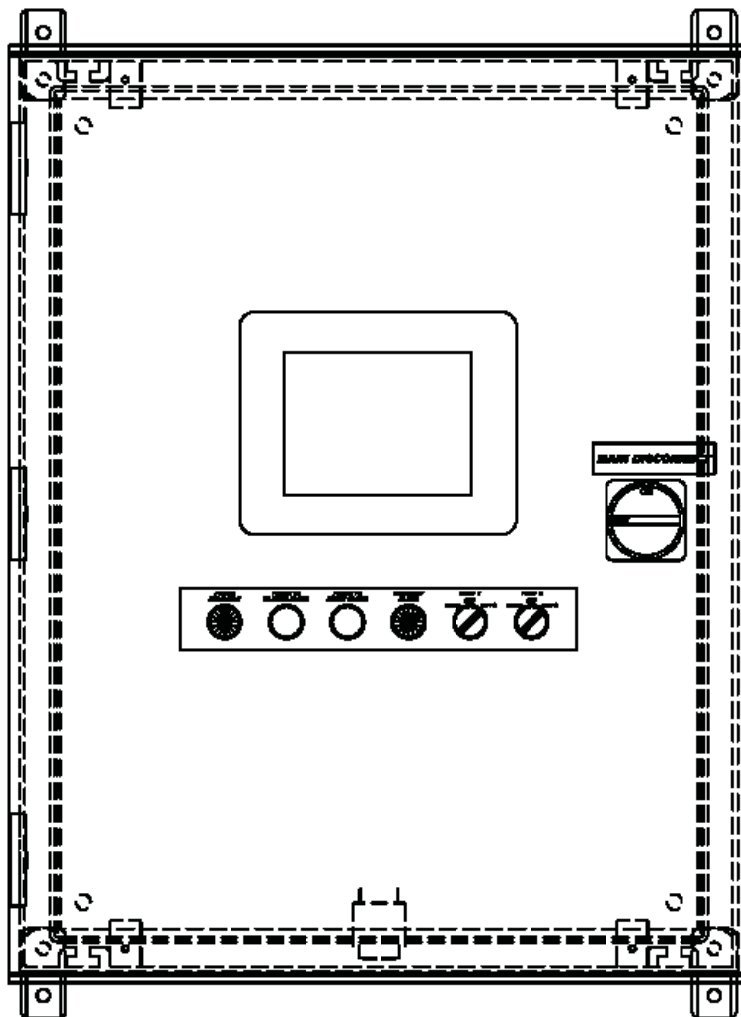


SIMPLEX™

SPS PACKAGED PUMPSET WITH PLC DAY TANK CONTROL PANEL

September 2011



Contents

DESCRIPTION	2
PRIMARY INSPECTION	2
INSTALLATION.....	2
PRIMING THE SYSTEM (REQUIRED)	3
OPERATION.....	4
Automatic Operation	4
Manual Operation.....	6
INSTALLATION	7
MAINTENANCE	8
TROUBLESHOOTING	8
No Fuel Delivered.....	8
Insufficient Fuel Delivered	8
Rapid Pump Wear	8
Pump Delivers for Short Period and Quits	8
Pump Requires Too Much Power	9
Noisy Operation	9
Pump Requires Frequent Re-priming	9
Motor Does Not Turn or Turns Intermittently	9
Pump Leaks Fuel	9
DRAWINGS AND PARTS LIST	9
APPENDIX A - ABBREVIATIONS USED IN THIS MANUAL.....	10
APPENDIX B - TECHNICAL DATA	11
Flammable Liquids	12
Flash Points.....	12

The information herein is the property of Simplex, Inc. and/or its subsidiaries. Without written permission, any copying, transmitting to others, and other use except that for which it is loaned, is prohibited.

