

October 2013 Safety Meeting

Incomplete Combustion

Combustion is the rapid oxidation of a fuel. To start and maintain combustion, three ingredients are needed:

- Fuel – The fuel propane is hydrocarbon.
- Oxygen – The oxygen for combustion is obtained from air. Air is 20% oxygen, 79% nitrogen and 1% other gases.
- Ignition Source

Using propane as a fuel source and oxygen from the air, propane appliances control the mixture of propane at the burner. The ideal combustion rate for propane is 1 part propane (4%) to 24 parts air (96%). For every 1 cubic ft. of propane to be burned 24 cubic feet of air is needed to support combustion. Under normal conditions, combustion products of propane in air mixtures are not harmful when the appliance is achieving complete combustion. However, when combustion is incomplete, the products can be harmful to life and property. Proper adjustment of the air supplied to the burner is very important and too much or too little air must be avoided.

When combustion is incomplete, harmful products can be generated. The poorer the ventilation and the more inefficient the burning, the greater the possibility that by-products of incomplete combustion will be present. These by-products include (a) carbon monoxide, (b) excessive water vapor, (c) aldehydes, and (d) soot.

(a) **Carbon Monoxide** – The most potentially dangerous product of incomplete burning is carbon monoxide. Carbon monoxide has no odor, color, or taste so it cannot be detected by bodily senses. It is flammable and can produce an explosion. Carbon monoxide can only enter the body through the respiratory system. Inhaled, carbon monoxide is absorbed into the blood. It combines with hemoglobin in the blood to exclude the oxygen. Carbon monoxide combines with hemoglobin in the blood longer than oxygen. It acts to reduce the oxygen carrying function of the blood. A person exposed to carbon monoxide can die from a lack of oxygen.

Concentrations of carbon monoxide in air above 0.05 percent or 500 parts per million can be dangerous. When the level is more than 1 percent, unconsciousness and death can occur without signs. Headaches, dizziness, nausea, vomiting, and cherry-red skin can occur at many concentrations, based on an individual's dose and exposure. The breathing rate or length of exposure should also be taken into account. An individual's general physical condition, age, and degree of physical activity all affect the carbon monoxide levels in the blood.

Propane employees should check for carbon monoxide if any of the following conditions exist: the house plants are dying, there is an aldehyde odor present, or excessive water vapor forms on cool surfaces in the house.

Portable carbon monoxide (CO) detectors are used for measuring the carbon monoxide levels in the air. Propane marketers that do not have detectors available should identify before the need arises which agencies could assist on carbon monoxide calls. Certified Employee Training Program (CEPT) in “Basic Principles and Practices of Propane” covers where, how, and when to check for carbon monoxide.

(b) **Excessive Water Vapor** – Excessive water vapor can also be produced with incomplete combustion. It may damage appliances or venting systems.

(c) **Aldehydes** – Aldehydes are also products of incomplete combustion. They have a sharp, penetrating odor. The odor of aldehydes differs from odorants added to propane and the two should not be confused. Aldehydes will sometimes leave a metallic taste in the mouth, along with a burning sensation in the nose and eyes. If the odor of aldehydes is present, it is very likely that carbon monoxide (CO) will also be present. However, if the odor of aldehydes is not present, CO may still be present. Aldehydes are toxic.

(d) **Soot** – Carbon soot, may also be generated by improper combustion.

Closing

Carbon monoxide is the most deadly by-product of incomplete combustion. It is very important that you understand your role and company policy when dealing with these calls. Employees should always treat these calls as high priority.

October 2013 Incomplete Combustion

Name: _____

Date: _____

Instructions: Read and answer the following questions. When complete, grade the test and review incorrect answers so each employee is “armed” with the correct answers before they leave the training.

1. By-products of incomplete combustion include all of the following except
 - A. carbon monoxide
 - B. carbon dioxide
 - C. aldehydes
 - D. excessive water vapor

2. The most potentially dangerous product of incomplete combustion, that has no odor, color or taste is
 - A. aldehydes
 - B. hydrogen
 - C. carbon monoxide
 - D. carbon dioxide

3. A product of incomplete combustion that is toxic and gives off a strong metallic odor
 - A. aldehydes
 - B. hydrogen
 - C. carbon dioxide
 - D. carbon monoxide

4. If an odor of aldehydes is present, then carbon monoxide is most likely present.
 - A. True
 - B. False

5. When incomplete combustion of propane exists _____ may be produced and is lethal even in small amounts.
 - A. hydrogen
 - B. carbon
 - C. carbon monoxide
 - D. soot

October 2013 Test
Answer Sheet

1. B
2. C
3. A
4. A
5. C