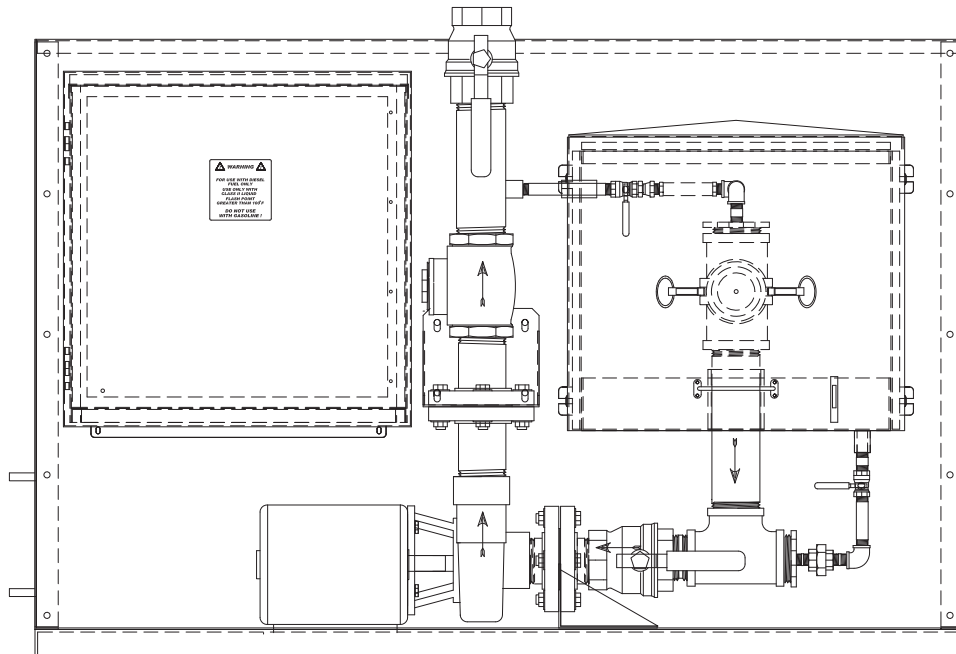


SIMPLEX[®]

SMARTPUMP MANUAL

July 2011



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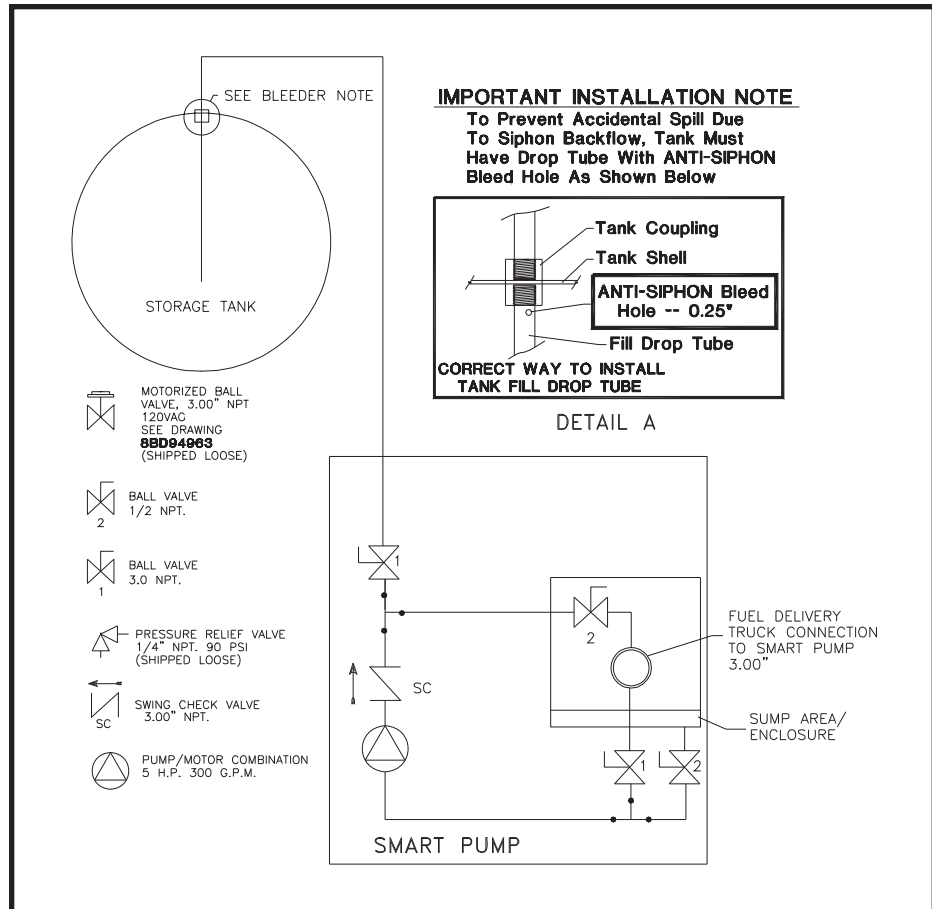
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DESCRIPTION

