ENDCAPE GENERATORS

MADE IN BRITAIN

# FUEL SYSTEMS

## Bulk Storage

The fuel system must supply the diesel engine with a continuous and clean supply of fuel. Bulk fuel is usually stored in a large tank, and the fuel transferred to a smaller, day tank near the engine, by means of an electric motor-driven pump. The system must be located and constructed in accordance with good safety practices and local codes. Any flexible non-metallic lines used to route the fuel inside the building should meet Fire Regulations.

The quantity of fuel stored may also be regulated.

A large capacity storage tank is desirable to encourage bulk purchases and minimise dirt contamination. Maintaining a full tank minimises condensation, particularly if the fuel is seldom used. It may be located either above or below ground level, but the high fuel level in any part of the system must not exceed the height of the injectors in the engine. This prevents any possibility of fuel leaking by the injectors into the cylinder.

The storage tank fill tube should be located for convenience and safety of the filling operation. A vent must be provided to relieve air pressure created by filling and prevent a vacuum forming as fuel is consumed.

A means of periodically drawing water and sediment from the tank must be provided. The tank bottom must be rounded and tilted about $2^{o}$ to allow complete removal of these contaminants. Ground settling must also be taken into account when installing the tank to ensure that the drain cock remains at the lowest level. In underground tanks, water may be removed by pumping through a tube placed down the fill pipe. Avoid seasonal settling by burying the tank below the frost line.

If a day tank is not used, the bulk tank must be located to provide a ready fuel supply to the engine mounted transfer pump.

Copper bearing steel tanks are preferable but black iron tanks and fittings are satisfactory. Galvanised fittings or tanks should be avoided, because of possible reactions with fuel impurities clogging the fuel filter.

The delivery line for carrying the fuel to the engine mounted fuel transfer pump and the return line for carrying excess fuel back to the tank should be no smaller in size than the fittings on the engine. If the distance from the fuel tank to the engine exceeds 30’ (9.15 m), or if ambient temperature is extremely low, larger fuel supply and return lines should be used to ensure adequate flow.

The fuel line may be constructed from steel, black iron pipe, or from copper tubing; galvanised pipe or any zinc bearing alloy **must not be used**. The overflow line from the day tank (or, if no day tank is used, the fuel return line from the engine) should be of the same material and one size larger.

The return line should enter the top of the tank and contain no shut-off valves. Avoid dips in this line so that air may pass freely and prevent any vacuum in the fuel system. The fuel suction line should be positioned to remove fuel from a point about 2" (5.1 cm) above the bottom and, if possible, at the opposite end of the tank to the return line. If the fuel line enters the top of the tank, a pipe should be provided inside the tank to extend the line to the proper distance from the bottom.

Joint cement which may be affected by fuel should not be used in any part of the system. All connections should also be made without dependence in any way on gaskets. A length of flexible fuel line should be installed between the pipe from the fuel source (bulk storage or day tank) and the engine fuel inlet and return to prevent vibration damage to the pipes and fittings.

**Auxiliary Tank**

Auxiliary or "day tanks" are desirable if the main fuel tanks are located more than 50' (15.25 m) from the engine, or located above the engine, or are more than 12' (3.65 m) below the engine. Total suction head should not exceed 12' (3.65 m). Although they will not aid the engine in fast starting, they do offer a convenient and ready storage of fuel. Day tanks also provide a settling reservoir so water and sediment can separate from the fuel.

The auxiliary tank is located so that the level of the fuel is no higher than the fuel injection valves on the engine. The tank should be close enough to the engine to minimise total suction lift.

**Filters**

Clean fuel filters ensure maximum engine life and dependability. Anything else will endanger these characteristics. The engine filter protects the fuel injection pumps and nozzles. The incoming fuel must never bypass these filters.

Primary filters with 0.012" screens are available to extend the life of the engine filter and the transfer pump. Water and sediment traps and filters can also be included upstream of the transfer pump, but pump performance must not be restricted.

In warm climates with large bulk storage, the diesel fuel may require full filtering every six to twelve months. Every two years the fuel supply should be renewed to remove water, scale and bacterial growth.

**Fuel Selection**

**Engine Requirements**

The fuel normally recommended for diesel generator sets is No. 2 furnace oil. When this fuel is also used for heating the building, a common storage tank for both the heating plant and the generator set is practical. In addition to reducing installation costs, this arrangement may reduce fuel costs, as a consequence of quantity purchasing, and also eliminate fuel deterioration concerns.