DESCRIPTION

Packaged as a pre-engineered, integrated system of pumps, pump motors, controls and accessories, pre-plumbed and pre-wired, Simplex Packaged Pump Sets and Skid Pump Sets provide the user with the reliability of job engineered, system matched components, and factory assembled systems. These pump sets are intended for use with fuel oil, lube oil (class II or class III combustible liquids having a flash point of 100° F or higher).

Simplex Packaged Pump Sets are totally enclosed units suitable for wall or pad mounting. All devices, wiring and plumbing are contained within the weatherproof enclosure. Isolated compartments are provided for mechanical and electrical devices. External ports are provided for connection of field plumbing. The pump sets include a catch basin with a leak detector.

Due to design layout, Simplex Skid Pump Sets offer the customer a greater variety and quantity of options but because of its open catch basin they are suitable for indoor installation only.

PRIMARY INSPECTION

Preventative visual inspection of the shipping crate, Remote Pump Unit, and accessories must be performed before installation. Physical or electrical problems due to handling and vibration may occur during shipment.

1. If the packing crate shows signs of damage inspect the cabinet for damage. Check the entire outside of the cabinet for damage which could cause internal mechanical or electrical problems.
2. Check main disconnect switch, door and hinge operation.

3. Check pump/motor hardware for tightness. Rotate motor shaft by hand and check for smooth operation. Check pump/motor coupler for proper alignment and spacing. The coupler should have approximately 1/8" clearance between coupler halves. If this clearance is reduced or the pump and motor are not properly aligned excessive noise and pump/motor wear will occur.
4. Check all electrical terminals and connections for tightness.

INSTALLATION

1. Properly mount and attach all components as shown in the dimensional drawings using the mounting feet/holes and plumbing provided. The pressure relief manifold should be plumbed back to the main fuel tank.
2. Connect all components to earth ground at ground studs provided as shown on the electrical drawings. Unit must be grounded for operator safety.
3. If equipped, install level and alarm indication accessories as shown on dimensional drawing and connect them to the Pump Unit as shown on the electrical drawings.
4. If equipped, connect dry alarm contacts for customer use per specifications on the electrical drawings.
5. Connect pump motor/control power to the Remote Pump Unit per specifications on the electrical drawings.



This manual represents a generic configuration. Please refer to the operator's manual supplied with your equipment.

PRIMING THE SYSTEM (REQUIRED)

The pumps supplied with Simplex Pump Set are not self-priming. If a pump is allowed to run without fuel, pump damage will occur. Pump Sets are shipped from the factory filled with #30 oil to facilitate system priming. On systems that contain a hand pump the hand pump may be utilized to lift the fuel into the pump set cabinet. This will not eliminate the need to prime the system at the pump.

The Pump Set may be primed by installing a priming tee on the inlet side of the pump. An alternative is to disconnect the inlet line at the pump and fill the line with fuel. If the system contains a fuel strainer the strainer must be disassembled, filled with fuel, and reassembled.

PRIMING PROCEDURE

1. Ensure the Pump is filled with #30 priming oil.
2. Ensure that all ball valves are in the open position.
3. Open the pump inlet line or priming tee, fill the line with fuel, close the line (it is recommended that a foot valve be installed at the main fuel tank to hold the fuel column.)
4. If the system contains a fuel strainer, fill the strainer with fuel.
5. Energize the pump and observe fuel flow.

WARNING

If the pump is allowed to run dry, the priming oil shipped in the pump will be depleted and it may be necessary to disconnect the plumbing at the pump input to re-prime the pump.

WARNING

Ground must be connected as shown in the wiring drawing. Failure to properly ground the unit will result in a fire and personnel safety hazard.

WARNING

Care must be taken when connecting control power to a system requiring three-phase control power. If the system is not properly wired the motor rotation will be reversed and damage to the pump shaft seal may occur. Standard pump rotation is clockwise as viewed from the motor end. Any pump which has been allowed to run in reverse must be checked for fuel leaks around the pump shaft. If the pump is leaking around the shaft the seals must be re-seated or replaced.