The Simplex Fuel Supply System provided on this work order consists of a Simplex Smart-Pump designed to transfer fuel from gravity trucks to an above ground fuel storage tank, control the filling operation to prevent overfilling of the tank, and allow for full draining of the truck delivery hose. A floatswitch assembly is shipped loose for installation on the above ground fuel storage tank.

INSTALLATION

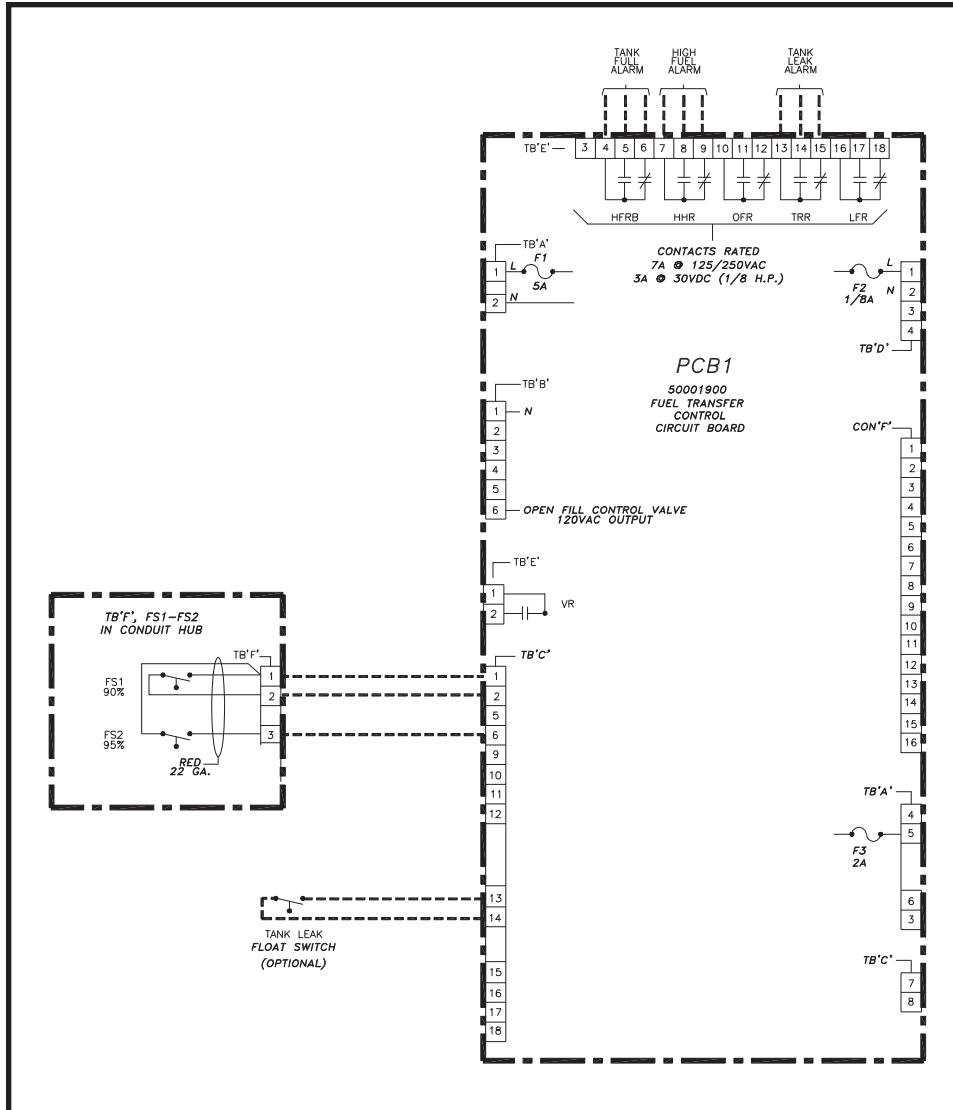
1. Anchor the Smart-Pump to concrete pad using mounting holes provided in the base of the unit.
2. Connect to an earth ground using the threaded ground stud in the lower left-hand corner of left-hand side panel. Connect ground wires from SmartPump to the above ground storage tank.
3. See *Piping Drawing*:
 - a. Connect the outlet of SmartPump to the above ground storage tanks using 3 inch steel pipe or black iron pipe.
 - b. Install the SmartPump Transducer, Floatswitch assembly and optional Tank Leak Floatswitch, if provided, in the appropriate NPT fittings in the top of the fuel storage tank.



