

PRYCO, INC.

SUGGESTED SPECIFICATION

FUEL CONTROL AND MONITORING SYSTEM

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DETAIL SPECIFICATIONS

INTRODUCTION

PRYCO's **FUEL CONTROL and MONITORING (FCM)** system is the most sophisticated and powerful control tool available for your fuel supply system -- electronic or mechanical. It may be mounted on a day tank, subbase tank or a remote pumping unit. **FCM** is a computerized total system designed to control and monitor the activities of up to four pumps and motors. Through electronic settings, the assigned duty of the four pumps and motors can be any combination of Fill or Reverse Flow.

STANDARD FEATURES

- Ultra-Sonic Sensor - 4-20ma
- 24vdc Input For Continuous Operation (Main, Auxiliary or Backup Power to FCM)
- Power Available LED
- System Ready LED
- Electronic Fuel Gauge
- HOA Switch
- Control Panel System Test Switch
- Control Panel Alarm Test Switch
- Control Panel Alarm Reset Switch
- Control Panel Audible Alarm Silence Switch
- Safety High Switch w/Fill Motor Shut Down ^[1]
- High Fuel Level Notification ^[1]
- Low Fuel Level Notification ^[1]
- "Dry Tank" Prevention w/Reverse Pump Shut Down
(will be replaced by Critical Low, if purchased)
- Secondary Containment Leak Detection
(when optional rupture basin or double wall construction specified)

OPTIONS

- Controls and Piping for Duplex Fill Pump & Motor
- Lead/Lag Alternation Of Duplex Fill Pumps/Motors
- Controls and Piping for Reverse Flow Pump(s) - Single or Duplex
- Lead/Lag Alternation Of Duplex Reverse Flow Pumps/Motors
- Pump(s) Fail Detection w/Automatic & Manual Reset
- Critical Low Level Notification (see footnote on preceding page)
- Computer Control & Monitoring Software
- Industrial Quality UART Modem

^[1] These features include a Control Panel Alarm LED and an N.O. & N.C. Remote Signal Contacts for Engine Shut Down, etc.

NORMAL ACTION LEVELS

ACTION LEVEL	PY5 - PY10	PY15	PY25	PY50	PY60	PY75 - PY150	PY200 PY1000
Top Of Tank	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Safety High Level	3.0	3.0	3.0	3.0	3.0	3.0	3.0
High Fuel Level	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Secondary Reverse Flow - ON	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Primary Reverse Flow - ON	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Fill Pumps - OFF (100% Full)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Reverse Pumps - OFF	5.5	6.0	6.0	6.0	6.0	6.0	6.0
Primary Fill Pump - ON	6.0	8.0	8.0	8.0	8.0	8.0	10.0
Secondary Fill Pump - ON	6.5	10.0	10.0	10.0	10.0	10.0	14.0
Low Fuel Level	7.0	12.0	14.0	14.0	14.0	14.0	18.0
Critical Low Level	8.0	14.0	19.0	26.0	34.0	39.0	44.0
Dry Tank Protection Level	9.5	15.5	20.5	27.5	35.5	40.5	45.5
Empty Tank (0%)	12.5	18.5	23.5	30.5	38.5	43.5	48.5

THE INTERFACE BOARD

The Interface Board is where external devices, such as pump motors, heaters, alarms, etc., are connected. Features of this board are:

- connectors for incoming 120vac power,
- a connector to supply 24vdc **main, auxiliary or back up** power for the FCM system only. (This 24vdc power is also supplied to a modem, if installed, to keep the FCM “on line”.)
- a Normally Open (N.O.) relay for each pump motor. The “ON/OFF” setting of this relay is controlled by the FCM *Firmware* (a computer program that “talks” directly to the FCM hardware).
- a N.O. relay to control operations of an optional heater,
- a set of “dry contact” connectors for the following:
- remote annunciation of abnormal level detection. These six-position connectors are a direct extension of a relay that FCM activates (both N.O. and N.C.) when the following levels have been read by the Ultra-Sonic Sensor or from external switches: High Fuel level, Low Fuel level, Critical Low level, Critical High level, and secondary containment leak detector.

- Pump Fail (no fuel detected in the fuel line) and control. These connectors/relays are similar to the preceding N.O. and N.C. remote annunciation except FCM activates the relay based upon input from a flow switch. There are two additional terminals on each connector that receives the input.
- other supporting electronic parts and components.

