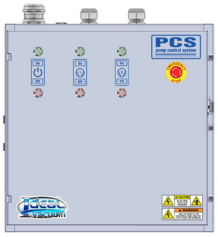

OUR PRODUCTS DEVELOP TOMORROW'S TECHNOLOGIES™

PCS
pump control system

USER MANUAL

Model: P1010043

PCS-07092024 - V 1.0.2

WARRANTY

Ideal Vacuum warrants to the original purchaser, this product to be free from defects in workmanship and materials for a period of one year from the original delivery date. The liability of Ideal Vacuum, under this warranty, is limited to servicing, adjusting, repairing or replacing any unit or component part which, at Ideal Vacuum's sole discretion, is determined to have failed during normal, intended use. This warranty does not cover improper installation, process related damage, product use in any way other than defined in this manual, or any misuse, abuse, negligence, accident, or customer modification to the product.

Prior to returning any product, we require that you contact us by phone or email to determine if the issue can be resolved quickly. A technical support representative will work with you to resolve the problem. If the issue cannot be resolved in that manner, we will issue an RMA number and provide product return instructions.

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CUSTOMER SERVICE AND SUPPORT

If you have any questions concerning the installation or operation of this equipment, or if you need warranty or repair service, please contact us. Customer Service and Technical Support is available weekdays, from 8am-5pm, Mountain Time.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SAFETY

IMPORTANT SAFETY INFORMATION

Thank you for purchasing this equipment from Ideal Vacuum Products. We want you to operate it safely.

- **Read this manual and all associated equipment manuals before installing or operating this equipment. Failure to follow the warnings and instructions may result in serious injury or equipment damage.**
- **Keep this manual in a safe location for future reference.**
- **This equipment should only be installed and operated by trained, qualified personnel, wearing appropriate protective equipment.**
- **Follow all codes that regulate the installation and operation of this equipment.**

WARNING SYMBOLS AND DEFINITIONS

This is the universal safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER	**Indicates an imminently hazardous situation that, if not avoided, will result in death or severe injury.**
WARNING	**Indicates an imminently hazardous situation that, if not avoided, could result in death or severe injury.**
CAUTION	**Indicates a potentially hazardous situation that, if not avoided, could result in moderate or minor injury. It may also be used to alert against unsafe practices.**
NOTICE	**Indicates a potentially hazardous situation that, if not avoided, could result in equipment or property damage.**
NOTE	**Indicates helpful tips and recommendations, as well as information for efficient, trouble-free operation.**

Internationally recognized safety symbols may be used with safety warnings to specify the type of hazard or a safety protocol to follow. For example:

Indicates an electric shock hazard

Indicates safety glasses are required

1. INTRODUCTION

Vacuum pumps require fuses, on/off switches, contactors or soft starters, and other supporting hardware to operate safely. To bridge the gap between power hookup and safe pump operation, Ideal Vacuum offers the Pump Control System (PCS) as a turnkey solution, specially designed for large vacuum roughing pumps.

The Ideal Vacuum Products (IVP) PCS is a build-to-order, configurable, 30" X 30" X 8" control box panel that uses a single 3-phase power input and can be built for single or two pump systems requiring up to a combined 88 full load amps. The system is particularly well suited for use with pump/blower packages. The PCS provides basic, low voltage operational controls for safety and include system power on/off, individual pump start/stop, pump hour meters, and emergency stop. Depending on application requirements, optional build upgrades could include motor soft starters to decrease large pump inrush currents, motor overtemperature protection, RS-485 serial connectivity for real-time pump data acquisition, and I/O for simple remote switching by instruments such as our ExploraVac automated thermal vacuum chambers. To achieve the highest standards of safety and reliability, Ideal Vacuum is a UL 580A certified panel shop and offers optional UL certification and labeling when required by the customer.

The PCS ships with this operation and installation manual, datasheet with technical information about the specific build, and schematics and bill of materials located inside the PCS enclosure. The input power cable, pump cables (i.e., power and overtemp), and communication cables are available and purchased separately.

Standard PCS features include:

- On/off control of one or two 3-phase pumps
- 208-240, 380-415, or 440-480 VAC, 50/60Hz, voltage options
  (All pump motors in the system must have the same input voltages)
- Magnetic starters/contactors prevent pumps from restarting automatically after a power failure
- Integrated safety interlocks prevent pumps from being turned on in the wrong order
- Safe low voltage front panel console controls
- System power and pump on/off illuminated switches display operational states
- Emergency stop switch
- Each pump has its own run time hour meter
- Wall mounting

Optional PCS features include:

- Soft starters (decrease inrush current of large pump motors)
- Pump overtemperature protection via thermal switch or contact temperature probe (CTP) positive temperature coefficient thermistors (PTCs)
- RS-485 serial and I/O communications
- Separate fan driver circuit for pumps with electric cooling fans
- UL 508A Safety Certification
- Freestanding panel stand or mount to pump skid or frame

2. PANEL MOUNTING OPTIONS

The PCS panel may be mounted in one of three ways described below.