Part of Typical Piping Diagram

! WARNING !
ALL PIPING MUST RISE ABOVE THE SMARTPUMP. Low spots can cause air locks in the line and prevent proper pump operation.

! WARNING !
To prevent an accidental spill due to siphon backflow the tank must have drop tube with an anti-siphon bleed hole.



Part of Typical Wiring Diagram

4. See *Wiring Drawing*. Run all wiring in solid conduits.
 - a. Connect control power to terminal block as shown on the drawing.
 - b. Using #20 AWG or larger, connect the floatswitch assembly as shown.
 - c. If required, connect leak sensors and remote alarm contacts as shown. Contacts are rated 7A @125/250VAC, 3A @ 30VDC (max.).
 - d. Using #20 AWG or greater shielded wire, connect contacts on the Smartpump to the Level Transducer as shown.



WARNING

Lethal high voltages may exist within the control compartment. The customer supplied control power circuit breaker must be in the Off position before opening the compartment.

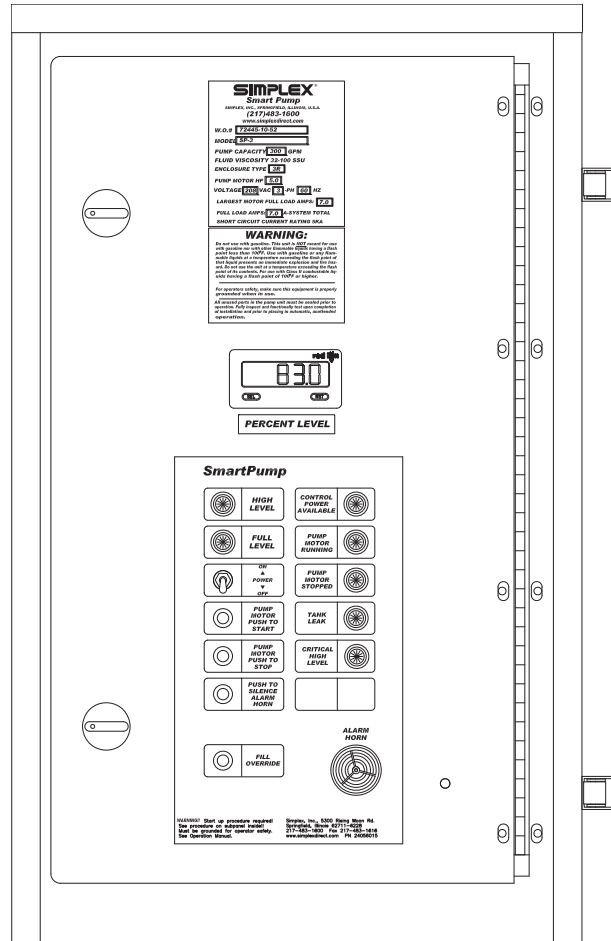


WARNING

Rotating equipment. Pump/motor shafts and coupler rotates at 3600 RPM. Observe guards.

INITIAL START-UP TEST PROCEDURES

1. The unit is operated with the control panel outer door open to reveal operators control panel. Do not access the interior of the control panel with the customer supplied control power circuit breaker On.
 - a. The Power Available indicator will illuminate.
2. Flip the customer supplied control power circuit breaker to the On position.
 - a. The Power Available indicator will illuminate.
 3. Test the optional annular space leak sensor.
 - a. Ensure the customer supplied control power circuit breaker is Off.
 - b. Open the Control Panel inner door to access the control compartment.
 - c. Install a wire jumper from terminal block TB'C' terminal 13–14.
 - d. Close the inner door and turn customer supplied control power circuit breaker On.
 - e. Tank Leak indicator should be illuminated and the tank leak relay TRR should energize.
 - f. Ensure the customer supplied control power circuit breaker is Off.
 - g. Open the Control Panel inner door to access the control compartment. Remove wire jumpers.
 4. Check direction of rotation and operation of the pump and motor.
 - a. Place the customer supplied control power circuit breaker in the Off position.
 - b. Remove shaft coupler guard from the pump.