FCM STANDARD FEATURES

ULTRA-SONIC SENSOR 4-20ma

This device emits a signal downwards into a tube extending the depth of the tank. When the signal encounters an object (the fuel), it bounces back to the emitting device that has a built-in receiver. The elapsed time between emission of the signal and its return is converted into an electrical voltage, which in turn, is changed to inches of air space from tip of emitter to fuel level.

Important to note - nothing (inductance probe, or such) touches the fuel. Hence, there are no erratic and low voltage level readings caused by gum-up or other undesirable phenomenon which are inherent to similar out-dated systems. Periodic cleaning and re-adjustment of probes and the system is not necessary.

24vdc ALTERNATE/AUXILIARY POWER INPUT

120vac is the normal voltage for the FCM; however, there are some cases where it is not available or it may be desirable to use "battery" power. At startup time, if 120vac power is not available, FCM automatically switches to 24vdc as an **alternate** voltage for its internal power.

If 120vac power is interrupted for whatever reason and a 24vdc **auxiliary** power, such as a battery, is connected to the FCM, it will automatically switch to its alternate power input and normal operations continue.

POWER AVAILABLE LED

This green LED is used to report that power is on and the FCM is energized. It does not imply the FCM is functioning properly (FCM system performance is reported by the System Ready LED).

SYSTEM READY LED

This slow flashing yellow LED reports the status of the overall FCM system. When the system is powered on, the above POWER AVAILABLE LED is turned on and the system undergoes a "Power On Self Test" (POST). All features and options are checked internally for reasonableness to ensure they are operational and within tolerances. If all POST checks are completed successfully, the SYSTEM READY LED is turn on and the FCM is then operational.

ELECTRONIC FUEL LEVEL GAUGE

This gauge is an electronic measurement of the fuel level. It features a set of eight LED's to report the usable fuel in the tank. The 100% or FULL level is normally set to the Fill Pump shut off level (not the top of the tank); the EMPTY level of the gauge is normally set to the bottom of the tank. Each lighted LED represents fuel present at a linear determination of about 1/8 of the calculated usable span.

HOA SWITCH

This is actually a series of three switches per pump motor that function as an HOA switch in an OFF, ON and AUTO position. In an ON position, FCM surrenders control of the pump motor except actions at the specified control points -- Critical High, High Fuel, Low Fuel, and the Critical Low fuel levels. In the AUTO position, the FCM automatically controls the activities of the motors based upon fuel level readings and control points.

SYSTEM TEST SWITCH

This feature is used for a visual test of the LED's only. When pressed, all LED's on the control panel are lighted and should be illuminated. It does not test any monitor/control functions of the FCM.

ALARM TEST SWITCH

This feature actually tests the controls and relays associated with the four alarm levels (Critical High, High Fuel, Low Fuel and Critical Low), and the four pump fail functions. It is also a local visual test that will notify the operator of any error.

ALARM RESET SWITCH

This optional switch, located on the control panel, is used to turn off a visual alarm that had reported an abnormal condition that was corrected. When an abnormal condition exists, it is reported by changing the appropriate LED to a flashing ON state and sounds a horn, if installed. The LED continues to flash until the condition is corrected. Then:

- if this option **is not active**, the LED is turned off automatically when the condition is corrected.
- if this option **is active**, "*Alarm Latching*" is also active. Alarm Latching changes the flashing LED to a solidly lit LED when the condition is satisfied. This provides an historical account that an abnormal condition did occur. The solid LED remains lit until this optional switch is pressed.

ALARM SILENCE SWITCH

This optional switch, also located on the control panel, is used to turn off an installed alarm horn that is sounding as an abnormal condition exists. (The horn will shut off automatically when the condition is corrected.) This is welcome relief to workers who are correcting the problem.

SAFETY HIGH FEATURE

This standard feature is **always installed**. It acts as a mechanical fail-safe to prevent flooding should an electronic fault occur preventing the Fill Pumps/Motors from shutting off at the specified level.

The Safety High Level is always set to 3.0” down from the top of the tank. It will always shut off all Fill Pump/Motors (internally controlled by FCM).

Two sets of *Dry Contacts* are provided, (1 - N.O. and 1 - N.C.). If the day tank is supplied by a gravity-feed main tank, this is a good place to receive a signal to close a normally open solenoid valve in the intake line. The customer must supply external power for any remote alarms/lights.

