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AEROSPACE INFORMATION REPORT

SAE AIR5373

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Submitted for recognition as an American National Standard

Fuels in Ground Support Equipment (Other Than Gasoline or Diesel)

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1. SCOPE:

This SAE Aerospace Information Report (AIR) is intended as a source of comparative information and is subject to change to keep pace with experience and technical advances. This document describes currently used fuels and fuels which may be used in the future. Conventional gasoline and diesel fuels are intentionally omitted from this document.

1.1 Purpose:

The purpose of this document is to provide basic information regarding fuels which can be used in aircraft ground support equipment. This document is recommended for use by those engaged in the design, selection, or maintenance of ground support equipment, and their fuel systems.

1.2 Field of Application:

This document is applicable to spark ignition or compression ignition engines, and battery powered electric motors.

CAUTION: Always follow the specific recommendations and guidelines of the engine manufacturer, regarding suitable fuel types for a particular engine. The use of unauthorized fuels may void the warranty and result in damage or injury.

2. APPLICABLE DOCUMENTS:

There are no referenced publications specified herein.

3. TERMINOLOGY:

3.1 SPARK IGNITION ENGINE:

An internal combustion engine utilizing a positive ignition system to ignite the air/fuel charge. All gasoline fueled engines are of the spark ignited type.

3.2 COMPRESSION IGNITION ENGINE:

An internal combustion engine utilizing high compression to ignite the air/fuel charge. All diesel fueled engines are of the compression ignition type.

3.3 STOICHIOMETRIC AIR/FUEL RATIO:

The ideal air/fuel ratio, resulting in complete combustion of all fuel and air. This ratio is dependent on fuel type.

3.4 LEAN AIR/FUEL RATIO:

More air and less fuel than the stoichiometric air/fuel ratio.

3.5 RICH AIR/FUEL RATIO:

More fuel and less air than the stoichiometric air/fuel ratio.

3.6 CARBON MONOXIDE (CO):

Carbon monoxide is produced when combustion takes place with insufficient oxygen. Carbon monoxide emissions can be a concern in spark ignited engines as they are typically operated near stoichiometric at part load and rich at full load. Carbon monoxide emissions are lower for diesel engines as they generally operate in a lean condition.

3.7 HYDROCARBON (HC):

The HC portion of exhaust gas emissions represents incomplete combustion of fuel. Some HC classes, such as methane, are essentially inert and do not react to form smog. Other HC classes react to form smog.

3.8 OXIDES OF NITROGEN (NO_x):

Both nitric oxide (NO) and nitrogen dioxide (NO_2) are collectively grouped as oxides of nitrogen (NO_x). NO_x is a primary constituent of smog. Diesel and gasoline powered engines have similar concentrations of NO_x.

3.9 SULPHUR OXIDES (SO_x):

Both sulphur dioxide (SO_2) and sulphur trioxide (SO_3) are collectively grouped as SO_x. SO_x is the primary cause of acid rain.

3.10 PARTICULATE EMISSION:

Unburned hydrocarbon emission in the solid form of soot. Diesel engines have significant particulate emissions.

3.11 ALTERNATIVE FUEL:

A specific fuel listed in a regulatory document (i.e., Clean Air Act in the U.S., etc.) as an approved alternative fuel. Not all fuels listed in this document are classified as alternative fuels.

4. COMPRESSION IGNITION ENGINES:

4.1 Bio-Diesel:

Bio-diesel is a direct substitute to diesel fuel consisting of a blend of Rapeseed Methyl Ester (RME) and standard diesel fuel. This fuel reduces particulate emissions and increases NO_x emissions.

4.2 Clean Diesel:

Clean diesel is a direct substitute to diesel fuel, and has a significantly reduced sulfur content, relative to standard diesel fuel. SO_x and particulate emissions are reduced.

4.3 Gaseous Fuels:

Gaseous fuels (natural gas and LPG) can be burned in compression ignition engines by utilizing a fumigation system. Fumigation involves a lean mixture of gaseous fuel and a small amount of diesel fuel. Gaseous fuels do not have the self-ignition characteristics of diesel fuel. The diesel fuel is added to provide self-ignition of the air/fuel charge. Dual fuel engines can be designed to work on mostly diesel fuel or mostly gaseous fuel.

4.4 Alcohols:

Alcohol fuels (methanol and ethanol) can be used with direct injection, if the compression ratio is raised, and a glow plug is added for part throttle conditions. Alcohol can also be blended with diesel, via fumigation into the air intake system, similar to the gaseous fuels.

4.5 Jet A:

Jet A can be used as a direct replacement for standard diesel fuel. Jet A has lower lubricity than diesel fuel and may require the use of an upgraded fuel system, or a fuel additive to retain acceptable fuel system life. Engine power is reduced by approximately 5% compared to standard diesel fuel.

5. SPARK IGNITED ENGINES:

5.1 Natural Gas:

Natural gas is available as a liquid or vapor. Low cost, abundance and low emissions are the major advantages of natural gas. Unburned methane and NO_x are the principle pollutants in most applications. Engine power is reduced approximately 15% compared to standard gasoline fuel.

In some applications, it is favorable to operate a dual fuel arrangement. Gasoline and natural gas fuel systems are installed on the same engine, although only one can be used at a time.

5.2 Liquid Petroleum Gas:

One of the most common alternative fuels is liquefied petroleum gas, also known as LPG. Since most LPG fuel systems operate in a lean mode, HC and CO emission levels are lower and NO_x is slightly higher when compared to gasoline. Engine power is reduced approximately 5% compared to standard gasoline fuel.

In some applications, it is favorable to operate a dual fuel arrangement. Gasoline and LPG fuel systems are installed on the same engine, although only one can be used at a time.