WARNING

If the pressure relief line is plumbed back to the pump suction line, the pump suction line between the pressure relief manifold and main tank cannot contain a foot valve or a check valve or damage to the pump will occur.

OPERATION

The PLC Level Controller nameplate contains the Day Tank operation status indicators and controls. The control panel is the central point for Day Tank operation and is where the Day Tank operating mode is selected.

The PLC Day Tank control panel contains the following components:

1. Indicator Lights:
 - a. Power Available
 - b. Summary Alarm
2. Press to Reset Alarm push-button
3. Press to Silence Alarm push-button
4. Fill Pump 1 Auto-Off-Hand switch
5. Fill Pump 2 Auto-Off-Hand switch
6. HMI Touch-screen Controls and Indicators:
 - a. Fill Solenoid Valve Energized
 - b. Fill Pump 1 Running/Stopped/Failed
 - c. Fill Pump 2 Running/Stopped/Failed
 - d. Fill Pump 1 Runtime
 - e. Fill Pump 2 Runtime
 - f. Day Tank Fuel Level – Percent
 - g. Day Tank Fuel Level – Gallons
 - h. Test Fill push-button
 - i. View Alarms push-button
 - j. Leak Detected Indicator
 - k. Day Tank Fuel Level Indication – Graphically
 - l. Day Tank Fuel Level Indication
 - a. High-High – 98%
 - b. High – 95%
 - c. Full Tank/Fill Stop – 90%
 - d. Fill Start – 50%
 - e. Low – 25%
 - f. Low-Low – 10%

Each of these controls and indicators has a specific function and is described in the Automatic and Manual operation sections.

WARNING!! Always connect the Day Tank and Controller to an earth ground before Day Tank operation! Electrical shock can cause personal injury or death!

The programmable logic controller gets the tank level from the Day Tank's level transducer to energize and de-energize fill pumps and solenoid valves as necessary to maintain proper fuel levels within the Day Tank. Day Tank level float-switches work in parallel with the level transducer should a transducer failure occur. As the fuel level rises and falls, the level transducer is continually calibrated based on the float-switch activation points.

AUTOMATIC OPERATION

The Fill Pump 1 and Fill Pump 2 Auto-Off-Hand mode switches are provided to allow the operator complete control over the Pump Set/Day Tank. The 3-position mode switches should be placed in the Auto mode for Automatic, hands-free operation. As the prime mover consumes fuel, the Day Tank will cycle through the normal fuel range as determined by the fuel level transducer. This normal operating range is Fill Start – 50% through Full Tank/Fill Stop – 90%. The control panel HMI will continuously, visually announce the fuel level in the Day Tank from both the level transducer and the individual float-switch indicators. Automatic operation is explained below.

The operator selects the Auto mode for both fill pumps via the respective pump 3-position switches. As fuel is consumed the level drops below the Fill Start-50% level and a lead fill pump is energized along with the respective

solenoid valve. As fuel enters the Day Tank, the fuel level rises to the Full Tank/Fill Stop-90% level, at which time the fill pump and solenoid valve will be de-energized. During a pump running condition, a normally closed, flow switch is monitoring fuel progression and should the flow switch not detect sufficient fuel motion for a period of 30 seconds, the lead Fill pump and solenoid valve is de-energized and considered failed and the lag Fill pump and solenoid valve is then energized. The fuel progression sequence is again monitored. Once a loss of flow condition is detected, an indicator is illuminated on the HMI touch-screen, an alarm horn will sound, and the respective Fill pump and solenoid valve is locked from use until the condition is reset by pressing the Reset Alarm push-button. During normal automatic, operation, fuel is consumed and replenished as necessary and the Day Tank cycles between the 50% and 90% levels.