HIGH FUEL FEATURE

This standard feature is **always installed**. In its basic setup, when the fuel reaches a specified “high” level, it will turn on a High Fuel Light/Alarm. Optionally, as a safety feature, FCM can be programmed with a “Shut Fill Pump(s) Down” feature.

The High Fuel Level is normally set to 3.5” down from the top of the tank.

Additionally, two sets of *Dry Contacts* are provided, (1 - N.O. and 1 - N.C.). The customer must supply external power for any remote alarms/lights.

LOW FUEL FEATURE

This standard feature is **always installed**. When the fuel reaches a specified “low” level, it will turn on a light on the control panel and will shut off any installed Reverse-Flow Pumps/Motors.

Low Fuel Level is normally set at predetermined distance from the top of the tank. These settings are:

Py5 & PY10	7.0”
Py15	12.0”
Py25 - PY150	14.0”
Py200 - PY1000	18.0”

Two sets of *Dry Contacts* are provided, (1 - N.O. and 1 - N.C.). The customer must supply external power for any remote alarms/lights.

“DRY TANK” PREVENTION

This feature is to prevent the emptying of the tank due to reverse flow pump-out. If the customer did not purchase a Critical Low option, this feature is installed for fail-safe protection. Unlike a Critical Low, it does not support generator engine shut down or remote annunciation. Its activation point is 3.5” from the bottom of the tank.

SECONDARY CONTAINMENT SWITCH

This is a standard feature that is activated when secondary containment is purchased. It will light an LED on the control panel and activate an alarm.

Additionally, two sets of *Dry Contacts* are provided (1 - N.O. and 1 - N.C.) for remote annunciation. The customer must supply external power for any remote alarms/lights.

FCM OPTIONAL FEATURES

DUPLEX SUPPLY PUMP

An additional fill pump and motor of any size and voltage may be installed on the day tank, subbase or on a remote pumping unit and controlled by FCM. This second pump/motor is referred to as **Pump #2** on the FCM control panel and by software. FCM will control it regardless where it may be mounted.

Pump #2 has its own set of “HOA” switches as well as a “turn ON” level, pump running LED, and a pump fail LED/reset switch. It will however, turn OFF at the same level as **Pump #1** (the Standard Fill Pump/Motor).

Pump #2, in its basic setup, is always in a “lag” position, i.e., it will only turn ON when the fuel level has dropped past a point where it has been determined that Pump #1 cannot keep up with the draw-down of the generator. The Alternation of Duplex Pumps option explained below will override this permanent “lag” assignment.

If Alternation of Duplex Pumps option is not installed, Pump #1 is always referred to as the **Primary Fill Pump** and Pump #2 is the **Secondary Fill Pump**.

REVERSE FLOW PUMP(s) - SINGLE or DUPLEX

As a safety feature, the fuel supply system can be optionally configured with a sub-system that will pump the fuel in the day tank or subbase to another container – normally back to the main supply tank. This operation is referred to as “reverse flow”. It can be configured as either a single pump/motor or as a duplex.

The single pump/motor of a reverse flow (or the first of a duplex setup) is always referred to as **Pump #3**. If the configuration is a duplex reverse flow, the second is **Pump #4**.

Both reverse flow pumps have their own set of “HOA” switches, “turn ON” levels, pump running LEDS, and a pump fail LEDS and reset switches. And both share a common “turn OFF” level.

Pump #4, in its basic setup, is always in a “lag” position, i.e., it will only turn on when the fuel level has risen past a point where it has been predetermined that Pump #3 cannot keep up with the filling of the tank. The Alternation of Duplex Pumps option explained below will override this permanent “lag” assignment.

If Alternation of Duplex Pumps option is not installed, Pump #3 is always referred to as the **Primary Reverse Pump** and Pump #4 is the **Secondary Reverse Pump**.

When a reverse flow pump is turned ON, the fill pump(s) will automatically be turned OFF in case either has caused the problem. The voltage, size, type of current, etc. of reverse flow pump(s) and motor(s) are not required to match those of the fill pump(s) and motor(s).

ALTERNATION of DUPLEX PUMPS

If the fuel supply system has been designed correctly and the “lead” pumps/motors (Pumps #1 & #3) have been sized to match the demands of the generator, and no unusual condition or problem arises, it is conceivable that the “lag” pumps/motors (Pumps #2 & #4) will never or very seldom see action. This “alternation” option switches the lead/lag assignment of each class (Fill or Reverse Flow) of pump/motor in an attempt to equalize the run time.

