Detailed results of DEEP projects are available at ***www.deep.org***

Glossary of Terms

Additives
Chemicals added to fuel in very small quantities to improve combustion and/or to lower emissions.

Aftertreatment Devices
Devices which remove pollutants from exhaust gases after the gas leaves the combustion chamber (e.g., catalytic converters or diesel particulate filters).

Air Toxics
Toxic air pollutants, as classified by pertinent regulations. Examples of substances classified as air toxics by the US Clean Air Act include acetaldehyde, benzene, 1,3-butadiene, formaldehyde, and polycyclic organic matter (POM). California air toxics regulations also classify diesel exhaust particulates as a toxic air contaminant.

Ambient
Pertaining to the surrounding air, as opposed to the undiluted exhaust gas.

Biodiesel
Renewable fuel derived from vegetable oils, animal fats, or other feedstocks, for use in diesel engines. Manufactured in a process where the feedstock is reacted with methanol. Chemically, biodiesel is a mixture of methyl esters of long chain fatty acids.

Carbon Dioxide (CO_2)
A colorless, odorless, non-toxic gas. It is one of main products of fossil-fuel combustion. Carbon dioxide is a greenhouse gas that contributes to the potential for global warming.

Carbon Monoxide (CO)
A colorless, odorless and toxic gas. It blocks the lungs' ability to obtain oxygen. CO is produced by incomplete combustion of fossil fuels and is a major air pollutant. Compression ignition (diesel) engines generate significantly lower CO emissions than spark ignited engines.

Carcinogens
Substances known to cause cancer.

Catalyst
A substance which influences the rate of a chemical reaction but is not one of the original reactants or final products and is not consumed or altered in the reaction. Catalysts are used in many processes in the chemical and petroleum industries. Emission control catalysts are used to promote reactions that change exhaust pollutants from internal combustion engines into less harmful substances.

Cetane Index
A calculated value, derived from fuel density and volatility, giving a reasonably close approximation to cetane number.

Cetane Number
A measure of ignition quality of diesel fuel. The higher the cetane number the easier the fuel ignites when injected into an engine, resulting in lower emissions.

Compression Ignition (CI)
The form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

Cordierite
A ceramic material of the formula $2MgO\text{-}2Al_2O_3\text{-}5SiO_2$ which is used in many automotive catalyst substrates and ceramic diesel particulate filters.

Diesel Oxidation Catalyst (DOC)
Catalyst promoting oxidation processes in diesel exhaust. Usually designed to reduce emissions of the organic fraction of diesel particulates, gas-phase hydrocarbons, and carbon monoxide.

Diesel Particulate Filter (DPF)
A device which physically captures diesel particulates, preventing their discharge from the tailpipe. Collected particulates need to be removed from the filter, usually by continuous or periodic oxidation ("burning off") in a process called *regeneration*.

Diesel Particulate Matter (DPM)
~~P~~articles found in diesel exhaust. Most emission regulations specify DPM measurement methods in

which particulates are sampled on filters from cooled exhaust gas. The cooling causes condensation of vapors in the gas sampling train. Thus, the DPM is composed of both solid and liquid particles and is generally classified into three fractions: (1) inorganic carbon (soot), (2) organic fraction (often referred to as SOF or VOF), and (3) sulfate fraction (hydrated sulfuric acid).

Direct Injection (DI)

In diesel engines with direct injection the combustion chamber is not divided and fuel is injected directly to the cylinder.

Elemental Carbon (EC)

Inorganic carbon, as opposed to carbon in organic compounds, sometimes used as a surrogate measure for diesel particulate matter, especially in occupational health environments. Elemental carbon usually accounts for 40-60% of the total DPM mass.

Gravimetric

Relating to measurement by weight.

Indirect Injection (IDI)

In diesel engines with indirect injection the fuel is injected to an auxiliary pre-chamber. Combustion starts in the prechamber and continues in the cylinder.

Inorganic Substances

Chemical compounds that, unlike *organic* compounds, do not contain carbon atoms combined with hydrogen. Inorganic substances include all non-carbon compounds, as well as some simple carbon compounds, such as carbon monoxide, carbon dioxide, carbonate salts, or forms of pure carbon itself (graphite, diamond).

Lean NO_x Catalyst (LNC)

Catalyst designed to reduce nitrogen oxides from diesel or spark-ignited engine exhaust gases under net oxidizing conditions, i.e., in the presence of large amounts of oxygen.

Micron (µm)

A unit of length equal to one millionth of a meter. Called also *micrometer*.

National Institute for Occupational Safety and Health (NIOSH)

U.S. federal agency responsible for conducting research and making recommendations for the prevention of work-related disease and injury.