- c. Place the customer supplied control power circuit breaker in the On position.
- d. Press the Pump Start push-button. The pump should start and run.
- e. Observe shaft rotation. Rotation should be clockwise as viewed from above.
- f. If rotation is incorrect:
 - 1. Press the Pump Stop push-button.
 - 2. Insure the customer supplied control power circuit breaker is Off.
 - 3. Open the Control Panel inner door to access the control compartment.
 - 4. Locate the overload relay, labeled OLR. On either side of the relay, reverse the black and red wires: connect the red wire to line one and the black wire to line two.
 - 5. Close the Control Panel inner door and repeat steps C through E.
- g. Place the customer supplied control power circuit breaker to the Off position. Reinstall the shaft guard.

OPERATION

- 1. The Simplex SmartPump is operated with the control panel weatherproof outer door open to reveal the operators control panel. Unlock and open door.
- 2. Do not access the interior of the control panel with the control power On, high voltage within.
- 3. Flip the customer supplied control power circuit breaker to the On position.
 - a. The Power Available indicator will illuminate.
- 4. Connect the ground from the fuel delivery tuck to the trucker ground stud provided. Connect the delivery hose to the fuel inlet fitting in the lower compartment.
- 5. Open supply valve on truck and check inlet fittings for leaks.
- 6. Check that the purging valve is closed and the fuel inlet valve in SmartPump is open.
- 7. Open the fuel outlet valve in SmartPump and check all fittings for leaks.
- 8. Purge system of air, if necessary. See the following instructions.
- 9. Press the Pump Start pushbutton. The pump motor will start, delivering fuel to the above ground storage tank.
- 10. The pump may be stopped at any time by pressing the Pump Stop pushbutton.
- 11. At 90% level the audible alarm will sound for 30 seconds, the 90% Alarm indicator will illuminate, and the pump motor will stop.

12. Pressing the Fill Override push-button will allow the pump to be restarted for the purpose of draining the fill hose or the spill containment. The override circuit will activate the pump for 30 seconds and can be reactivated by pressing the push-button until the fuel level reaches the 95% fuel level.
13. If the tank should reach the 95% fuel level the pump motor will stop, the 95% Alarm indicator will illuminate, and the audible alarm will sound until the Alarm Silence pushbutton is pressed. At this point the pump cannot be restarted unless the fuel level drops below 95%.
14. Close the fuel outlet valve.
15. Close the fuel inlet valve.
16. Disconnect the fuel supply hose.
17. If any fuel has spilled in the containment basin, refer to instructions below.
18. When filling operations are complete, turn the Pump Motor/Control Power switch to the Off position.
19. Disconnect ground cable to the tanker.
20. Close and padlock all doors.

TO DRAIN WITH MOTOR-PUMP

1. Start the pump by pressing the Pump Start pushbutton. If 90% alarm is activated, press the Fill Override pushbutton. Override is activated for 30 seconds and can be reactivated until the 95% fuel level is reached.
2. The pump will start. Operate the hand pump to prime the pump.
3. Open the hand pump bypass valve.
4. The pump will empty the spill basin.
Note: Full basin will be emptied in about 20 seconds.
5. Stop the pump when the basin is empty by pressing the Pump Stop pushbutton.

TANK LEAK ALARM

The Tank Leak alarm is activated by a sensor (optional) located within the interstitial space of the double wall above ground tank. Activation of this alarm indicates a leak within the tank that has been captured within the secondary containment of the tank. Relay contacts to announce this alarm are provided at terminal block TB'E' terminals 13–15.

PURGING THE PUMP

Failure to Pump May Be Due to Air in the System

It is necessary to purge the pump of air on initial start-up or whenever air has entered the pump system. Open the SmartPump inlet and outlet valves to flood the system. Open the air purge valve located at the pump discharge then close the valve. The pump should now be purged of air and able to deliver oil.

FIELD CALIBRATION (MAY BE REQUIRED)

1. A final calibration check may be required before the system is fully operational. The “Zero” point is set at the factory and should not need adjustment.

2. Example: Percent level

a. 400 gallon tank is filled with a known 360 gallons of fuel. With the system on, the meter is reading 87% level. Adjust the meter “OFFSET” value within the meter menuing system so the meter reads 90%.

3. The meter can be adjusted to read gallons instead of percent. Use the following adjustment procedures. (RECTANGULAR TANKS ONLY)

4. Example: # of gallons

a. 400 gallon tank is filled with a known 360 gallon volume of fuel. With the system on, the meter reads 87 percent. Adjust the meter “DSP 2” value within the meter menuing system to read 400 gallons. Then adjust the meter “OFFSET” value within the meter menuing system so the meter reads exactly 360 gallons.

