burner pressures. An air vent or bleed will help get rid of the air on the discharge side of the pump, but it is a nuisance if it is necessary to use it very often. Again a compromise seems to work out quite well. Line size for suction piping in a system with a lift that may be used for either No. 2 or No. 6 oil should be no more than one size larger than the pump port size. If calculations indicate a need for a larger pipe, consider the following: lower the capacity requirements, reduce the lift, shorten the piping run or relocate the pump. With regard to the check valve, consider one in the first horizontal run above the storage tank.

PUMP RECOMMENDATIONS

- Heavy duty or general purpose internal gear pumps depending on service duty and differential pressure; external gear pumps for low flow or high pressure
- Steel fitted and jacketing as viscosity requires
- Single mechanical seals (Viton elastomers recommended for No. 6 due to varying composition)
- Carbon bushings for No. 2 fuel oil. Bronze bushings for No. 6 may be suitable depending on viscosity, but are not recommended for No. 2. Typically No. 6 contains some amount of solids and abrasive resistant options such as hardened iron bushings may be needed.
- If the pump will be handling both No. 2 and No. 6, the clearances in the pump should be set with no more than is required for temperature or 'step 1' clearances. Clearances for high viscosity reduce the motor power required to turn the pump, but are not required for successful operation. If too much clearance is added to the pump for No.6 fuel oil, the slip will increase and the desired flow will not be met on the thinner No. 2 fuel oil.
- Standard construction of Viking pumps are rated to at least 225°F (107°C). High temperature construction is available for most models.
- Some Viking pumps are U.L. listed for fuel oil transfer or in the assembly of power operated oil burners. These pumps are designated with a -X at the end of the model numbers.

STRAINERS

Strainers are designed to keep large solids out of the pump. No. 2 fuel oil applications can potentially use strainers with a very fine mesh due to its low viscosity. The actual mesh size will depend on the user's preference, experience and is limited by the suction conditions. No. 6 fuel oil applications typically use strainers that are coarser than No. 10 mesh because of the higher viscosity. If the pump will be handling both No. 2 and No. 6, using the strainer for a No. 2 fuel oil will cause too great of a pressure drop when pumping a No. 6 fuel oil. Either use the strainer for No. 6 all the time or change baskets when changing oils. If a lower pressure drop is needed, use an oversized strainer.

During the start up of a new system, a strainer is vital to make sure that pipe scale, thread chips, dirt and other foreign particles do not get into the pump. A strainer should not have more than 0.14 BAR (2 PSI) pressure drop across it when clean and should be cleaned when the pressure drop reaches 0.3 BAR (5 PSI) or as needed to allow adequate suction conditions.

PRESSURE RELIEF VALVES

Any positive displacement pump should have a pressure relief valve or there should be some provision in the system or drive to protect the pump and piping from excessive pressures in case of unintentional closing of the discharge line. All Viking pumps are fitted with integral relief valves as standard. Often a second pressure relief valve is mounted in the line set at a lower pressure than the one on the pump. This keeps the pump mounted valve from bypassing except in case of an emergency. Continual bypassing of the pump mounted valve can cause heat buildup, which creates vapor bubbles. These decrease capacity and cause excessive pump wear. Inline pressure relief valves should be mounted near the pump or if this is not possible the setting should be made, keeping in mind that there may be a significant pressure drop between the pump and the valve inlet. Also consider the size of the return line from the valve; a small line may have significant pressure drop which would add to the differential pressure across the valve.

For more information, contact your local Authorized Viking Pump Distributor or contact Viking at:

VIKING PUMP, INC.
A Unit of IDEX Corporation
406 State Street
Cedar Falls, Iowa 50613-0008 U.S.A.
Telephone: (319) 266-1741
Fax: (319) 273-8157
E-mail: info.viking@idexcorp.com
Web site: www.vikingpump.com

CANADA
Windsor, Ontario
Phone: (519) 256-5438
Fax: (519) 256-5070
www.vikingpumpcanada.com

EUROPE
Shannon, Ireland
Phone: +353 (61) 471933
Fax: +353 (61) 475046
www.vikingpumpeurope.co.uk