Nitrogen Oxides (NO_x)

Several air-polluting gases composed of nitrogen and oxygen, and which play an important role in the formation of smog. Nitrogen oxides are collectively referred to as "NO_x", where "x" represents a changing proportion of oxygen to nitrogen. Internal combustion engines are significant contributors to worldwide nitrogen oxide emissions. For the purpose of emission regulations, NO_x is composed of colorless nitric oxide (NO), and the reddish-brown, very toxic and reactive nitrogen dioxide (NO_2). Other nitrogen oxides, such as nitrous oxide N_2O (the anesthetic "laughing gas"), are not regulated emissions.

Organic Substances

Chemical compounds that contain carbon combined with hydrogen. It was once believed that organic compounds were exclusively produced by living organisms. Today, a number of organic compounds are synthesized from inorganic ones. Carbon can link with itself forming long carbon chains and its chemistry is far more complex than that of other elements. An example of organic compounds is the hydrocarbons found in fossil fuels.

Oxidation

A chemical reaction which changes an element from a lower to a higher oxidation state (frequently realized by a combination with oxygen atoms).

Polycyclic Organic Matter (POM)

A class of air toxics defined in the US Clean Air Act as compounds with more than one benzene ring and a boiling point of 100°C and higher. Includes practically all of diesel PAH material.

Polynuclear Aromatic Hydrocarbons (PAH)

Aromatic hydrocarbons with two or more (up to five or six) benzene rings joined in various, more or less clustered forms.

Reduction

A chemical reaction which changes an element from a higher to a lower oxidation state (e.g., by removing oxygen atoms from oxygen-containing compounds). Chemically, reduction is the opposite process to *oxidation*.

Respirable Combustible Dust (RCD)

A method of measuring ambient DPM exposures using a combustion process. Used in underground mines in Canada.

Selective Catalytic Reduction (SCR)

Term frequently used as a synonym for catalytic reduction of NO_x in diesel exhaust or flue gases by nitrogen containing compounds, such as ammonia or urea. Such SCR systems are commercially

available for NOx control in stationary applications. However, "selective catalytic reduction" is a generic term, which is also used in regards to other reactions.

Size Selective Sampling (SSS)

A method of measuring airborne DPM exposures through a mechanical separation of particles into two fractions: above and below (typically) 0.8 µm, followed by weighing of the smaller sized particles.

Soluble Organic Fraction (SOF)

The organic fraction of diesel particulates. SOF includes heavy hydrocarbons derived from the fuel and from the engine lubricating oil. The term "soluble" originates from the analytical method used to measure SOF which uses solvents to dissolve and isolate these hydrocarbons to measure them.

Substrate

A ceramic or metallic honeycomb-like structure inside a catalytic converter, called also a catalyst support. Exhaust gases flowing through the substrate channels contact the catalyst, such as platinum or palladium, which is coated on the channel walls. Diesel particulate filter substrates are honeycombs similar to catalytic converters, but with alternate channel ends plugged to force gas flow through their porous walls.

Total Particulate Matter (TPM)

The total particulate matter emissions including all fractions of diesel particulates, i.e. the carbonaceous, organic (SOF), and sulfate particulates.

Threshold Limit Value (TLV)

Time-weighted average concentration of an air pollutant at the workplace for a conventional 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed without adverse health effects (this definition after the TLV Committee of the American Conference of Governmental Industrial Hygienists).

Total Carbon (TC)

The sum of the elemental carbon and organic carbon associated with diesel particulates. Typically amounts to 80-85% of the total DPM mass.

Turbo Lag

The time delay between increased injection of fuel (such as from pressing the accelerator pedal), and the delivery of air to the intake manifold by the turbocharger. This phenomenon may cause black smoke emissions in some turbocharged diesel engines during acceleration.

Turbocharging

A process of compressing the engine intake air charge in order to allow more air and fuel into the cylinder and, thus, to increase the engine power output. The compressor, called the turbocharger, is driven by an exhaust gas propelled turbine.

Volatile Organic Compounds (VOC)

Hydrocarbon-based gases and vapors released through evaporation or combustion. The term VOC is usually used in regard to stationary emission sources.

Volatile Organic Fraction (VOF)

The organic fraction of diesel particulate matter as determined by vacuum evaporation. It may or may not be equivalent to the SOF fraction. Depending on the exact analytical procedure, the VOF may include the organic material (SOF) as well as some of the sulfate particulates which, being composed primarily of sulfuric acid and water, are also volatile.

White Smoke

The smoke emitted during a cold start from a diesel engine, composed mainly of unburnt fuel and particulate matter.