct.

Step 8: Rotate the thermostat dial and select the “star sign”

Step 9: Select “Type: dual fuel”; “Source: Gas” (Slide #24, view #11).

So far, we have set up the “star wire terminal” for dual fuel and the thermostat itself for dual fuel. There is one last setting.

Select “Continue” from the last menu. A menu appears as “Your System” where the user must select “alternate heating” and then select continue. Next, at the “Equipment Settings” the user selects Dual Fuel” and that brings the last setting of setting the “Outdoor Air Temperature at which the heat pump stops operating and the gas furnace takes over the home’s heating (Slide #25).

**Problem Set 3.2:**

1. (True/False) The ecobee thermostat has a “star signal” wire terminal.
2. Which settings does the ecobee have for outdoor temperature?
   1. Compressor Min Outdoor Temperature
   2. Aux Heat Max Outdoor Temperature
   3. Both