LATIN AMERICA
Mexico D.F., C.P.
Phone: +52 (55) 5255-1357
Fax: +52 (55) 5255-1356

Brazil - Sao Paulo
Phone: +55 (19) 3871-3500
Fax: +55 (19) 3871-6400

ASIA-PACIFIC GROUP
Singapore
Phone: +65-6763-6633
Fax: +65-6764-4020
www.idexfmt-asia.com

China - Shanghai
Phone: +86-21-5241-5599
Fax: +86-21-5241-8339
www.idexfmt-asia.com

China - Beijing
Phone: +86-10-6566-9090
Fax: +86-10-6567-5152
www.idexfmt-asia.com

China - Guangzhou
Phone: +86-20-3886-6156
Fax: +86-20-3886-2776
www.idexfmt-asia.com

India - Mumbai
Phone: +91-22-66976634
Fax: +91-9820334270
www.idexfmt-asia.com

ASIA-PACIFIC GROUP
China - Chengdu
Phone: +86-28-86767458
Fax: +86-28-86767468
www.idexfmt-asia.com

China - Suzhou
Phone: +86-512-62833000
Fax: +86-512-62833010
www.idexfmt-asia.com

Korea - Seoul
Phone: +82-2-501-3302
Fax: +82-2-556-0788
www.idexfmt-asia.com

Australia & New Zealand
Phone: +61 2 4577 4534
Fax: +61 2 4577 5987
www.idexfmt-asia.com

MIDDLE EAST
IDEX Middle East FZE
Dubai, UAE
Phone: +9714-7017735/40
Fax: +9714-7017741
www.idexfmt-asia.com

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VIKING PUMP

A Unit of IDEX Corporation

AD-22

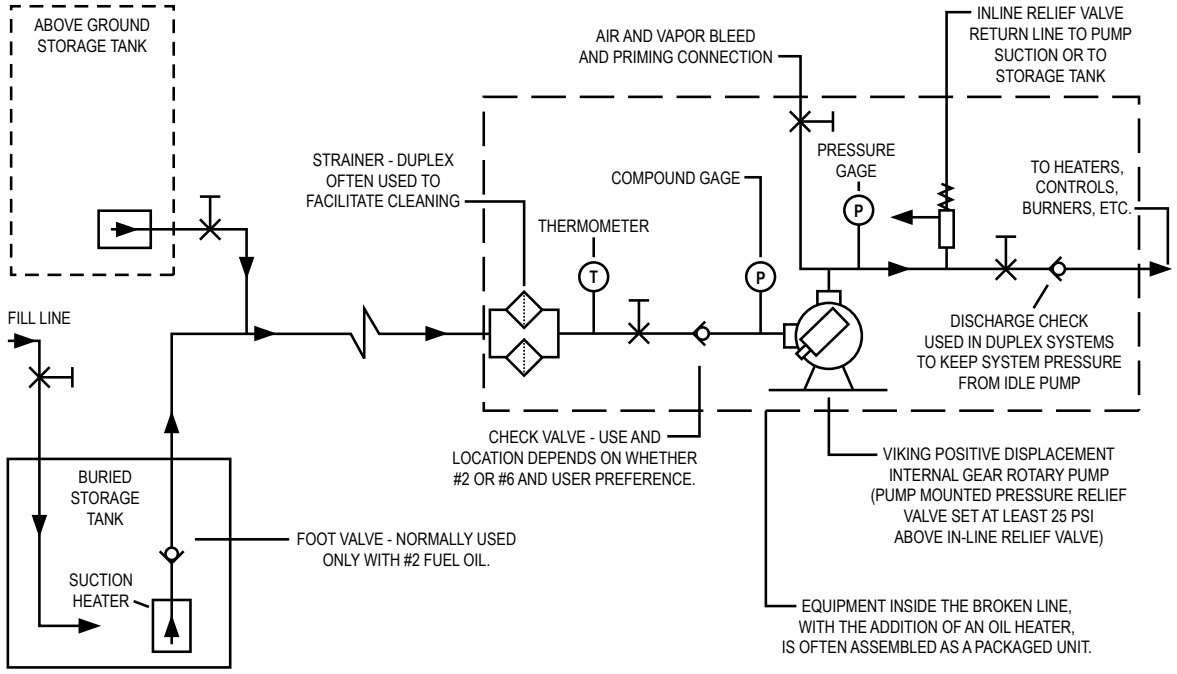
The handling of fuel oils in loading, unloading, transfer, circulating, and burner feed is a large market for the use of Viking internal and external gear pumps. Application details vary widely - capacities range from less than 1 GPM to more than 1000 GPM (4 LPM - 225 M^3/Hr), differential pressures up to and exceeding 250 PSI (17 BAR), viscosities from 1 cSt - 1600 cSt, temperatures up to 250°F (120°C) and over various duty cycles. "Typical" applications include fueling diesel generators, boosting low pressure fuel oil to boilers or furnaces and oil filtration. Viking pumps have been used in all of them. Using past history and experience, selecting a Viking pump for a fuel oil application is easy.

