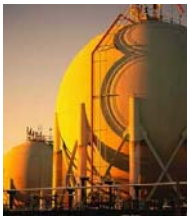
Pumping Fuel & Fuel Oil

Fuels & Rotary Pumps

Though the handling of fuel oil is not necessarily "challenging," the reliable handling of fuel oils is critical for heating and transportation systems. Rotary pumps are an excellent means of loading/unloading, transfer, and circulating fuels. Some examples include:

- Diesel Fuel (#2 Fuel Oil)
- Heavy Oils (#5 & #6 Fuel Oils)
- Crude Oil
- Gasoline
- Kerosene (#1 Fuel Oil)
- Jet Fuel (JP4 & JP5)
- LP Gas



As the following table shows, application details also vary widely.

Capacities	0.1 GPM (0,02 m^3/hr)	to	1,000+ GPM (230+ m^3/hr)
Pressures	25 PSI (1.75 BAR)	to	250 PSI (17.5 BAR)
Viscosities	30 SSU (1 cSt)	to	7,500 SSU (1,650 cSt)
Temperatures	Ambient Outdoor	to	250°F (120°C)

These variances from application to application result in a wide range of pump constructions and drives. Despite this variance, there are some common guidelines to follow to insure smooth operation and long pump life.

Do's & Don'ts

Slower speeds, lower pressures, and materials designed for the anticipated temperature will pay off in longer trouble-free service, even if oil properties vary from those originally anticipated. Additionally, be sure to…

- Install the pump as close as possible to the supply tank.
- Leave working space around the pumping unit.
- Use large, short, and straight suction piping. "Short and fat" pipes are excellent.
- Install a strainer in the suction line.
- Double-check alignment after the unit is mounted and the piping is hooked up.
- Provide overpressure protection for the discharge side of the pump, either in-line or on the pump.
- Extend service life with preventive maintenance procedures such as periodic lubrication, adjustment of end clearance, and examination of internal parts.
- Obtain, read, and keep the maintenance instructions furnished with your pump, drive, and other system equipment.

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Conversely, **DO NOT**…

- Run a pump at faster than approved speeds.
- Run a pump at higher than approved pressures.
- Run a pump at higher than approved temperatures.
- Use extra large, extra long suction line with a suction lift.

Installing a vacuum gauge and a pressure gauge on or near the pump will also help lengthen service life. Gauges provide a window into what is happening inside the pumping system. Properly interpreted readings can give clues to the nature of many problems. Long-term readings will show gradual changes taking place within the system.

Given the availability of certain fuels at any particular time, many fuel oil systems now accommodate various fuels (#2 through # 6 fuel oil for example). Each fuel oil differs slightly in properties and these differences place unique demands on the system. Be sure to discuss these differences with your pump/system supplier.

Handling Crude Oil

Crude oil is a naturally occurring liquid found in formations of the earth. It's typically extracted by large reciprocating pumps called pump jacks. The crude oil is then refined into fuels such as gasoline, diesel, kerosene, and other fuel oils. Characteristics such as color and viscosity vary from site to site, but typically fall into the following ranges:

Location	Viscosity
Texas, Oklahoma	40-780 SSU (4-170 cSt) at 60°F (15°C)
	34-210 SSU (2.5-45 cSt) at 100°F (38°C)
Wyoming, Montana	75-1,200 SSU (15-250 cSt) at 60°F (15°C)
	45-300 SSU (5.5-65 cSt) at 100°F (38°C)
California	40-4,800 SSU (4-1,050 cSt) at 60°F (15°C)
	34-700 SSU (2.5-150 cSt) at 100°F (38°C)
Pennsylvania	45-200 SSU (5.5-40 cSt) at 60°F (15°C)
	38-90 SSU (3.5-18 cSt) at 100°F (38°C)

Due to crude oil's high viscosity and wide range of application conditions, rotary pumps are well suited to handling crude oil. Rotary pumps are used for transport, refining, and for high working pressure pipeline sampling applications. While compatible with cast iron, pumps for refinery and pipeline sampling applications are typically steel. Pump construction will depend on the particular oil and application.

Many crude oils contain dirt, sand, and other particulate prior to refining. Often pumps for dirty crude oil are supplied with hardened parts to prevent the particulate from damaging the pump.

