
ELECTRONIC PUMP CONTROL PANEL

INTRODUCTION

This specification covers the design, manufacture, and testing of Electronic Pump Control Panels

PART 1 - GENERAL

1. Standard products - use the same manufacturer for multiple units of same type.
2. "Tying" of equipment into packages for the purpose of thwarting competition shall be considered to be in non-compliance with these specifications.
3. Manufacturers shall price items under different subsections or sections separately.

PART 2 - PRODUCTS

2.01 ELECTRONIC PUMP CONTROL PANEL

A. GENERAL FUNCTION

The Electronic Pump Control Panel shall provide control between the pump control valve and the pump, to prevent surges in the system when the pump starts or stops. The control panel shall properly sequence and control the pump start-up and pump shut-down procedure, providing both visual and electronic status outputs for operating personnel. Panel shall protect the pumping system from damage due to mechanical, hydraulic or power failure. Panel shall be pre-wired and include an integral programmable valve controller to sequence the pump and pump control valve during all modes of operation. Controller shall be pre-programmed for most common pump control applications. Controller shall be easy to wire and adjust. Controller to include the following features:

- Sequence timers
- Local visual indication of pump and control valve status.
- Displays time for system to build pressure and for valve to open
- Contacts for remote or automatic start signal
- Local pump start & pump stop buttons
- Local emergency stop button
- Automatic shutdown of pump in emergency situations
- Terminal block connections for solenoid controls, valve limit switch, pump starter relay, remote automatic contact, pressure switch
- HOA switch for remote or local operation

Custom application programming is available upon request. The control panel shall include automatic recognition of common fault conditions and shall provide proper fault response sequencing to the pump control valve and pump starter as well as visual and electronic fault notification to operating personnel.

The integral programmable valve controller shall be housed in a NEMA 4X fiberglass enclosure with polycarbonate window, gasketed door, continuous stainless steel hinge, stainless steel twist/latch door fasteners, and padlockable door hasp.

The integral valve controller shall be capable of controlling both single and dual solenoid style pump control valves.

The pump control panel shall include alarms, adjustable timers, system indicators, providing local visual indicators for both normal operation and alarm conditions.

Panel shall include an externally mounted three position "Hand-Off-Auto" switch to provide local or remote pump start/stop operation. Externally mounted pump start and pump stop buttons shall be provided for local operation. The pump control panel shall be supplied with contacts for remote start, a pressure switch and a valve limit switch.

The pump control panel shall require a minimum amount of field wiring.

B. DUAL SOLENOID STYLE PUMP CONTROL VALVE

On pump startup, pressure builds against a closed pump control valve. Once system pressure has been made, the double solenoid pump control valve shall begin to slowly open. A dual solenoid pilot system simultaneously energizes/de-energizes solenoids at a rate controlled by the integral valve controller. The opening rate of speed shall be field programmable as a linear or non-linear function, satisfying various pressure conditions across the stroke of the valve. As the valve position signal approaches the opening speed setting, solenoid pilots either add or relieve line pressure from the cover chamber of the valve, causing the valve to smoothly open. The solenoid on/off pulse time shall gradually decrease to smoothly lock the valve in a full open position. Once the pump stop command is given, the control valve begins to close gradually, reducing flow while the pump continues to run. The closing rate of speed shall be field programmable and independent of the opening speed setting. When the pump control valve is nearing the fully closed position, a limit switch assembly affixed to the cover of the pump control indicates the valve is fully closed and the pump shuts off. Should a power failure occur while the pump is running, a built-in lift-type check valve or hydraulic check valve feature shall close valve the moment flow stops. Preventing reverse flow regardless of solenoid or diaphragm assembly position. Each valve solenoid is controlled by a solid state relay with zero switching voltage. The total cycle time between each pulse shall be programmable. When the feedback signal is within a programmable dead band, the opening and closing solenoids shall lock the cover and the valve will maintain position.