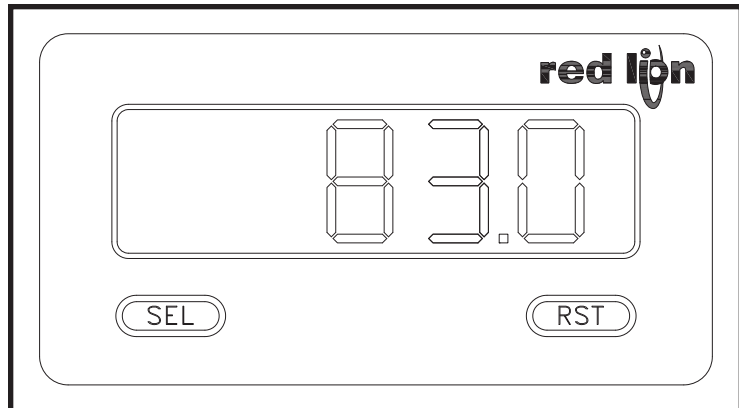
5. “OFFSET” value entry:

a. Press and HOLD the “SEL” button to enter the programming mode, you should see PRO on the display.

b. Press the “RST” button once, you should see “1-INP” on the display.

c. Press the “SEL” button three times, you should see “OFSET” on the display.

d. Press the “RST” button once, you should see the right-most digit flashing.



Standard Receiver / Indicator

e. Press the “RST” button multiple times to enter the desired OFFSET value.

f. NOTE: If the desired OFFSET value is to be negative, press the “SEL” button multiple times, you should see the left-most digit flashing. Press the “RST” button multiple times, you should see a “-” in the left-most digit position.

g. Press and briefly HOLD the “SEL” button once to save the OFFSET entry.

h. Press the “SEL” button multiple times, you should see “PRO NO” on the display.

i. Press the “SEL” button once to exit the programming mode, you should see “END” briefly flash on the display before returning to the numeric displayed value.

6. “DSP 2” value entry:

a. Press and HOLD the “SEL” button to enter the programming mode, you should see PRO on the display.

b. Press the “RST” button once, you should see “1-INP” on the display.

c. Press the “SEL” button ten times, you should see “DSP 2” on the display.

TROUBLESHOOTING

Pump runs but will not pump.

The principle cause of a no-flow condition with the pump running is air trapped in the pump. Be sure that all outlet piping rises away from the SmartPump. Be sure that all inlet and outlet valves are open. Be sure that the hand pump bypass valve is closed and the hand pump 3-way valve is in the Hose position. Open the purge valve located at the pump discharge and observe the clear purge hose. Purge until all air is removed and there is solid liquid flow out of the valve. The centrifugal motor pump should now pump. If there is still no flow open the purge valve with the pump running until solid liquid flow is observed.

DRAWINGS AND PARTS LIST

The drawings included in this manual are the most accurate source of part numbers for your Fuel Supply System. When ordering replacement parts, always consult the Parts Legend on the right hand side of the applicable 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 located on each drawing legend. *A typical drawing legend and parts list is illustrated at right.*

SIMPLEX®		SPRINGFIELD, ILLINOIS
SCALE : ~	APPROVED BY :	DRAWN BY : CJG
DATE : 01-11-11		REVISED :
FUEL TRANSFER EQUIPMENT		SP-4/4 WIRING DIAGRAM-1
W.O. # 75123-10-52		DRAWING NUMBER 218180

ASSEMBLY				
ITEM	QTY.	PART #	DESIG.	DESCRIPTION
1	1	218177	SP	SP-4/4 SMARTPUMP 4 - TANK 5HP, 400GPM
2	1	218178	ENC	SMARTPUMP CONTROLLER 30x30x10, TYPE-3R
3	1	154637	DD	OUTER DOOR 30x30x10 BOX
4	1	204982	ID	INNER DOOR 30x30x10 BOX
5	3	22433010	RB1	REDUCER BUSHING 3.00" x 1.00"
6	2	22440678	QD	QUICK DETACHABLE COUPLING (PART-B) 3.00" FEMALE COUPLING, MALE THREAD ALUMINUM
7	2	22440904	DP	DUST PLUG, QUICK DETACHABLE 3.00" COUPLING ALUMINUM
8	2	22532003	TEE1	TEE, 3.00"
9	1	-----		CROSS, 3.00"
10	4	22630000	FLG	BOLT FLANGE, RAISED FACE SLIP ON, 3.00"
11	1	-----		REDUCING FLANGE 150# 4.00"x3.00"
12	2	22630001	GSKT	BOLT FLANGE GASKET KIT 3.00"
13	1	24748500	P/M	PUMP/MOTOR 300 GPM 462 IMPELLER, VITON SEALS BRONZE FITTED, CLOSE COUPLED TO BEARING FRAME MOTOR 5HP, 230/460VAC, 3PH., 60HZ TEFC
14	2	22919000	BV1	BALL VALVE, 3.00" NPT
15	1	22918200	BV3	3-WAY BALL VALVE 1.00" NPT
16	2	22918010	BV2	BALL VALVE 1.00" NPT
17	1	22925003	SC	SWING CHECK VALVE 3.00" NPT
18	1	-----	WC	WAFER CHECK VALVE 3.00"
19	1	22924000	CV	CHECK VALVE 1.00" NPT
20	1	24748300	MHP	HAND PUMP 1-GAL/5-STROKES
21	1	25242140	LS1	FUEL LINE LEAK SENSOR