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Handling Gasoline and Light Fuel Oils

Light oils such as gasoline, kerosene, and jet fuels have low boiling points and as such, are the first to be distilled off from crude oil. They are used primarily as fuels. All are fairly easy to handle, but are thin (29-35 SSU / 0.9-2.5 cSt), non-lubricating, and have high vapor pressures. Lifts (when the pump port is above the liquid level in the supply tank) should be kept to 6 feet or less to prevent vaporizing the liquid at the pump inlet. Be sure to check the system NPSH to make sure it's adequate.

Handling #2 & #6 Fuel Oil

Fuel oils in the United States have six classifications based on their boiling points, composition, and purpose. #2 and #6 are most commonly used. #2 fuel oil is used for truck fuel, heating, and power generation. #6 fuel oil is used for ship fuel (commonly referred to as Bunker C oil), heating (though usually reserved for larger buildings), and power generation. Typical application conditions for handling fuel oils are as follows:

Viscosity:

- #2 fuel oil ranges from 2.5 to 7 cSt (35 to 50 SSU), but may get even thicker at temperatures below freezing because of congealing wax.
- #6 fuel oil ranges from 20 to 1,650 cSt (100 to 7,500 SSU) in the normal handling temperature range, but may vary widely depending on the source of the oil, sulfur content, and blend.

Normal Handling Temperatures

- #2 fuel oil is typically handled in the range of -20° to 100°F (-30° to 38°C).
- #6 fuel oil is typically handled above 100°F (38°C) to reduce the viscosity for ease of handling.
- Unheated, buried tanks with two or more feet of ground cover will normally stay within a range of 40° to 70°F (4.5° to 21°C), depending on locale and time of year.

Lift should be kept to a minimum. For #2 fuel oil the vacuum reading at the pump should not exceed 15" Hg under the worst conditions. Lifts should be kept to under 10 feet and may be even less depending on suction piping length, fittings, and priming conditions. The vapor pressure of #2 fuel oil is less than 0.1 PSI (0.0069 BAR) at ambient temperatures. If the vacuum at the pump exceeds 15" Hg, entrained air in the oil may cause capacity and noise problems. Under vacuum conditions the air will expand and the pump will not deliver its full capacity of oil. While the rotary pumps are self priming, a foot valve is typically recommended to minimize the chance for losing suction.

For #6 fuel oil under the worst conditions (i.e., highest viscosity and lowest liquid level), position the pump and select pipe and fitting size to give vacuum readings of 15" Hg or less. The viscosity of #6 Fuel Oil varies from one tank car load to the next. Some tank cars contain "light ends" which affect viscosity and may cause lift problems.

For systems to handle #2 or #6 fuel oil, designing a system to handle either liquid presents problems in sizing the suction lift, fittings, and strainer.

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Large rotary pumps are often used in the refining process of fuel oil as well as for transport and delivery. Upon delivery, smaller rotary pumps take over (usually 30 GPM & smaller), often assembled as a duplex pump system complete with drive equipment, strainers, valves, and controls *(figure 1)*. These duplex systems insure continuous oil delivery to critical applications such as:

- Fuel supply to diesel generators used for backup power
- Transferring fuel from storage tanks to smaller day tanks
- Boosting Low Pressure Fuel Oil to Burner Pressure on Oil-Fired Furnaces
- Recirculation Oil Filtration System to Ensure Clean and/or Water-Free Oil

Depending on the service and system location, these pumps may require special construction and testing (i.e. pumps which are UL-343 listed for fuel oil service).