DAY TANK HIGH-HIGH FUEL

High-High – 98% fuel level detection is provided as a redundant backup to the High – 95% fuel level. Should the Day Tank fuel level reach a High-High-98%, the call for fuel will terminate, all Fill pumps and solenoid valves will be locked from use until the fuel level within the Day Tank is lowered below the High-95% level. Visual indicators will be illuminated on the HMI touch-screen and an alarm horn will sound. Once the fuel level has been lowered, the Reset Alarm push-button must be pressed to resume normal Day Tank operations.

DAY TANK HIGH FUEL

High – 95% fuel level detection is provided as a redundant backup to the Full Tank/Fill Stop – 90% fuel level, such that, should the Fill Stop fail to engage, the High 95% performs backup functionality to stop the call for fuel signal de-energize the Fill pump and solenoid valve and halt any further fuel entry into the Day Tank. The Day Tank High fuel alarm indicates the fuel level has reached or exceeded 95%. Should the Day Tank fuel level reach a High-95%, the call for fuel will terminate, all Fill pumps and solenoid valves will be locked from use until the fuel level within the Day Tank is lowered below the High-95% level. Visual indicators will be illuminated on the HMI touch-screen and an alarm horn will sound. Once the fuel level has been lowered, the Reset Alarm push-button must be pressed to resume normal Day Tank operations.

LOW FUEL LEVEL

As fuel is consumed, the Fill Start-50% level will energize the Fill pump and solenoid valve to refill the Day Tank. Should the Fill Start fail to engage, or fuel consumption exceeds the fill rate of a single Fill pump, the Low-25% will provide backup to energize a lag Fill pump and solenoid valve and run parallel with the lead Fill pump and solenoid valve, until the fuel level is brought to the Full Tank/Fill Stop-90% level. Should the Day Tank fuel level reach a Low-25%, visual indicators will be illuminated on the HMI touch-screen and an alarm horn will sound. Once the fuel level has been increased above the 25% level, the Reset Alarm push-button must be pressed to resume normal Day Tank operations.

LOW-LOW FUEL LEVEL

Should the Day Tank fuel drop below the Low-Low – 10% level, the operator should consider generator shutdown to prevent fuel starvation to the generator injectors. Dry contacts are provided as means of automatically stopping generator operations on a Low-Low fuel level detection. Should the Day Tank fuel level reach a Low-Low-10%, visual indicators will be illuminated on the HMI touch-screen and an alarm horn will sound. Once the fuel level has been increased above the 10% level, the Reset Alarm push-button must be pressed to resume normal Day Tank operations.

DAY TANK LEAK

Should a Day Tank Leak condition occur, this indicates the inner tank has ruptured and allowed fuel detection within the secondary containment. Upon a Day Tank Leak detection, the call for fuel will terminate, all Fill pumps and solenoid valves will be de-energized and locked from use to prevent any further fuel entry into the Day Tank. Should a Day Tank Leak be detected, a visual indicator will be illuminated on the HMI touch-screen and an alarm horn will sound. Once the fuel leak has been resolved and the secondary containment drained, the Reset Alarm push-button must be pressed to resume normal Day Tank operations.

MANUAL OPERATION

For Manual (continuous run) Day Tank operations, the operator must choose the HAND mode on one of the Fill pump 3-position mode switches. This will energize the respective Fill pump and solenoid valve to increase the fuel level within the Day Tank. Caution must be used when in the Manual mode and the Day Tank should never be left

unattended. Manual mode allows the Day Tank to acquire the High-95% fuel level, at which time the High fuel alarm will be annunciated and the Fill pump and solenoid valve will be de-energized. Once the fuel level is brought down to below the High-95% level, the reset alarm push-button must be pressed to resume normal Day Tank operations. By placing the Fill pump 3-position switch back in the AUTO mode, the Day Tank will resume hands-free, automatic operation and maintain fuel levels between the 50% and 90% range. Should general maintenance or repairs be required, the OFF mode is provided.

