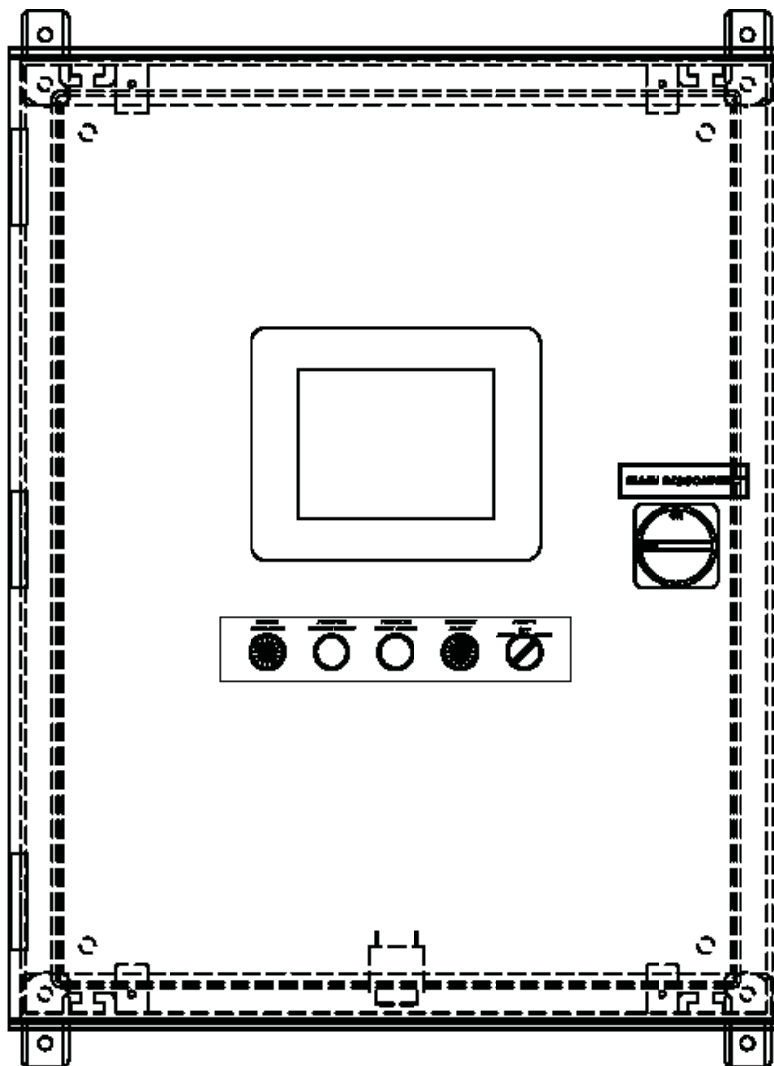


# SIMPLEX™

## PLC DAY TANK CONTROL PANEL

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## **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 controller for damage. Check the entire outside of the controller for damage which could cause internal mechanical or electrical problems.
2. Check main disconnect switch, door and hinge operation.
3. 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 provided.
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 Control Panel as shown on the electrical drawings.
4. If equipped, connect dry alarm contacts for customer use per specifications on the electrical drawings.
5. Connect control power to the Control Panel per specifications on the electrical drawings.



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

## **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 / Day Tank Auto-Off-Hand switch
5. HMI Touch-screen Controls and Indicators:
  - a. Fill Pump 1 / Day Tank Filling
  - b. Fill Pump 1 / Day Tank Call For Fuel Runtime
  - c. Day Tank Fuel Level – Percent
  - d. Day Tank Fuel Level – Gallons
  - e. Test Fill push-button
  - f. View Alarms push-button
  - g. Leak Detected Indicator
  - h. Day Tank Fuel Level Indication – Graphically
  - i. 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 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/Day Tank Auto-Off-Hand mode switch is provided to allow the operator complete control over the Day Tank. The 3-position mode switch 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 annunciate 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 via the Fill Pump 1/Day Tank 3-position switch. As fuel is consumed the level drops below the Fill Start-50% level and a fill pump is energized via relay contact closure. As fuel enters the Day Tank, the fuel level rises to the Full Tank/Fill Stop-90% level, at which time the relay contacts open and the fill pump will be de-energized. During a pump running condition, a customer supplied, normally closed, flow switch is