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

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

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

SUPER X-L PUMP

PUMP MODEL	DISPLACEMENT IN ³ (CC/REV.)	RPM	Flow, GPM (LPM)				
			100 PSI (6.9 Bar)	1000 PSI (69 Bar)	1500 PSI (103 Bar)	2000 PSI (138 Bar)	2500 PSI (172 Bar)
SUPER XL-11	.262 (4.29)	1800	1.99 (7.54)	1.86 (7.05)	1.79 (6.78)	1.73 (6.56)	1.66 (6.29)
SUPER XL-39	.942 (15.44)	1800	7.08 (26.83)	6.87 (26.04)	6.77 (25.66)	6.66 (25.24)	6.56 (24.86)
SUPER XL-62	1.47 (24.14)	1800	11.10 (42.07)	10.81 (40.97)	10.70 (40.55)	10.60 (40.17)	10.40 (39.42)
SUPER XL-90	2.23 (36.5)	1800	16.70 (63.29)	16.50 (62.54)	16.30 (61.78)		
SUPER XL-114	3.35 (54.9)	1800	25.30 (95.89)	24.90 (94.37)	24.60 (93.23)	24.40 (92.48)	

PUMP PERFORMANCE DATA 40 SSU • 200 SSU • 500SSU (SERIES 420)

		40SSU						200SSU											
		0 PSI		50 PSI		100 PSI		0 PSI		50 PSI		100 PSI		200 PSI		300 PSI		500 PSI	
MODEL	RPM	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
420	1200	1.9	¼	1.7	¼	1.5	⅓	1.9	⅛	1.9	⅛	1.7	¼	1.5	⅓	1.4	½	1.2	¾
	1800	2.9	¼	2.7	½	2.5	½	2.9	⅛	2.8	¼	2.7	⅓	2.5	½	2.3	¾	2.1	1½
422	1200	3.7	⅓	3.4	½	3.1	¾	3.7	⅛	3.4	¼	3.1	¼	2.8	½	3.0	1	2.8	1½
	1800	5.4	½	4.9	¾	4.8	1	5.5	¼	4.9	⅓	4.9	½	4.6	¾	4.3	1½	3.8	2
424	1200	9.0	¾	7.6	¾	6.0	1	9.0	⅓	8.6	½	8.2	1	7.7	2	7.1	3	-	-
	1800	11.5	⅓	11.1	1	10.7	1½	13.7	½	13.3	1	12.9	1½	10.9	3	10.2	5	-	-
426	1200	10.0	¾	8.2	1	6.3	1½	12.0	¾	11.0	1	10.5	1½	-	-	-	-	-	-
	1800	15.0	1	12.2	1½	9.5	3	18.0	1	17.0	1½	16.0	3	-	-	-	-	-	-
428	1200	20.9	¾	17.4	1½	14.0	3	24.5	¾	23.8	1½	23.0	3	-	-	-	-	-	-
	1800	31.2	1½	26.1	3	21.0	5	37.0	1½	36.0	3	35.0	5	-	-	-	-	-	-
429	1200	34.0	1½	29.0	3	22.0	5	41.0	1½	40.0	3	38.5	5	-	-	-	-	-	-
	1800	53.0	3	45.0	5	36.0	7½	61.7	3	61.0	5	60.0	7½	-	-	-	-	-	-

