

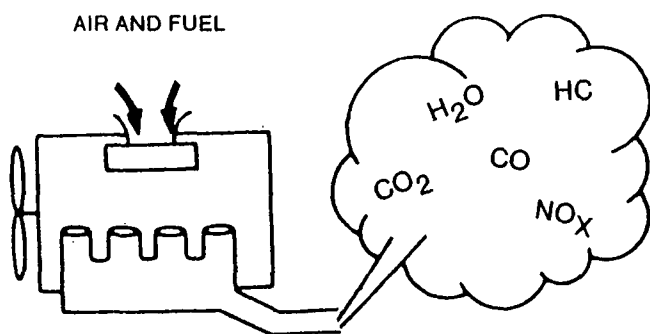
OBJECTIVES:

When you have completed this chapter, you should be able to:

- List the three major emissions that are the by-products of internal combustion.
- Describe the various emission control systems, both pre- and post-combustion types.
- Explain the principle of the catalytic converter, how the various types of converters work and what they control.
- List the two types of emission control filters.
- Describe where emission recycling system hoses are used.

In a society that has become increasingly dependent on the automobile, one of the inevitable side effects has been the emission of pollutants into the air that are the by-products of the internal combustion engine.

To understand these emissions and how they're created, we must first review the process that takes place inside the engine.



(Figure 43) Combustion.

For any organic combustion to occur, three basic elements are required: fuel, oxygen and heat. Under ideal conditions, combustion produces heat, carbon dioxide (CO_2), and water vapor (H_2O). But in almost every internal combustion reaction, other by-products are produced.

The three major pollutants caused by the operation of the internal combustion engine—carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NO_x)—have been determined to be hazardous to human health. Legislation has been passed which limits the maximum

levels of these pollutants which can be emitted by the cars and light trucks sold in the United States.

- Carbon Monoxide (CO)—Carbon monoxide is a molecule made up of equal parts of carbon and oxygen. It is a colorless, odorless gas, and is one of the results of incomplete combustion. CO is extremely poisonous. By weight, carbon monoxide accounts for about 47% of air pollution.
- Hydrocarbons (HC)—Hydrocarbons are made up of carbon and hydrogen atoms in various combinations. They are the product of any engine that does not operate at 100% efficiency using a hydrocarbon fuel. Hydrocarbons are a major component in the formation of photochemical smog.
- Oxides of Nitrogen (NO_x)—Oxides of nitrogen consist of nitrogen combined with varying amounts of oxygen. NO_x is produced by heat and pressure during the combustion process. NO_x is also a main component of photochemical smog.

Photochemical smog results when HC and NO_x are combined in the presence of bright sunlight. Smog, originally thought to be a combination of smoke and fog, is actually the formation of ozone, nitrogen dioxide and nitrogen nitrate when HC, NO_x and bright sunlight are combined.

Exhaust systems also emit lead and carbon (soot). Lead is being eliminated from gasoline for three reasons: because it is such a hazardous pollutant, because engines are being designed which no longer need it as a lubricating agent, and because lead in an exhaust system can rapidly destroy the efficiency of a catalytic converter.

Carbon or soot is a by-product of incomplete combustion in a diesel engine. There are currently no federal standards for soot emissions. One reason is that a properly adjusted engine emits very little soot. Another is that no effective controls have been developed to contain or trap soot.

EMISSION CONTROL SYSTEMS

There are two basic types of emission control systems: those which prevent the formation of pollutants ("pre-combustion" systems—the