TEST FILL PUSH-BUTTON

A Test Fill push-button is provided on the HMI/Touch-screen to confirm Day Tank fill functionality. With the fill pumps in the Auto mode and the fuel level below the Full Tank/Fill Stop – 90% level, the operator may press and release the Test Fill push-button to energize the lead fill pump and solenoid valve. This will increase the Day Tank fuel level to the 90% level, at which time the fill pump and solenoid valve will de-energize.

ALARM HORN SILENCE PUSH-BUTTON

Should an alarm condition occur, such as High-High Fuel, High Fuel, Low Fuel, Low-Low Fuel, or Day Tank Leak, the alarm horn will energize. By pressing the alarm horn silence push-button, the alarm horn can be silenced.

RESET ALARMS PUSH-BUTTON

The Reset Alarm push-button is used to reset any alarm condition, should they occur.

POWER AVAILABLE LIGHT

To confirm control power is present within the Day Tank control panel, the power available light will remain illuminated.

SUMMARY ALARM LIGHT

A Summary Alarm light is contained on the Day Tank control panel to indicate the presence of an alarm condition, should one occur. This allows the operator to monitor the panel from a distance for any possible alarms. Should an alarm condition exist, the operator can investigate more detailed information on the HMI/Touch-screen contained within the Day Tank control panel.

DAY TANK CALIBRATION

By pressing the Calibrate Level push-button on the HMI/Touch-screen, the operator can accurately set the Day Tank level for the level transducer. The Day Tank Calibration routine requires the operator to enter an upper fuel level setting and a lower fuel level setting. Best results are obtained if the operator can increase the fuel to the Full Tank/Fill Stop – 90% level for the upper setting and then reduce the fuel to the Low-Low – 10% level for the lower setting. Graphical and text-based displays inform the operator at all times of the upper and lower fuel levels. After the calibration process is complete, the operator may return to the main Day Tank status screen.

PUMP SET LEAK

If fuel is detected within the sump basin of the pump set cabinet, the fuel line leak alarm will be indicated in the alarm history log and the alarm horn will sound. By draining all fuel from the sump basin within the pump set, the condition may be reset by pressing the Reset Alarm push-button.

INSTALLATION

Location of the Day Tank is of prime importance and should be done by trained personnel. It is one of the most critical factors involved in reliable and safe operation. The Day Tank must be positioned and installed according to the main fuel storage tank and engine location. In general locate the Day Tank as close to the engine as possible consistent with applicable local and national plumbing and electrical codes. Always position the Day Tank so that the highest fuel level in the tank is lower than the engine injectors. Never locate the Day Tank in a confined space without consideration for accidental fuel spillage and use a rupture basin when necessary. Never locate the Day Tank near a surface or object which may be adversely affected by fuel oil. Never locate a Day Tank system above a residential living space.

WARNING

Do not fill with gasoline. This Pump Set is not meant for use with gasoline nor with other flammable liquids having a flash point less than 100°F. Use with gasoline or use with any flammable liquids at a temperature exceeding the flash point of that liquid, presents an immediate explosion and fire hazard. Do not use the Pump Set at a temperature exceeding the flash point of its contents.

MAINTENANCE

Simplex Pump Sets should be visually inspected for maintenance purposes every six months during light duty cycles. Pumps sets used daily for long hours should be inspected every month.

- Prior to performing the maintenance procedure ensure that the optional main disconnect switch illustrated above is operating properly, the user supplied circuit breaker is in the **OFF** position, and that all sources of power are isolated from the Pump Set. Proceed only after this is verified.
- Check main disconnect switch, door and hinge operation.
- Test pumps in tri-plex pump sets. Ensure all pumps are operating normally, test each pump individually, test simultaneous operation, test alternating operation.
- Check pump/motor hardware for tightness.
- Rotate shaft by hand and check for smooth operation.
- Check all electrical terminals and connections for tightness.
- All motors are permanently lubricated and do not require any lubrication
- Check all plumbing joints for leaks. Tighten fittings and joints as necessary. Drain accumulated fuel in catch basin as necessary by removing catch basin plug.
- Inspect all fuel strainers. Disassemble strainer and clean strainer element, replace as necessary. Reassemble unit and check for leaks.
- Test hand pump operation, check for fuel leaks, tighten as necessary.