C. SINGLE SOLENOID STYLE PUMP CONTROL VALVE

On pump startup, pressure builds against a closed pump control valve. Once system pressure has been made, the single solenoid style pump control valve is energized by the integral valve controller and the valve begins to slowly open. The opening rate of speed shall be controlled by the hydraulic opening speed control. Line pressure is gradually increased to full pumping head. When the pump is signaled to shut-off, the single solenoid control shall first de-energize and the pump control valve begins to close slowly, at a rate controlled by the closing speed control. Flow is gradually reduced while the pump continues to run. When the pump control valve is nearing the fully closed position, a limit switch assembly affixed to the cover of the pump control indicates the valve is fully closed and the pump shuts off. Should a power failure occur while the pump is running, a built-in lift-type check valve or hydraulic check valve feature shall close valve the moment flow stops. Preventing reverse flow regardless of solenoid or diaphragm assembly position.

D. PANEL TECHNICAL INFORMATION AND CONSTRUCTION:

Visual Indications:

1. Pump Status - Red = Pump Off, Green = Pump On
2. Pressure Switch Status - Red = Below Minimum, Green = Pressure OK
3. Valve Status - Red = Valve Closed, Green = Valve Open
4. Emergency Stop Status - Emergency stop enabled when displayed
5. System Failure Status - Indicates a system failure when displayed
6. Time for System to build Pressure - Displays time in seconds
7. Time for Valve to Open - Displays time in seconds
8. Valve Solenoid Status - Indicates whether the valve solenoid is energized or de-energized

Timers and Settings:

The pump control panel shall include the following timers and settings, programmable from a set-up screen on the integral controller:

1. Pressure Timer - Allowable time for pump to build pressure.
2. Valve Open Timer - Allowable time for control valve to open.
3. Power Failure Pump Restart Timer - Delay time for automatic pump re-start following power failure.

The pressure timer is configurable from 0 to 60 seconds. After the pump has been started, the system has the configurable amount of time to build pressure. If the timer has expired and the pressure switch contacts have not closed, the pump will shut off and display a system failure.

The Valve open timer is configurable from 0 to 60 seconds. After the valve solenoid/solenoids have been energized, the valve has the configurable amount of time for the valve to begin opening. If the timer has expired and the limit switch contact does not change state, the pump will shut off and display a system failure.

Normal Pump Start (Hand or Auto):

A pump start command shall be initiated by turning the HOA switch to the "Local" position and pressing start or by a remote contact closure with the HOA switch in the "Auto" position; either of these operations shall immediately turn on the pump & can be seen by the indicator on the controller screen. The valve shall not start to open until a pressure switch contact has been made, notifying the controller minimum system pressure has been established.

If using a dual solenoid style pump control valve, an opening curve shall be configured to open the control valve in a configurable amount of time.

If using a single solenoid style pump control valve, the speed of valve opening shall be controlled by a hydraulic needle valve (opening speed). Once the opening sequence is complete, all system indicators can be seen in green.

Normal Pump Shutdown:

A normal pump shutdown sequence shall be initiated by either depressing the stop button if in "local" mode or by remotely breaking contacts of the remote start circuit with the HOA switch in the "Auto" position. Initiating this command, the pump control valve relay will open and cause the control valve to close.

Utilizing a dual solenoid style pump control valve, a custom control curve can be programmed to slowly close the valve in a configurable amount of time. Once the valve is fully closed, the pump contact shall open and shut down the pump.

Utilizing a single solenoid style pump control valve, the solenoid shall be de-energized to initiate a normal valve closure. At a pre-set position, the pump control valve shall actuate the limit switch which opens the motor starter contacts and turns the pump off. With the pump control valve closed and the pump off, all system indicators can be seen in red.

Pump Malfunction:

Anytime during the pump operation when the pump discharge pressure is not capable of satisfying the pressure switch setting, a visual indicator shall turn red, indicating a loss of pressure, causing the control valve to close, pump motor contacts shall open to turn off the pump. A screen indicator shall display "System Failure", and a manual reset of the emergency stop switch will be required to clear the fault and reset the system.