### **⚠ 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.**

monitoring fuel progression and should the flow switch not detect sufficient fuel motion for a period of 30 seconds, the relay contacts open and the fill pump is de-energized and considered failed. Once a loss of flow condition is detected, an indicator is illuminated on the HMI touch-screen, an alarm horn will sound, and the fill pump 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 pump start contacts will open, the fill pump will stop and no further fill start requests will be generated 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 open the pump start relay

contacts, de-energize the fill pump 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 pump start contacts will open, the fill pump will stop and no further fill start requests will be generated 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**

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 pump start contacts will open, the fill pump will be de-energized and no further fill start requests will be generated 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 the Pump 1/Day Tank 3-position mode switch. This will generate a Fill Start request, close the relay contacts, and energize the fill pump 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, the Fill Start contacts will open, and the fill pump 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 Pump 1/Day Tank 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 Pump 1 / Day Tank 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 generate a Fill Start contact closure and energize a fill pump. This will increase the Day Tank fuel level to the Full Tank/Fill Stop-90% level, at which time the relay contacts open and the fill pump 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.

#### **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.

<b>AC</b> -Alternating Current	<b>MOT</b> -Motor
<b>AHR</b> -Alarm Horn Relay	<b>N.C.</b> -Normally Closed
<b>AR</b> -Alarm Horn	<b>NEC</b> -National Electric Code
<b>BPRV</b> -Back Pressure Regulating Valve	<b>NEMA</b> -National Electric Manufacturers Association
<b>BRK</b> -Motor/Pump Bracket	<b>NFPA</b> -National Fire Protection Association
<b>BV</b> -Ball Valve	<b>N.O.</b> -Normally Open
<b>C</b> -Contactor	<b>NP</b> -Nameplate
<b>CB</b> -Circuit Breaker	<b>NPT</b> -National Pipe Thread
<b>CSR</b> -Check Strainer Relay	<b>O.D.</b> -Outside Diameter
<b>CV</b> -Check Valve	<b>OLR</b> -Over Load Relay
<b>DC</b> -Direct Current	<b>OPT</b> -Option
<b>DPDT</b> -Double Pole Double Throw	<b>PCB</b> -Printed Circuit Board
<b>F</b> -Fuse	<b>PCRX</b> -Pump Control Relays
<b>FLS</b> -Flowswitch	<b>PG</b> -Pressure Gauge
<b>FS</b> -Floatswitch	<b>PLR</b> -Pipe Leak Relay
<b>FSR</b> -Simplex Fuel Strainer	<b>PRV</b> -Pressure Relief Valve
<b>GA</b> -Gauge	<b>PS</b> -Pressure Switch
<b>GAL</b> -Gallons	<b>PSI</b> -Pounds Per Square Inch
<b>GPM</b> -Gallons Per Minute	<b>PSR</b> -Pressure Switch Relay
<b>HFL</b> -High Fuel Level Relay	<b>PRR</b> -Pump Running Relay
<b>HG</b> -Mercury	<b>SC</b> -Swing Check Valve
<b>HP</b> -Horsepower	<b>SOL</b> -Solenoid
<b>HZ</b> -Hertz	<b>SST</b> -Simplex Super Tank
<b>I.D.</b> -Inside Diameter	<b>TB</b> -Terminal Block
<b>JB</b> -Junction Box	<b>T</b> -Control Transformer
<b>Hz</b> -Hertz	<b>TDR</b> -Time Delay Relay
<b>INHG</b> -Inches of Mercury	<b>TEFC</b> -Totally Enclosed, Fan Cooled
<b>L</b> -Lamp	<b>THR</b> -Tank Heater Control Relay
<b>L.E.D.</b> -Light Emitting Diode	<b>TS</b> -Transducer Pressure Switch
<b>LAFD</b> -Los Angeles Fire Department	<b>V</b> -Voltage
<b>LFF</b> -Loss of Flow Relay	<b>VAC</b> -Voltage, Alternating Current
<b>LFL</b> -Low Fuel Level Relay	<b>VDC</b> -Voltage, Direct Current
<b>LPR</b> -Low Pressure Relay	<b>VG</b> -Vacuum Gauge
<b>MDB</b> -Main Distribution Block	
<b>MDS</b> -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 D<sup>2</sup> 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
<b>Auto Lubricating S.A.E.-</b>									
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								
<b>Fuel Oil-</b>									
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
<b>Turbine-</b>									
Heavy	.91 Avg.	4,800	1,280	625	350	170	86	57	
Light	.91 Avg.	770	330	208	138	87	58.8		