Generally when a problem develops with a fuel oil system, it seems that the pump is considered the cause of the problem. When the pump is started and there is no flow, the pump is at fault. More times than not, the fault lies elsewhere in the system. If Viking or its distributors can offer suggestions that will help avoid system, operating or other problems, everyone will benefit. With that in mind, the following guidelines for pump selection and system design are offered.

- Over-speeding a pump up to 20% is OK provided the differential pressure is at or lower than the catalog rating. Suction conditions, specifically NPSH, should be considered when over-speeding the pump.
- Over-pressuring a pump up to 50% is OK provided the viscosity is greater than 540 cSt and the speed is reduced by the same percentage. For viscosities less than 540 cSt, consult the factory.
- Being conservative by using slower speeds and lower pressures within the pump rating will pay off in terms of longer trouble-free service. It will also help to avoid trouble when oil properties or application requirements vary from those originally anticipated.
- Install the pump as close to the supply tank as possible.
- Install a strainer in the suction line particularly prior to start up.
- Where possible leave work space around the pumping unit.
- After the unit is mounted and the piping is hooked up, double check the alignment. It should be within the coupling manufacturer's recommendation.
- A pressure relief valve for the discharge side of the pump either in-line or on the pump is recommended.
- Have available spare parts, pumps or standby units. See TR-802 for spare part recommendations.
- Obtain, read and keep maintenance instructions for the pump.
- Remember that preventive maintenance procedures such as periodic lubrication, adjustment of end clearance and examination of internal parts will extend the service life of the pump. Pump inspection reports and technical references are available through the factory.

Fuel Oil Systems

IDEX CORPORATION



1. SLOPE PIPING FROM ABOVE GROUND STORAGE TANK DOWN TO PUMP
2. SLOPE PIPING FROM BURIED STORAGE TANK UP TO PUMP.
3. PROVIDE SOME DEGREE OF FLEXIBILITY IN SUCTION PIPING TO ALLOW FOR TANK SETTLING, TEMPERATURE CHANGES, ETC.
4. GO AROUND, NOT OVER, OBSTRUCTIONS WHERE POSSIBLE - GOING OVER RESULTS IN VERTICLE LOOPS WHICH CAN TRAP AIR OR VAPOR.

FIGURE 1 - Line Drawing of Typical Fuel Oil System

There is one point that can never be stressed too much regarding a system and that is to install gauges on the pump. The gauges need to be on or near the pump; a vacuum (or compound) gauge on the suction side and a pressure gauge on the discharge side. Gauges are the best tools for understanding what is taking place in the pump and system. When properly interpreted, the readings can help troubleshoot the nature of many problems. In addition to being helpful for troubleshooting and start up, gauges left on the equipment will indicate any gradual changes that take place over time.

Figure 1 shows a typical fuel oil system along with some notes regarding suction piping installation.

Many fuel oil installations are designed to handle anything from No. 2 through No. 6 fuel oils. Several items relating to system design are significantly affected by the oil to be handled and should be considered.