TROUBLESHOOTING

NO FUEL DELIVERED

1. Pump not primed.
2. Lift is too high.
3. Rotation direction incorrect.
4. Check valve installed backwards.

INSUFFICIENT FUEL DELIVERED

1. Air leak at inlet.
2. Defective solenoid valve or check valve.
3. Lift too high.
4. Pump worn.
5. Inoperative foot valve.
6. Piping improperly installed.
7. Fuel strainer plugged.

RAPID PUMP WEAR

1. Dirt or grit in fuel.
2. Pipe strain on pump causing bind.
3. Worn pump/motor coupler.
4. Pump has been run dry or with insufficient fuel.

PUMP DELIVERS FOR SHORT PERIOD AND QUILTS

1. Leak at inlet.
2. End of inlet not deep enough.
3. Air or gas in fuel.
4. Supply exhausted.
5. Vaporization of fuel at inlet.
6. Air or gas in inlet line.
7. Sand or abrasives in fuel.

PUMP REQUIRES TOO MUCH POWER

1. Air in plumbing lines.
2. Liquid heavy or too viscous.
3. Misalignment of pump/motor coupler.

NOISY OPERATION

1. Insufficient fuel supply.
2. Air leaks in the inlet pipe.
3. Air or gas at inlet connection.
4. Pump and motor out of alignment.
5. Worn out spider coupling.
6. Pump coupler out of balance.

PUMP REQUIRES FREQUENT RE-PRIMING

1. Inoperative foot valve.
2. Inoperative check valve.
3. Inoperative solenoid valve.
4. Pump cavitation.
5. Plumbing air leaks.
6. Lift too high.
7. Pump seal leaking.

MOTOR DOES NOT TURN OR TURNS INTERMITTENTLY

1. Control power not available.
2. Motor thermal overload condition.
3. Pump failed and seized.
4. Motor failure.

PUMP LEAKS FUEL

1. Loose pump plumbing fittings.
2. Worn pump shaft seal.
3. Pump pressure relief valve failure.
4. Fuel leak elsewhere running towards pump area.
5. Excessive head from overhead storage tank.
6. Worn pump seals.

DRAWINGS AND PARTS LIST

The drawings included in this manual are the most accurate source of part numbers for your Pump Set. When ordering replacement parts for Simplex Pump Sets, always consult the Parts Legend Drawing. When contacting the Simplex Service Department always have your work order and drawing number ready for reference. The Work Order Number and the Drawing Numbers are also located on each drawing legend.

APPENDIX A - ABBREVIATIONS USED IN THIS MANUAL

Listed below are abbreviations of terms found on Fuel Supply Systems. When following a drawing utilize this guide to define abbreviated system and component names. As this is a master list, drawings and text pertaining to your equipment may not contain all these terms.