When a pump motor (Fill or Reverse) is cycled into lead position, it assumes the title as the **Primary**, whereas, the lag pump/motor is the **Secondary**. This does not change the fact that the secondary pump will back up the primary at a predetermined level.

PUMP FAILURE w/MANUAL and AUTOMATIC RESET

This option works in conjunction with an optional Flow Switch to report a “no fuel present” condition in the fuel line from the main storage tank. Without this option, there is a possibility of the pump losing its prime or running dry (which will eventually cause pump damage).

When a pump/motor starts, there is a approximate 10 second delay to give the line time to get charged with fuel, if not already filled. After this delay, the FCM will initiate failure testing based upon a possible signal from the flow switch. If a “no fuel in line” condition is received, the FCM enters another approximate 10-second delay to validate the condition. After the second delay and “no fuel” condition still exists, the FCM determines that a failure has occurred and takes the following actions:

- shuts off pump/motor
- lights the appropriate LED (solid)
- sounds a horn, if installed.
- makes note of the “failed” pump intended action, i.e., the position of the HOA switch, “ON” or “AUTO”

If the FCM is programmed to restart manually, it will wait for the operator to press the Reset switch to repeat the start-up process.

Optionally (no charge), it is possible to allow the FCM to attempt to restart the pump/motor automatically (after the 10 + 10 delay when the motor was shut off). If the option is set to Auto-Restart and a specified time (1 to 240 minutes) has elapsed, the FCM will attempt the restart. This attempt to restart will continue indefinitely until the condition is corrected. Manual override is permitted during Auto-Restart.

CRITICAL LOW OPTION

This option is to prevent the emptying of the tank due to abnormal engine draw-down or reverse flow. It turns on an alarm condition and when wired to the ignition switch of the generator engine, will shut it off to prevent loss of prime and possible damage.

The Critical Low level is normally set to 3.5” up from the bottom of the tank.

Two sets of *Dry Contacts* are provided, (1 - N.O. and 1 - N.C.) to connect external alarm devices (N.O.) and to turn off the power to the engine ignition. The customer must supply external power for any remote alarms/lights.

COMPUTER MONITOR and CONTROL SOFTWARE

An optional PC computer software system, named ***Smart Control***, is available to control and monitor the activities of the FCM at a location relatively close to the unit or at any distance using an FCM-compatible modem. The features of Smart Control are described in the next section.

COMMUNICATIONS MODEM

If Smart Control is to be utilized in a location more than the maximum allowed for a direct connection to a PC computer's serial port, a modem and telephone lines are required.

The FCM modem must be one that is "industrial strength" to withstand environmental conditions and will interface with the proper attributes, protocols, etc. required by FCM. The optional modem is designed to meet these requirements. An off-the-shelf modem sold at computer stores, etc. is not capable of this assignment.

EXTERNAL CONNECTIONS

INTERFACE BOARD LAYOUT

The FCM Interface Board (graphically shown on page 15) is where connection(s) are made for all external inputs and outputs. Located on the left side of the board is a group of seven larger relays (referred to herein as the “30-amp relays”). These provide terminals connecting the incoming 120vac power for the FCM, and for the output of pump motors and an optional 120vac heater.

There are smaller 5-amp relays (not shown) positioned around the remaining perimeter of the board. Associated with these relays are six and eight pin connectors. Both types of connectors have two sets of N.O. terminals for “dry contact” remote annunciation and two sets of N.C. for external actions, such as engine shut down. The rightmost terminals of the eight-position connectors are input from optional Fuel Flow Switches or from the Critical High and Rupture float switches.

Finally, there are two other connectors: 1) two-position for 24vdc battery power for FCM system operational backup; and, 2) three-position for a N.O. or N.C. external Common Alarm connection.

SPECIFICATIONS - 30-AMP RELAY

Relay Type ----- Single Pole - Single Throw
Relay Load Rating --- 30 amp. @ 120vac - 1 hp rated
Connector ----- Normally Open (N.O.)

SPECIFICATIONS - 5-AMP RELAY

Relay Type ----- Double Pole - Double Throw
Relay Load Rating --- 5 amp. (600 watts @ 120vac) per pole
Connector ----- 2 sets of N.C. and N.O.