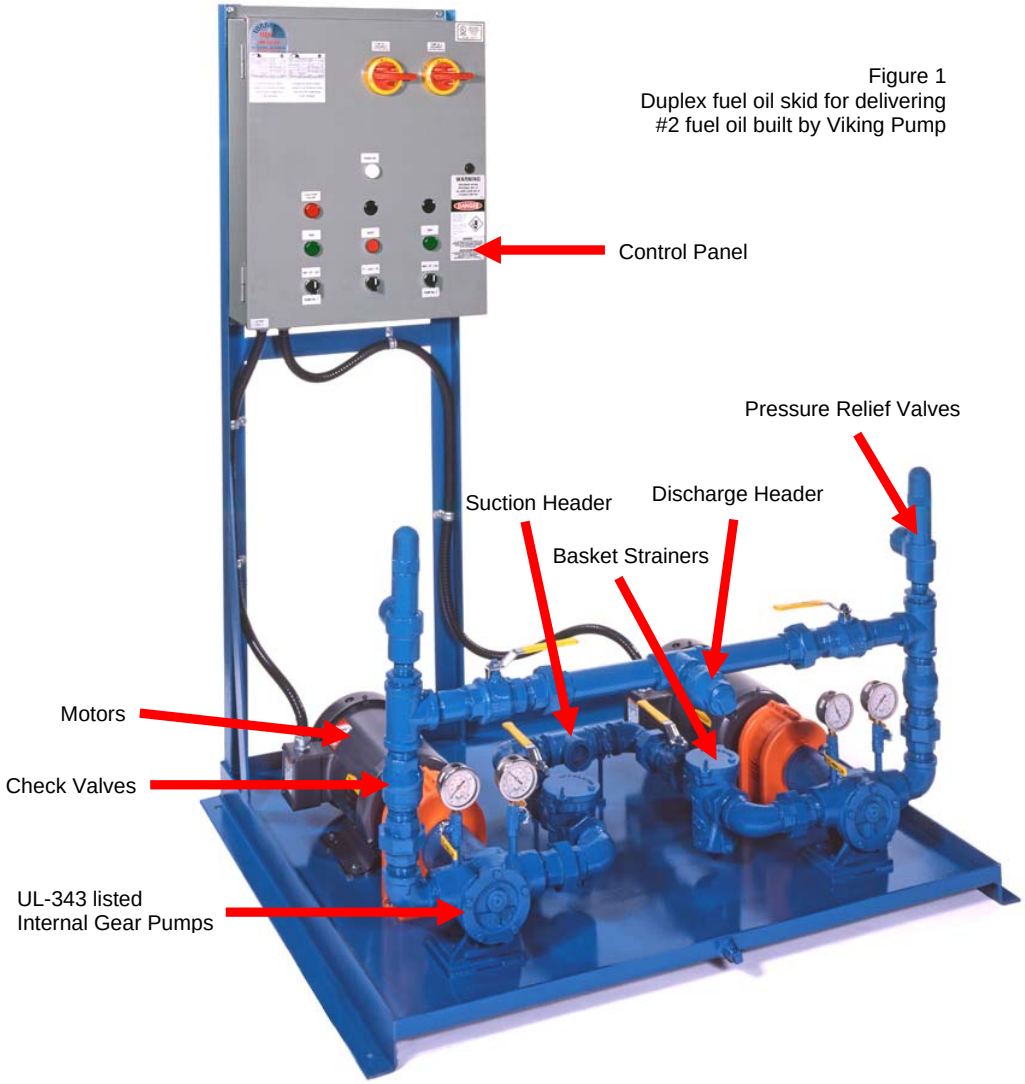

Figure 1
Duplex fuel oil skid for delivering
#2 fuel oil built by Viking Pump

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Handling LP Gas (Propane)

Propane is normally a gas, but is compressible to keep in its liquid state for storage and transport. LP gas is used for heating, as a cooking fuel for barbeques and portable stoves, and as fuel in some vehicles such as buses, locomotives, and fork lifts.

Rotary pumps are used for bulk plant transfer service, truck unloading, and bottle filling. Due to the high working pressure, high vapor pressure, and extremely low viscosity, LP gas pumps require special construction *(figure 2)*.

Due to the high vapor pressure, NPSH must not be overlooked. Placing the pump too far from the supply tank, allowing the LP gas to get too hot, or running the pump too fast may lead to cavitation, which in turn will lead to noise, reduced capacity, and reduced pump life. The LP gas pump in figure 1 features a return-to-tank pressure relief valve. This valve allows the LP gas to flow back to the supply tank when the discharge valve is closed, rather than cycling the gas through the pump. By doing so, less heat is imparted to the LP gas and the gas is not allowed to boil in the pump.

Figure 2
Cutaway view of a UL-51 listed Rotary Internal Gear Pump for handling LP gas

For Further Information

This document is just for general information purposes. The internet is a great source for further information including www.pumpschool.com, but before selecting a pump for fuel it's important to speak with the pump / system representatives to address all aspects of the application. Topics including seal selection, drive sizing, and NPSH, must all be addressed to insure years of reliable fuel handling.

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