		500SSU											
		0 PSI		50 PSI		100 PSI		200 PSI		300 PSI		500 PSI	
MODEL	RPM	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
420	1200	1.8	⅛	1.8	⅛	1.7	¼	1.6	⅓	1.4	½	1.1	1
	1800	2.7	¼	2.7	¼	2.6	⅓	2.5	½	2.4	1	2.2	1½
422	1200	3.6	⅛	3.5	¼	3.3	⅓	2.8	½	2.7	¾	2.0	1½
	1800	5.3	¼	5.2	⅓	4.9	½	4.4	1	4.0	1½	3.0	2
424	1200	8.7	½	8.6	¾	8.5	1½	8.2	2	7.8	3	-	-
	1800	2.9	1	12.8	1½	12.7	2	12.5	3	12.0	5	-	-
426	1200	12.0	1	11.5	1½	11.0	2	-	-	-	-	-	-
	1800	18.1	1½	18.0	2	16.3	3	-	-	-	-	-	-
428	1200	24.5	1½	24.0	2	23.7	3	-	-	-	-	-	-
	1800	37.0	3	36.5	5	36.0	5	-	-	-	-	-	-
429	1200	41.0	2	40.0	5	39.5	5	-	-	-	-	-	-
	1800	61.7	5	61.0	5	60.0	7½	-	-	-	-	-	-

PUMP PERFORMANCE DATA 1000 SSU • 5000 SSU • 10000SSU (SERIES 420)

		1000SSU											
		0 PSI		50 PSI		100 PSI		200 PSI		300 PSI		500 PSI	
MODEL	RPM	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
420	1200	1.9	1/8	1.9	1/8	1.8	1/4	1.7	1/3	1.6	1/2	1.4	3/4
	1800	2.8	1/4	2.7	1/4	2.7	1/4	2.6	1/2	2.5	3/4	2.2	1 1/2
422	1200	3.5	1/4	3.4	1/4	3.3	1/3	3.0	3/4	2.6	3/4	1.8	1 1/2
	1800	5.0	1/3	4.9	1/2	4.9	3/4	4.7	1	4.2	1 1/2	3.4	2
424	1200	8.8	3/4	8.7	1	8.5	1 1/2	8.2	2	7.8	3	-	-
	1800	13.0	1 1/2	12.7	2	12.5	2	10.2	3	9.9	5	-	-
426	1200	12.5	1 1/2	12.0	1 1/2	11.8	2	-	-	-	-	-	-
	1800	18.7	2	18.5	2	17.0	3	-	-	-	-	-	-
428	1200	24.9	2	24.5	3	24.0	5	-	-	-	-	-	-
	1800	37.4	5	37.2	5	36.5	5	-	-	-	-	-	-
429	1200	41.7	3	41.7	5	41.0	5	-	-	-	-	-	-
	1800	61.7	5	61.7	7 1/2	61.0	7 1/2	-	-	-	-	-	-

		5000SSU									10000SSU						
		0 PSI		50 PSI		100 PSI		200 PSI		300 PSI		0 PSI		50 PSI		100 PSI	
MODEL	RPM	PM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
420	1200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
422	1200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
424	1200	8.2	1	8.0	1 1/2	7.8	2	7.6	3	7.4	3	-	-	-	-	-	-
	1800	11.2	2	11.0	3	10.7	3	10.2	5	9.9	5	-	-	-	-	-	-
426	1200	12.5	2	12.4	2	11.6	3	-	-	-	-	-	-	-	-	-	-
	1800	18.7	3	18.5	3	17.5	5	-	-	-	-	-	-	-	-	-	-
428	1200	24.9	5	24.9	5	24.5	5	-	-	-	-	23.3	5	23.0	5	22.8	5
	1800	37.4	7 1/2	37.4	7 1/2	37.0	7 1/2	-	-	-	-	-	-	-	-	-	-
429	1200	41.7	5	41.0	5	40.0	7 1/2	-	-	-	-	-	-	-	-	-	-
	1800	61.7	7 1/2	61.7	7 1/2	61.0	10	-	-	-	-	-	-	-	-	-	-

MOTORS FOR PUMP DRIVE *CONTINUOUS DUTY, 40°C, UL RECOGNIZED***Single Phase Motors**

Split Phase Start, Drip Proof, Rigid Base, Class B
Insulation, Moderate Starting Torque, Sleeve Bearing

HP	RPM	Voltage	NEMA Frame	Bearing	Thermal Prot.	Service Factor	Approx. F.L. Amps
1/3	1800	115	48	Sleeve	Auto	1.0	6.6
1/2	1800	115	56	Sleeve	None	1.0	9.2

Capacitor Start, Drip Proof, Rigid Base, Class B Insulation,
High Starting Torque, Ball Bearing

HP	RPM	Voltage	NEMA Frame	Bearing	Thermal Prot.	Service Factor	Approx. F.L. Amps
1/3	1800	115/230	48	Sleeve	Auto	1.0	7.0/3.5
1/2	1800	115/230	56	Sleeve	Auto	1.0	9.2/4.6
3/4	1800	115/230	56	Sleeve	Auto	1.0	10.4/5.2