Valve Malfunction:

If the solenoids of the pump control valve fail, or if any other event should cause the valve to close without a normal pump shutdown command, the pump contact shall open turning the pump off. A screen indicator shall display "System Failure", and a manual reset of the emergency stop switch shall be required to clear the fault and reset the system.

Power Failure:

In the event of a power failure, even momentary, a pre-set time delay period is initiated as soon as power is restored which shall be indicated on the valve controller screen. The adjustable time delay period shall range from instantaneous to ten (10) hours. During the power failure delay period, it shall not be possible to have an automatic pump restart. After the delay period has expired, a normal pump start sequence shall be initiated if a local or remote pump start command exists.

E. CONSTRUCTION:

The Electronic Pump Control Panel shall have remote communication capabilities. The controller shall include six (6) configurable 4-20mA analog inputs; six (6) dry contact digital inputs; four (4) 4-20mA analog outputs; two (2) solid-state relays and two (2) mechanical relays. All inputs and outputs shall have a configuration menu which programs signal name, scaling, engineering units, precision, & filtering.

The electronic pump control panel shall have a maximum of four (4) PID loops for use with the 131 series pump control valve. Each loop shall have the ability to be broken into (4) different control zones with customizable PID parameters in each. Each PID loop shall have an independent output limiting feature which limits the duration a solenoid can remain energized, providing ultimate valve protection.

The control panel manufacture shall offer an optional a 120 watt heater with integral thermostat.

A gasketed emergency shut-down pushbutton shall be provided (locking type, with manual reset). Labeled, screw-type terminal blocks shall be provided for all input and output connections and supply voltage connection. A minimum of (8) spare terminal blocks shall be provided.

The electronic pump control panel shall have relay outputs capable of Alarm indication to SCADA and shall be capable of generating and sending signal loss warnings and other configurable control actions. Actions (alarm) can include system failures.

The electronic valve controller shall have a high speed logging feature which captures all I/O at a maximum sample rate of 1Hz. Captured data shall be downloadable in .csv file format to a portable memory device such as a USB drive or FTP server.

The integral controller in the pump control panel shall have a color TFT screen to graphically display the valve application with real-time system information. The controller display shall have the ability to show all I/O signal readings, PID settings, I/O configuration settings, along with pump status, pressure switch status, valve status, solenoid status, emergency stop status, system failures, & timers/timer settings.

Security key codes shall be provided to protect against unauthorized changes. An IP-68 rated enclosure shall be provided to house the controller for environmental protection.

Sufficient clearance around electronic pump control panel shall be made for adequate access/wiring. Considerations should be made to comply with all the various local codes, standards and best practices.

INPUTS:

The Pump Control Panel shall be capable of monitoring the following inputs:

- Remote Start Command
- Valve Limit Switch Signal
- Discharge Pressure Switch Signal
- Local Start Pump Command
- Local Stop Pump Command
- Emergency Stop Command

Local inputs shall be entered by means of the integral controller and shall include set-up screen for setting of timers and user-selectable options. If a pressure switch is not used, a jumper can be inserted across its contacts.

OUTPUTS:

The Pump Control Panel shall provide the following powered outputs:

- (1) Pump Start Command
- Up to (2) Valve Solenoid/s
- Up to (2) Alarms

The pump start command is a non-powered dry contact normally open signal with a maximum amperage of 10 amps across the relay contact. The valve solenoid outputs are powered by the incoming VAC supply voltage and protected by a 5 amp circuit breaker. The alarm outputs are non-powered dry contact with a maximum amperage of 1 amp across the relay contact.

F. MODBUS COMMUNICATIONS

The electronic pump control panel shall come standard with Modbus protocol. This protocol defines a message structure that PLC's will recognize and use, regardless of the type of networks over which they communicate. The valve controller can be configured to communicate on standard Modbus networks using either of two transmission modes: TCP/IP or RTU. Users shall have the ability to select the desired mode, along with communication parameters (IP address, subnet mask, baud rate, etc). The electronic valve controller shall have a built in VNC server. A viewer/client uses TCP port 5900 to connect to a server (or 5800 for browser access), but can also be set to use any other port.