Wall Mounting:

The PCS may be mounted to a wall using customer supplied fasteners. Use the dimensional drawing (Figure 1) for mounting hole locations.

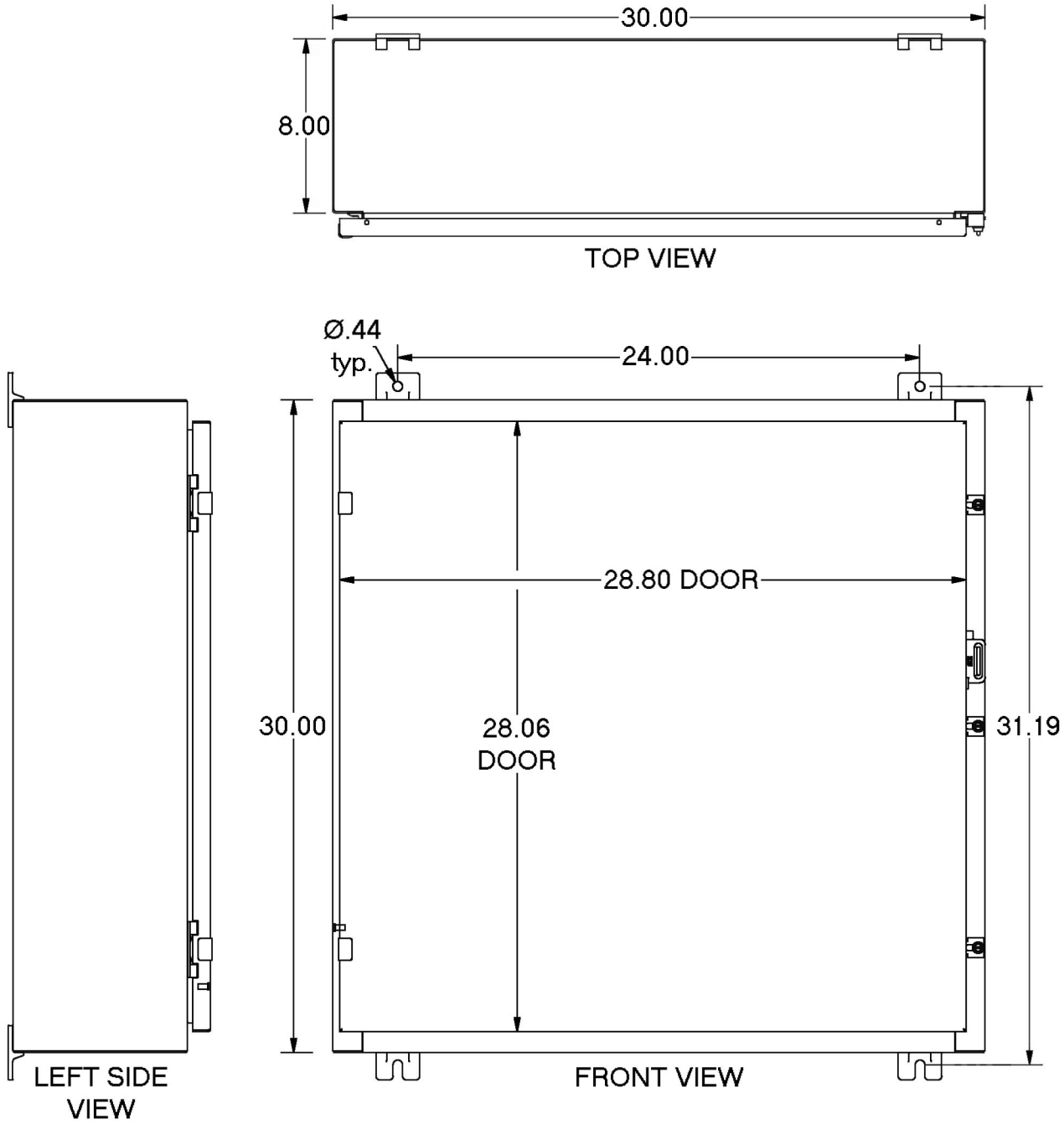


Figure 1 - Dimensional drawing with mounting hole locations

Freestanding Frame:

A freestanding panel stand is available for mounting the PCS and placing it in a convenient location (part number P1013570). Panel-to-stand mounting hardware is included. Holes are provided in the feet for mounting the stand to the floor.

⚠ CAUTION

Seismic restraints may be required if the system is installed in a seismically active area. Consult with a structural engineer to determine code requirements and if restraint hardware is needed.