AC -Alternating Current	MOT -Motor
AHR -Alarm Horn Relay	N.C. -Normally Closed
AR -Alarm Horn	NEC -National Electric Code
BPRV -Back Pressure Regulating Valve	NEMA -National Electric Manufacturers Association
BRK -Motor/Pump Bracket	NFPA -National Fire Protection Association
BV -Ball Valve	N.O. -Normally Open
C -Contactor	NP -Nameplate
CB -Circuit Breaker	NPT -National Pipe Thread
CSR -Check Strainer Relay	O.D. -Outside Diameter
CV -Check Valve	OLR -Over Load Relay
DC -Direct Current	OPT -Option
DPDT -Double Pole Double Throw	PCB -Printed Circuit Board
F -Fuse	PCRX -Pump Control Relays
FLS -Flowswitch	PG -Pressure Gauge
FS -Floatswitch	PLR -Pipe Leak Relay
FSR -Simplex Fuel Strainer	PRV -Pressure Relief Valve
GA -Gauge	PS -Pressure Switch
GAL -Gallons	PSI -Pounds Per Square Inch
GPM -Gallons Per Minute	PSR -Pressure Switch Relay
HFL -High Fuel Level Relay	PRR -Pump Running Relay
HG -Mercury	SC -Swing Check Valve
HP -Horsepower	SOL -Solenoid
HZ -Hertz	SST -Simplex Super Tank
I.D. -Inside Diameter	TB -Terminal Block
JB -Junction Box	T -Control Transformer
Hz -Hertz	TDR -Time Delay Relay
INHG -Inches of Mercury	TEFC -Totally Enclosed, Fan Cooled
L -Lamp	THR -Tank Heater Control Relay
L.E.D. -Light Emitting Diode	TS -Transducer Pressure Switch
LAFD -Los Angeles Fire Department	V -Voltage
LFF -Loss of Flow Relay	VAC -Voltage, Alternating Current
LFL -Low Fuel Level Relay	VDC -Voltage, Direct Current
LPR -Low Pressure Relay	VG -Vacuum Gauge
MDB -Main Distribution Block	
MDS -Main Disconnect Switch	

APPENDIX B - TECHNICAL DATA

Thermal expansion of oil is approximately 1 cubic inch per 1 gallon per 10°F rise in temperature.

Hydraulic Formulas

$$\text{Horsepower} = \frac{\text{GPM} \times \text{PSI}}{1714}$$

$$\text{Torque (lb. in.)} = \frac{\text{CU IN./REV.} \times \text{PSI}}{2}$$

$$\text{Torque (lb. in.)} = \frac{\text{HP} \times 63025}{\text{RPM}}$$

$$\text{Flow (gpm)} = \frac{\text{CU IN./REV} \times \text{RPM}}{231}$$

Head and Pressure Equivalents

When converting pressure from feet of water to P.S.I., the specific gravity of the liquid must be considered.

Here are some typical conversion figures:

1 P.S.I.=2.30 feet of water
(specific gravity 1.0)

1 P.S.I.=2.88 feet of oil
(specific gravity 0.8)

Conversion Factors

1HP = 33,000 ft. lbs. per minute

1HP = 42.4 btu per minute

1HP = 0.746 kwhr (kilowatt hours)

1 U.S. gallon= 231 cubic inches

Pipe Volume varies as the square of the diameter; volume in gallons = 0.0034 D² L where:

D=inside diameter of pipe in inches;

L=length in inches

Velocity in feet per sec.= $\frac{0.408 \times \text{flow (gpm)}}{D^2}$

where:

D=inside diameter of pipe in inches

Atmospheric pressure at sea level = 14.7PSI

Atmospheric pressure decreases

approximately 0.41PSI for each one thousand feet of elevation up to 23,000 feet.

Pressure (PSI) = feet head x 0.433 x specific gravity

Specific gravity of oil is approximately 0.85.

PRESSURE AND CONVERSION TABLE		
Feet Water	PSI Oil	PSI Water
1	.35	.43
2	.70	.87
3	1.05	1.3
4	1.4	1.73
5	1.75	2.17
10	3.5	4.33
15	5.2	6.5
20	7.0	8.66
25	8.7	10.8
30	10.5	13.0
35	12.2	15.2
40	14.0	17.3
45	15.7	19.5
50	17.5	21.7
55	19.2	23.9
60	21.0	26.0
65	22.7	28.1
70	24.5	30.5
75	26.2	32.5
80	28.0	34.6
85	29.7	36.8
90	31.5	39.0