G. MATERIALS

1. Material Specification for the Electronic Pump Control Panel as follows:

Panel Enclosure

Material	Flame retardant UL rated PC/ABS plastic
Enclosure Panel Dimensions	20.0" (508 mm) H x 18.0" (457 mm) W x 9.0" (228 mm) D
	The enclosure panel shall be provided with all necessary mounting brackets.

Panel Integral Controller

Display Type	4.3" Color TFT-LCD, 480 x 272 pixels
Display Update Rate	100ms
Programming Method	Mechanical Push Button VNC
Password	5 digit

Enclosure Environmental

NEMA 4X

Controller Mass Data Storage

Type	4GB SD Card
Language	English
Temperature Range	14°F to 158°F (-10°C to 70° C)
Humidity	90% RH, non-condensing
Memory Protection	10 year life lithium battery

Power Requirement

Power	120VAC @ 60Hz protected with 5 Amp Fuse & Circuit Breaker
Motor Starter Contacts:	10 amp maximum
Valve Solenoid Contacts:	10 amp maximum
Remote Alarm:	1 amp maximum

Controller Inputs

Analog	4-20mA; (6) Inputs Available (0-5 V / 0-10 V)
Resolution	10 bit
Digital	(6) digital inputs (Dry contact)
Units	Configurable
Decimal Point	0 / 0.0 / 0.00
Signal Filter	Configurable 1 to 60 seconds
Totalizer	Configurable Input and Units
Totalizer Reset	Yes
I/O Connection	Screw Terminals

Controller Outputs

Pump Relay	10 Amp Max
Control Valve Relays	120VAC @ 60Hz Output (single solenoid pump control valves) 24VDC Solid State Relay Output (dual solenoid style valves)
Alarm Relay	(2) Available and Configurable
Analog	4-20mA; (4) Outputs available
Resolution	10 bit
Solenoid	(2) Solid State Relay, Zero Switching Voltage
Relay	(2) Mechanical Relay, Rated Voltage 250VAC, Rated Current 6A

Logging

Configurable	Yes
Logging Speed	1 minute
Event Memory	128 Mbytes rolling memory up to 80,000,000 values capacity
Output	CSV format suitable for exporting to MS Excel

Controller Parameters

Control Input	4-20mA full scale / digital (dry contact)
Proportional Band	0-100% (50% default) adjustable in 1% increments Independently for opening and closing
Dead band	Adjustable 0 to full scale of setpoint signal
Cycle Time	0 to 60 seconds in 1 sec. increments
Loop Zoning	Adjustable up to (4) zones
PID Loops	4 Configurable
Control Curves	Allowing two independent non linear opening and closing
Retransmission	4 Analog (4-20mA signal)
Actions (Alarms)	4 (1 or 2 triggering conditions)

Controller Communication

Local	Mechanical Push Button
Remote	VNC Server
Interfaces	GPRS Modem Quad Band / Ethernet / RJ-45 / RS-232 / RS-485
Protocols	ModbusTCP / ModbusRTU / VNC

Controller Approvals

Conformity Marking	CE marking
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Controller Optional

<u>Features /Accessories</u>	Fan / Heater with integral thermostat
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H. MANUFACTURE

1. Each Electronic Pump Control Panel shall be factory assembled by the control valve manufacture.
2. Each Electronic Pump Control Panel shall be provided with an identifying nameplate
3. Each Electronic Pump Control Panel shall undergo full factory functional and operational testing.

I. PRODUCT DATA

1. Electronic Pump Control Panel manufacturer's technical product data shall be provided.

The Electronic Pump Control Panel manufacturer shall warrant the controller to be free of defects in material and workmanship for a period of one year from date of shipment provided the control panel is installed and used in accordance with all applicable instructions.

The Electronic Pump Control Panel shall be the **CLA-VAL Company Model No. PC-22D**, as manufactured by Cla-Val Co., Costa Mesa, CA 92627-4416.

END OF SECTION