NO. 2 FUEL OIL

Typical viscosity is 3.5 - 5 cSt (35 - 50 SSU). This oil may get sluggish at negative temperatures because of congealing wax. Generally handled at ambient temperatures of -40 - l00°F (-40 - 38°C). Suction lifts of greater than 10 ft (3 m) are not recommended for No. 2 fuel oil applications. While the vapor pressure of No. 2 fuel oil is less than 0.1 PSIA at ambient temperatures, experience indicates it contains dissolved or entrained air that will lead to pump cavitation (noise and flow loss) at greater suction lifts. **Figure 2** shows a typical duplex fuel oil set.

NO. 6 FUEL OIL (BUNKER "C")

Typical viscosity is 20 - 1600 cSt (100 - 7500 SSU) in the normal handling range of 100 - 250°F (38 - 120°C). This oil may vary widely in viscosity depending on the source of the oil, sulfur content and blend. Unheated, buried tanks with 0.5 m (2 ft) or more of ground cover will normally stay within a temperature range of 40 - 70°F (4 – 21°C) depending on locale and time of year. Tanks for No. 5 or No. 6 typically need heaters to decrease viscosity and pipe friction losses. If changing from No. 6 to No. 2, don't forget to turn off the heaters. Using the worst service conditions for No. 6 fuel oil (highest viscosity and lowest liquid level) position the pump, select pipe and fitting size to give vacuum readings of 400 mmHg (15 inHg) or less. Some No. 6 oils contain "light ends" which affect viscosity and may cause lift problems. A system designed to handle No. 2 may present some problems in terms of pipe size in the suction line, fittings and strainer when switching to No. 6. For further information, refer to Viking AD-19 NPSH. **Figure 3** shows a boiler that is fed by a No. 6 fuel oil pump.

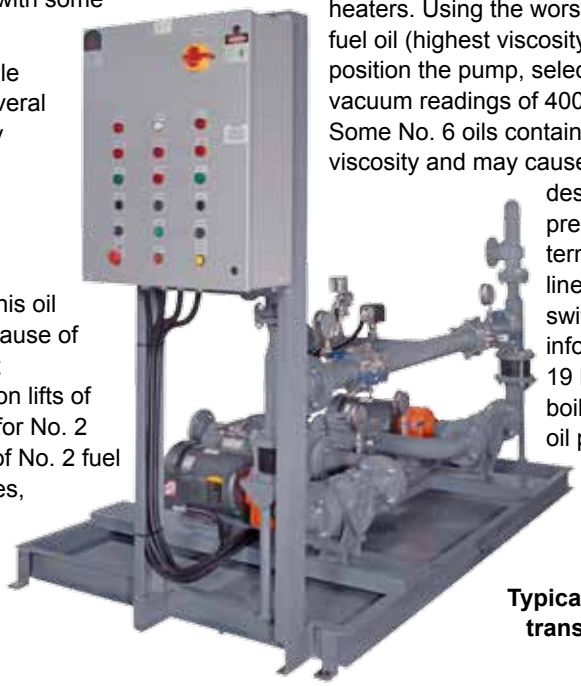


FIGURE 2
Typical duplex fuel oil set for transferring No. 2 fuel oil.

FIGURE 3
Boiler fed by No. 6 fuel oil pump.

SUCTION LINE SIZE AND CHECK VALVE LOCATION

Figure 4 shows the viscosity of several fuel oils and how the viscosity changes with temperature. Use suction pipe that is the same size or larger than the port size of the pump. Short and straight suction piping is preferred whenever possible. Suction line size on a fuel oil system, either No. 2 or No. 6, where the pump is below the storage tank, will present no problem as long as calculations indicate the vacuum condition at the pump will not exceed 15" Hg. Even with a "flooded" suction (a liquid level above the pump) it is possible to pull a vacuum at the pump if the pipe friction losses exceed the suction head pressure. With the pump above the liquid level (suction lift) in a buried or under- ground storage tank, the suction line size when handling No. 2 fuel oil should be at least equal to the port size of the pump. NPSH calculations would indicate if one size larger would be necessary. When handling only No. 2 fuel oil, it is common practice to install a foot valve in the end of the suction line at the bottom of the tank. In theory this is great; as long as the valve functions properly. If it should need attention, getting at it can be a problem. The best arrangement is to have a check valve just above the tank in a horizontal run. This keeps the line before the pump and the pump itself full and allows easier servicing of the valve. When handling No. 6 fuel oil with a lift, the suction pipe size would normally be larger than the pump port size. Often pump casings with oversize ports are used to facilitate hookup. Again NPSH calculations would permit determining the pipe size needed to stay below the 15" Hg. vacuum maximum at the pump. A foot valve is almost never used in a system handling No. 6 oil. A check valve is often installed at the pump. The heavier, more viscous No. 6 does not drain back to the tank as readily as No. 2.