Pipe Friction- Fuel Oil 2

Pressure Drop in PSI per 100 feet of Pipe and Tube

NOMINAL SIZES - INSIDE DIAMETERS								
Pipe Size, In.	2.0 GPM	7.0 GPM	10.0 GPM	17.0 GPM	23.0 GPM	30. GPM	40.0 GPM	50.0 GPM
.50	2.337	24.65	56.10	148.75	233.75	408.00		
.75		3.61	7.31	21.25	39.53	64.6	93.5	182.75
1.00	.306	2.00	4.16	11.70	19.55	31.87	54.40	80.75
1.25	.10	.51	1.00	2.55	5.10	8.50	14.88	22.10
1.5		.23	.425	1.10	2.04	3.27	5.70	8.33
2.00			.13	.34	.60	.96	3.10	2.38
2.50			.10	1.62	.30	.51	.94	1.275
3.00					.10	1.74	3.06	4.93

NOTE: Pipe sizes shown apply to standard weight schedule 40 pipe.
Tube is standard copper tubing

FLAMMABLE LIQUIDS FLASH POINTS

Excerpts from NFPA 325, "Fire Hazards properties of Flammable Liquids..."

	Flash Points °F(°C)
Diesel Fuel Oil No. 1-D	100 Min. (38) or Legal
Diesel Fuel Oil No. 2-D	125 Min. (52) or Legal
Diesel Fuel Oil No. 4-D	130 Min. (54) or Legal
Fuel Oil No. 1 (Kerosene) (Range Oil) (Coal Oil)	100-162 (43-72)
Fuel Oil No.2	126-204 (52-96)
Fuel Oil No. 4	142-240 (61-116)
Fuel Oil No. 5 Light Fuel Oil No. 5 Heavy	156-336 (69-169) 160-250 (71-121)
Fuel Oil No. 6	150-270 (66-132)
Jet Fuels Jet A and A-1	110-150 (43-66)
Jet Fuels Jet B	-10 to +30 (-23 to -1)
Jet Fuels JP-4	-10 to +30 (-23 to -1)
Jet Fuels JP-5	95-145 (35-63)

Specific Gravity and Viscosity of Oils

Oils	*Specify Gravity At 60°F	Viscosities In SSU at Various Temperatures							
		30°F	60°F	80°F	100°F	130°F	170°F	210°F	250°F
Auto Lubricating S.A.E.-									
10 Max.	.880 to .935	4,400	1,090	430	240	120	66		
20 Max.	.880 to .935	6,900	1,650	750	400	185	90	57	
30 Max.	.880 to .935	13,000	2,700	1,200	580	255	120	66	49
40	.880 to .935	25,000	4,850	2,000	950	380	150	80	55
50	.880 to .935	58,000	10,000	3,700	1,600	600	220	105	67
60	.880 to .935	100,000	15,000	5,300	2,300	800	285	128	76
70	.880 to .935		22,000	7,500	3,100	1,050	342	150	86
10W	.880 to .935								
20W	.880 to .935								
Fuel Oil-									
Diesel No. 2D	.82 to .95	138	70	53.6	45.5	39			
Diesel No. 3D	.82 to .95	390	145	92	65	48	39		
Diesel No. 4D	.82 to .95	4,400	700	280	140	70	44.2		
Diesel No. 5D	.82 to .95	16,500	3,500	1,500	750	320	136	76.5	54
No. 1	.82 to .95				35				
No. 2	.82 to .95	104	56	45.5	40				
No. 3	.82 to .95	126	68	53	45	39			
No. 5A	.82 to .95	1,480	420	215	125	72	48		
No. 5B	.82 to .95	850	600	490	400	315	235	178	141
No. 6	.82 to .95		72,000	21,500	7,800	2,150	590	225	110
Navy Spec.	.989 Max.	3,300	1,100	600	360	190	100	66	50.2
Navy II	1.0 Max.		24,000	8,600	3,500	1,150	370	160	89
Turbine-									
Heavy	.91 Avg.	4,800	1,280	625	350	170	86	57	
Light	.91 Avg.	770	330	208	138	87	58.8		