Diesel engines have the capacity to burn a wide variety of fuels. In general, the engine can use the lowest priced distillate fuel which meets the following requirements (fuel condition as delivered to the engine fuel filters), but you need clarification from each engine manufacturer.

The following additional information describes certain characteristics and their relation to engine performance.

A. Cetane Number: This index ignition quality is determined in a special engine test by comparison with fuels used as standards for high and low cetane numbers.

B. Sulphur: Since the advent of high detergent oils, sulphur content has become less critical. A limit of 0.4% maximum is used for engines, without reducing oil change periods. Oil change periods are reduced with higher sulphur fuel.

C. Gravity: The measurement is an index of the weight of a measured volume of fuel. Lower API ratings indicate heavier fuel which has a higher calorific value.

D. Viscosity: This factor is a time measure: flow resistance of a fuel. Some low viscosity fuels are lubricants; a viscosity which is too high makes for poor fuel atomisation, thereby decreasing combustion efficiency.

E. Distillation: This involves the heating of crude oil to relatively high temperatures. The vapour which results is drawn off at various temperature ranges, producing fuels of different types. The lighter fuels such as gasoline come off first, and the heavier fuels last.

F. Flash Point : The lowest temperature at which the fuel will give off sufficient vapour to ignite momentarily when a flame is applied.

G. Pour Point: This denotes the lowest temperature at which fuel will flow or pour.

H. Water and Sediment: The percentage by volume of water and foreign material which may be removed from the fuel by centrifuging. No more than a trace should be present.

I. Carbon Residue: Percentage by weight of dry carbon remaining when fuel is ignited and allowed to burn until no liquid remains.

J. Ash: Percentage by weight of dirt, dust, sand, and other foreign matter remaining after combustion.

K. Corrosion: To determine corrosion, a polished copper strip is immersed in the fuel for three hours at 122$^{o}$ F (50 $^{o}$ C). Any fuel imparting more than a slight discoloration should be rejected.

The customer should order as heavy a fuel as his diesel engine and temperature conditions permit. Fuel costs can represent approximately 80% of total operating costs for an engine. It is good economics to look closely at the largest cost first.

**Fuel Specification Requirements**

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| Cetane Number (Pre-combustion Chamber Engines): | 35 minimum |
| Viscosity: | 100 SUS at 100° F maximum |
| Pour Point: | 10° F (6° C) below ambient temperature |
| Cloud Point: | Not higher than ambient temperature |
| Sulphur: | Adjust oil change period for high sulphur fuel |
| Water and Sediment: | 0.1% maximum |