When selecting the proper size suction pipe for a system designed to handle both No. 2 or No. 6 oil a priming issue may arise. A suction line large enough to reduce friction loss to an acceptable level when handling the No. 6, may be large enough to present priming problems when handling No. 2. This is true when the line does not have a foot valve and the check valve is close to the pump. The large, often long pipe will be full of air. Since the pump will be running at reduced speeds required for handling No. 6 oil, it can take several minutes for the pump to remove the air from the line and prime itself. Positive displacement pumps do not serve well as air compressors, particularly if forced to discharge into a system where the pressure is controlled by a regulator set for

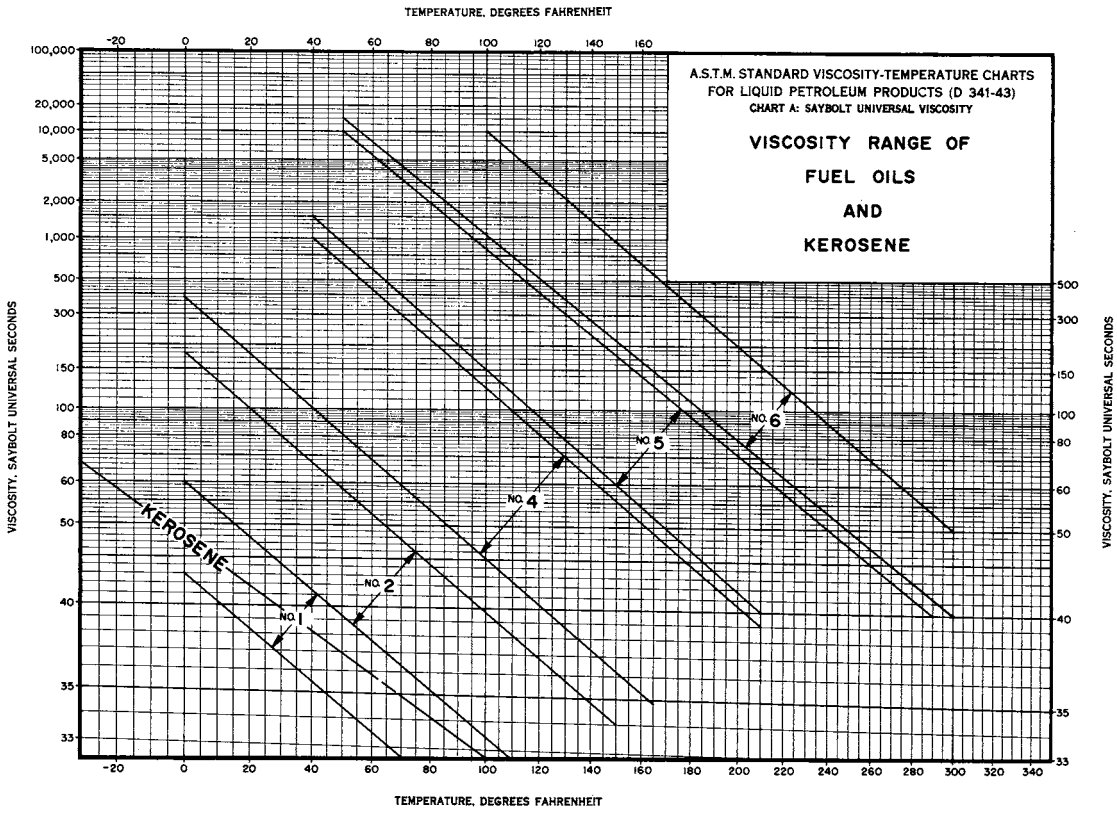


FIGURE 4