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DUAL FUEL (NATURAL GAS/DIESEL) ENGINES: OPERATION, APPLICATIONS & CONTRIBUTION

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There are an increasing number of dual fuel, natural gas/diesel engines in operation worldwide. They provide a relatively easy and inexpensive option to higher polluting diesel engines in a wide range of vehicles. The degree of sophistication of these engines varies depending upon fuel control strategies, however, they have proven reliable in many parts of the world and continue to expand their market share, particularly in regions where diesel pollution is a major concern and health hazard.

OPERATING CHARACTERISTICS AND ADVANTAGES

Most natural gas engines are either *bi-fuel* or *dedicated*. Bi-fuel engines are Otto cycle (spark ignited) that run on *either* natural gas *or* gasoline. The bi-fuel natural gas engine maintains two fuelling systems on board a vehicle: a natural gas system as well as a petrol system. While not necessarily optimised for natural gas operation, they tend to be more 'environmentally friendly' than petrol engines and have the advantage of running on petrol in the event that a natural gas fuelling station is not readily available.

Dedicated natural gas engines are Otto cycle (spark ignited) that are operated *only* on natural gas. They tend to be optimised, that is they have a compression ratio designed to take advantage of the 130 octane of natural gas, and have been designed to take into consideration the combustion characteristics of the fuel so that the engine is very low polluting.

Dual fuel natural gas engines are based upon diesel technology. The primary fuel is natural gas but they are designed to operate interchangeably with diesel as a 'pilot' ignition source (functioning on heat of compression and not with a spark plug). These engines also can operate on 100% diesel fuel. When idling these engines tend to operate on 100% diesel. As the vehicle begins to move to full load performance, an increasing amount of natural gas replaces the diesel fuel to 80% or more. This makes them especially valuable in circumstances where the use of natural gas is desired for environmental or economic reasons but where the natural gas supply is not available in all locations. It also is relatively easy to convert a diesel engine to dual fuel operation.

Some of the dual fuel engines are throttle controlled using a *fumigation* system that adds natural gas to the engine as higher speed is required. Other dual fuel systems are computer controlled to ensure that the optimal ratio of natural gas and diesel fuel is delivered to the engine depending upon load and performance requirements. These systems' performance and emissions vary depending upon operating conditions and the sophistication of the control system, but generally they can achieve much lower emissions diesel engines, especially of NOx and particulate matter.

APPLICATIONS OF DUAL FUEL ENGINES

Dual fuel natural gas/diesel engines are becoming popular in many parts of the world. The more expensive, sophisticated computer control systems are being introduced successfully in North America and Australia, and are being tested in European in anticipation of market entry. But their use in other parts of the world is expanding, particularly in Latin America, India, Pakistan, China and other parts of Asia. They tend to be used in large vehicles such as buses and refuse trucks, but also have applications in smaller commercial diesel engine vehicles.

IMPORTANCE OF DUAL FUEL ENGINES AVAILABILITY

Diesel engines can be converted as dual fuel natural gas engines relatively easily because typically there are no changes in the engine compression ratio, cylinder heads, or basic operation as a diesel cycle engine. Even the sophisticated computer controlled dual fuel systems are being developed as 'bolt on' technologies that can be removed if necessary, to resell the vehicle as a normal diesel engine. These conversions are easy to install and easy to maintain. This flexibility makes these engines very useful in many global markets.

Some cities in various parts of the world are reaching epidemically poor air quality limits and need an immediate remedy to pollution caused by urban diesel vehicles. Natural gas provides both an environmental benefit and, in most markets, a cheaper fuel than refined petroleum products. This compensates economically over the vehicle's lifetime for the additional cost of the natural gas equipment

Furthermore, the companies now developing and supplying these engines and dual fuel systems account for increased economic and employment opportunities in the countries they are located. Currently there are companies in Italy, the United Kingdom, United States, Canada and Australia, to name some, that are supplying a variety of dual fuel engines and technologies. Caterpillar Engine currently offers four different models of dual fuel capable engines that meet U.S. Federal and California emission standards. Detroit Diesel currently is developing a dual fuel, natural gas/diesel engine as well.

Regulations that impede these engines and engine systems from market entry should not be brought into force. Rather, regulations that foster market entry of such dual fuel systems, subject to them meeting national, regional, or worldwide homologation requirements, should be encouraged. Suggested language in ECE Regulation R110 prohibiting dual fuel engines should be amended to allow for the continued use of these systems worldwide.

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