Some fuel specifications that meet the above requirements:-

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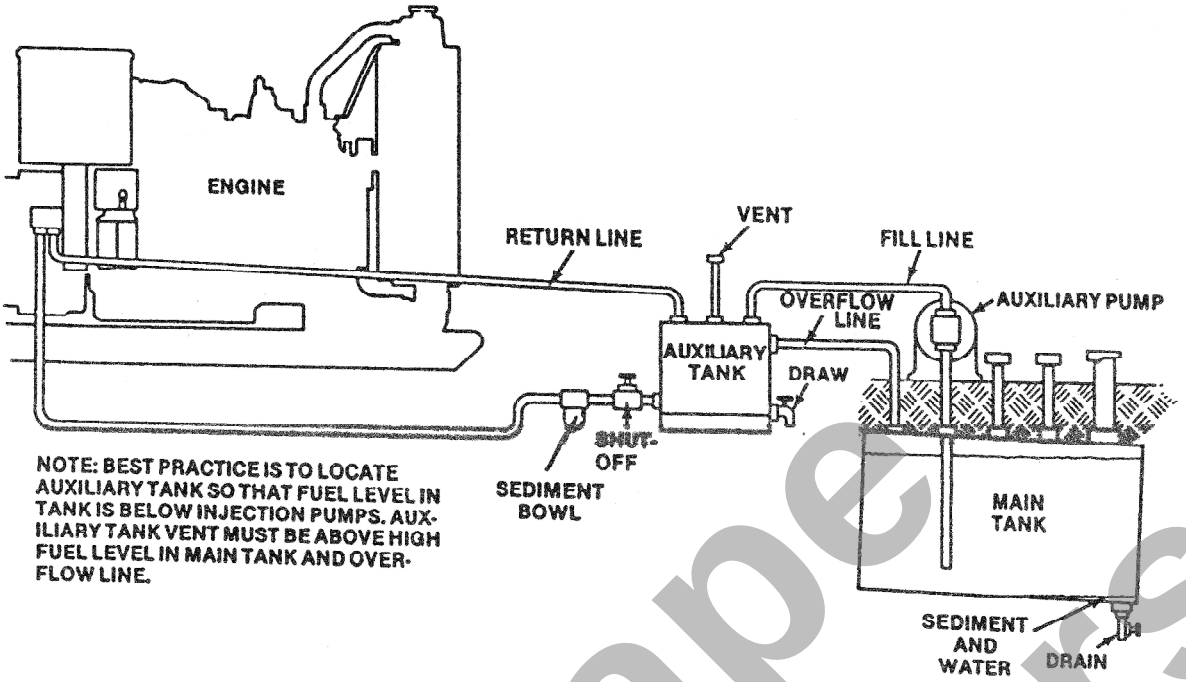
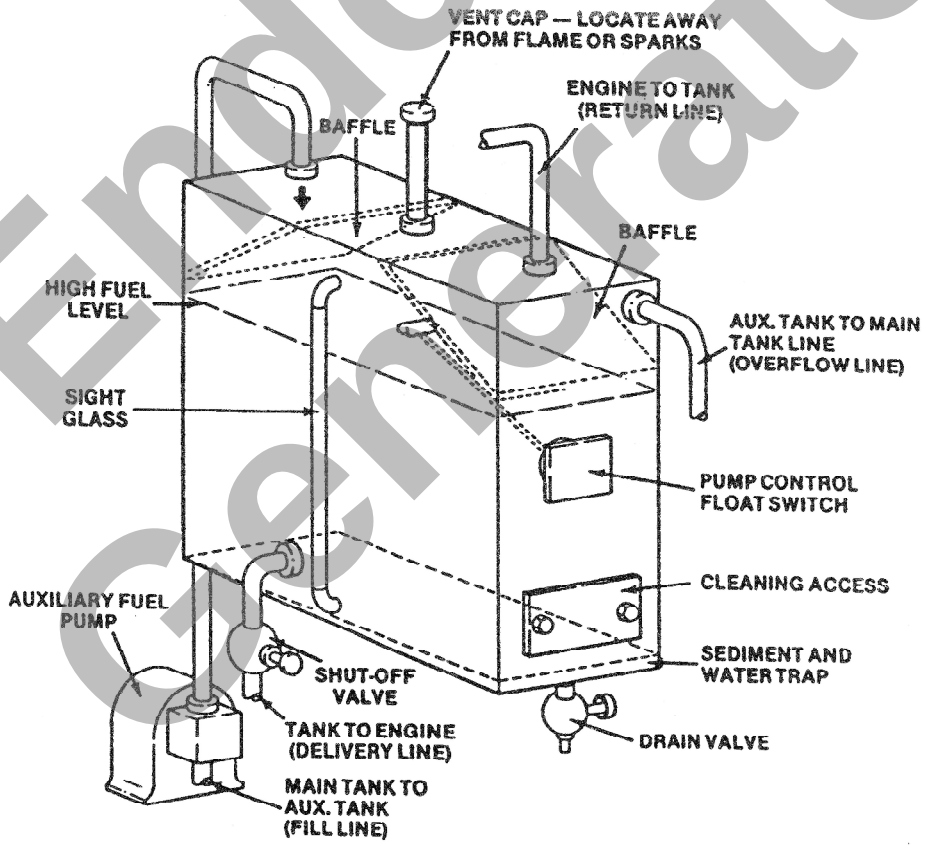
| **ASTM D396** | No. 1 and No. 2 Fuels (Burner Fuels) |
| **ASTM D975** | No. 1-D and No. 2-D Diesel Fuel Oil |
| **BS2869** | Class A1, A2, B1 and B2 Engine Fuels |
| **BS2869** | Class C, C1 and C2 and Class D Burner Fuel |
| **DIN51601** | Diesel Fuel |
| **DIN51603** | EL Heating Oil |




AUXILIARY FUEL TANK



Endcape Ltd, Interpower Building, Pickering North Yorkshire, ENGLAND
Email: sales@endcape.com Web: www.endcape.com Tel: +44(0)1751 476370