Capacitor Start, Drip Proof, Rigid Base, Class B Insulation,
Moderate Starting Torque, Sleeve Bearing

HP	RPM	Voltage	NEMA Frame	Thermal Prot.	Service Factor	Approx. F.L. Amps
1	1800	115/208-230	56	Auto	1.15	13.4/6.8-6.7
1 1/2	1800	115/208-230	56H	Auto	1.15	18.0/9.3-9.0
2	1800	115/208-230	145T	None	1.15	21.0/11.3-10.5
3	1800	115/208-230	184T	None	1.15	33.0/16.5
5	1800	208-230	184T	None	1.15	23.0-21.0
7 1/2	1800	208-230	215T	None	1.15	35.2

Capacitor Start, Totally Enclosed, Fan-Cooled, Rigid
Base, Class B Insulation, NEMA-L (≥ 1.0 HP) High Starting
Torque, Ball Bearing

HP	RPM	Voltage	NEMA Frame	Thermal Prot.	Service Factor	Approx. F.L. Amps
1/3	1800	115/208-230	56	Auto	1.15	6.6/3.1-3.3
1/2	1800	115/208-230	56	Auto	1.15	8.8/4.2-4.4
3/4	1800	115/208-230	56	Auto	1.15	11.0/5.4-5.5
1	1800	115/208-230	56	Auto	1.15	13.4/6.8-6.7
1 1/2	1800	115/208-230	56H	Auto	1.15	15.2/8.2-7.6
2	1800	115/208-230	145T	None	1.15	18.8/9.4
3	1800	115/208-230	184T	None	1.0	34.0/17.0
5	1800	208-230	213T	None	1.0	27.5-26.0
7 1/2	1800	208-230	215T	None	1.0	36.5-33.0

MOTORS FOR PUMP DRIVE *CONTINUOUS DUTY, 40°C, UL RECOGNIZED*

Three Phase Motors

Drip Proof, Rigid Base, Class B Insulation, NEMA B, High Starting Torque, Ball Bearing

HP	RPM	Voltage	NEMA Frame	Thermal Prot.	Service Factor	Approx. F.L. Amps
1/3	1800	208-230/460	56	Auto	1.35	1.5-1.6/0.8
1/2	1800	208-230/460	56	Auto	1.35	2.3-2.4/1.2
3/4	1800	208-230/460	56	Auto	1.25	2.9-3.0/1.5
1	1800	208-230/460	56	Auto	1.15	3.5-3.6/1.8
1 1/2	1800	208-230/460	145T	Auto	1.15	4.8-4.8/2.4
2	1800	208-230/460	145T	Auto	1.15	6.2-6.2/3.1
3	1800	208-230/460	145T	Auto	1.15	9.2-8.6/4.3
5	1800	230/460	184T	Auto	1.15	13.2/6.6
7 1/2	1800	230/460	213T	Auto	1.15	20.0/10.0
10	1800	230/460	215T	Auto	1.15	26.6/13.3

Totally Enclosed-Fan-Cooled, Rigid Base, Class B Insulation, Class F (182T -254T), NEMA B, High Starting Torque

HP	RPM	Voltage	NEMA Frame	Approx. F.L. Amps
1/3	1800	208-230/460	56	1.5-1.6/0.8
1/2	1800	208-230/460	56	2.3-2.4/1.2
3/4	1800	208-230/460	56	2.9-3.0/1.5
1	1800	208-230/460	56	3.5-3.6/1.8
1 1/2	1800	208-230/460	145T	4.8-4.8/2.4
2	1800	208-230/460	145T	6.0-5.8/2.9
3	1800	208-230/460	145T	8.6/4.3
5	1800	230/460	184T	14.0-13.2/6.6
7 1/2	1800	230/460	213T	21.0-20.0/10.0
10	1800	230/460	215T	28.0-27.0/13.5

DC Motors - Ampere Ratings and Fuse Sizes

Motors HP	Ratings of DC Motors Full-Load Amperes		Amp. Cap. of Fuses for Recommended Values	
	120 Volts	240 Volts	120 Volts	240 Volts
1/8	1.4	.7	3	3
1/6	1.8	.9	3	3
1/4	2.9	1.5	5	3
1/3	3.6	1.8	5	3
1/2	5.2	2.6	7	3
3/4	7.4	3.7	10	5
1	9.4	4.7	15	7
1 1/2	13.2	6.6	20	10
2	17	8.5	25	12
3	25	12.2	30	15
5	40	20	50	25
7 1/2	58	29	80	40
10	76	38	100	50

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		