

### 2.3.3 INPUT RATING

1. There are three gas pressures to be recorded during testing. The inlet test pressure is the pressure obtained at the inlet to the gas controls of the appliance. Typically a test port is provided in the gas supply piping of the lab close to the inlet to the heater. The meter pressure is the pressure of the gas at the test meter. This pressure will generally be closed to the test pressure unless there is significant distance from the meter to the unit under test. The other pressure is the manifold pressure. This is the pressure specified by the manufacturer and is measured at the point downstream from the heater regulator at a test connection provided by the manufacturer.
2. Operate heater for 15 minutes with heater adjusted to specified manifold pressure and inlet pressure adjusted to either 7.0 inch w.c. for natural gas or 11.0 inch w.c. for liquefied petroleum gases.
3. Obtain gas temperature and local barometric pressure for the purposes of determining a correction factor for the gas using one of the following equations:

#### For Dry Meters

$$CF = \frac{(P)(60 + 459.67)}{(t + 459.67)(30)}$$

where: P = Total pressure = barometer + meter pressure (in. Hg)  
t = Gas temperature (F)

#### For Wet Meters



$$CF = \frac{(P - E)(60 + 459.67)}{(t + 459.67)(30 - 0.5170)}$$

Where P = Total pressure = barometer + meter pressure (in. Hg)  
t = Gas temperature (F)  
E = Vapor pressure of water at t

4. Correction factors for wet and dry meters are found in table form in Attachments D and E.
5. The input rate is to be measured following 15 minutes of operation. When measuring the input rate using a stopwatch, it is important to recognize the type of gas meter being used. A wet meter requires only one complete revolution of the dial to secure an accurate rate. A dry meter requires a minimum of two revolutions to obtain an accurate rate. Depending on the time it takes to record a revolution of the dial, more than two revolutions is desirable.
6. Calculate input rating using the following formula:

$$\text{Input (Btu/Hr)} = \frac{(HV) (\text{cuft of gas measured}) (3600 \text{ Sec/Hr}) (CF)}{\text{Time (sec)}}$$



HV – Heating Value – If dry meter being used, multiply wet heating value by 1.0177.

7. Repeat for minimum rate condition, if applicable 
8. Verify that measured input rating in Btu/hr is within 2% of manufacturers specified input rating. If not, adjust manifold pressure  $\pm 10\%$  and repeat steps 1 through 6. If still not within 2%, test unit will need to be reorificed and retested until measured rate within 2% of specified.
9. It is important to consider the size of meter being used for this test. Meters are calibrated over a range of flow rates. Meters are typical rated in cubic feet per hr of flow. To determine flow rate, divide the Btu/HR input rating by the heating value of the gas. An approximation is:
  - a. Natural Gas  
$$\text{Input rate (Btu/HR)} / 1000 \text{ Btu/CUFT} = \text{CUFT/Hr}$$
  - b. For Propane   
$$\text{Input Rate (Btu/Hr)} / 2500 \text{ Btu/CUFT} = \text{CUFT/Hr}$$

## 2.4 COMBUSTION

### 2.4.1 NORMAL COMBUSTION

#### Procedure:

1. Install water heater as specified in section 2.1.7. Water heaters with draft hoods are to be tested without vent connector.
2. Operate the water heater for 15 minutes adjusting the water flow through the heater to maintain  $130 \pm 5$  F outlet water. The inlet water is to be maintained at 70 F. This is only necessary if the heater will not stay operating throughout the entire combustion test without water running through it. 
3. At the end of 15 minutes of operation, adjust the outlet pressure of the regulator to obtain 106.25% of manufacturer's specified input rate. After 5 minutes of operation at that condition, secure sample of flue gases. 
4. Return manifold pressure to normal setting. Adjust the inlet supply pressure to reduced condition of 3.5 inch w.c. for natural gas or 8.0 inch w.c. for liquefied petroleum gases. After 5 minutes of operation at that condition, secure a sample of flue gases.
5. For models with draft hoods, samples shall be secured before the relief opening of the draft hood to prevent dilution of sample. For power vent or direct vent models the sample shall be secured prior to dilution air being mixed with the flue products.
6. Flue gas samples shall be analyzed on an air free basis using the following formula:


$$\%COAF = (\%CO_2 \text{ in ultimate} / \%CO_2 \text{ flue}) (\%CO \text{ in flue})$$

$$CO_2 \text{ Ultimate} = 12.2\% \text{ for natural gas; } 14.0\% \text{ for LPG}$$

7. Compare the %COAF to the allowable in the standard.

$$106.25\% \text{ condition} - 0.04\%$$

$$\text{Reduced inlet pressure condition} - 0.02\%$$

8. On appliance designs intended for connection to vent and air intake systems, test shall be conducted with system and max and min vent/air intake lengths.
9. Repeat steps 2 through 7 with the water heater installed in enclosure specified in section 2.1.7. This condition is normally conducted as part of Wall, Floor and Ceiling test. The closet combustion is not needed for direct vent models. 
10. On designs with a min rate, the combustion test shall be repeated with the heater operating at a minimum test rate of 87% of the manufacturers specified min rate. 