Figure 2 - Freestanding PCS mounting stand

Pump Skid Mounting:

For skid or frame mounted pump/blower packages, a custom panel mount is available. It must be ordered with the pump package and installed by Ideal Vacuum. An example is illustrated below.

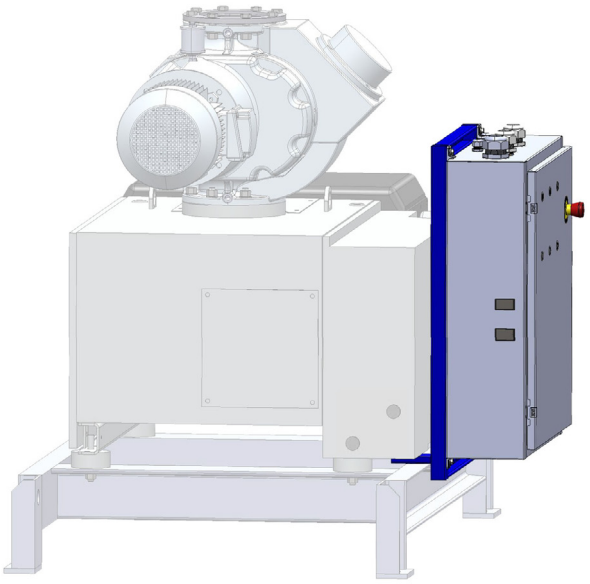


Figure 3 - Skid mounted PCS panel

3. SYSTEM INFORMATION

3.1 TECHNICAL SPECIFICATIONS

This manual contains general system information and descriptions of available PCS options.

Technical specifications and equipment options specific to your built-to-order PCS are provided in printed and/or digital formats.

The following three sections illustrate the major PCS system components. Depending on the options required, some illustrated components may not be installed.

3.2 EXTERNAL FEATURES

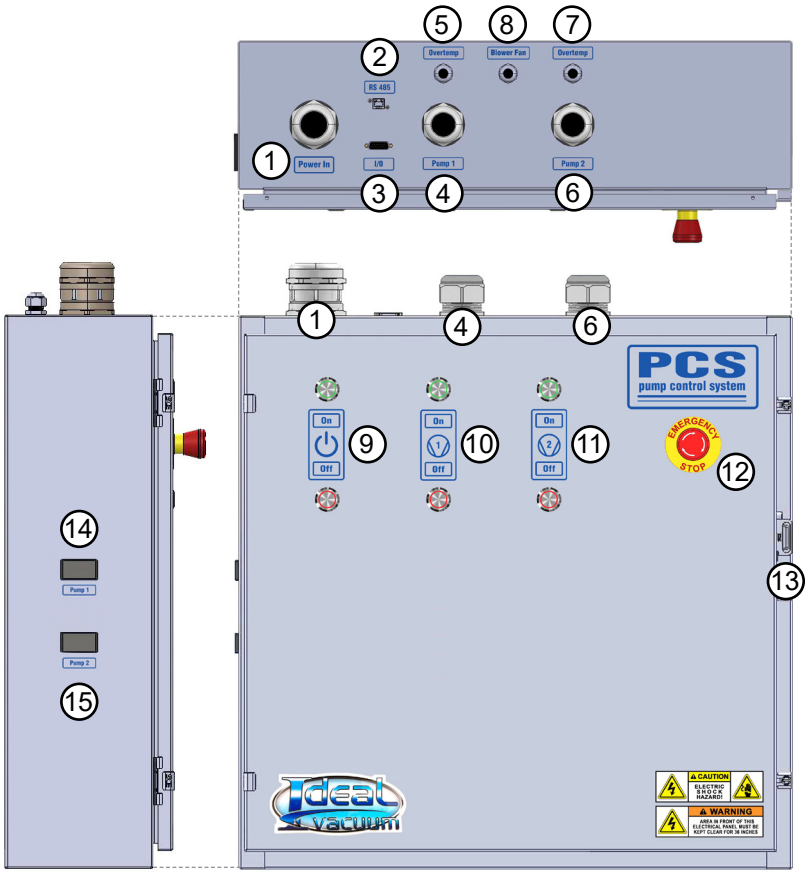


Figure 4 - PCS exterior features

Item	Description
1	Power cable entry
2	DB9 connector forRS485 serial
3	DB15 connector for I/O
4	Power to pump 1
5	Pump 1 overload
6	Power to pump 2
7	Pump 2 overload
8	Electric pump fan (Sec. 3.8, p. 13)
9	System (standby) on/off switches
10	Pump 1 on/off switches
11	Pump 2 on/off switches
12	Emergency stop switch
13	Padlock hasp for lockout
14	Pump 1 hour meter
15	Pump 2 hour meter

Table 1 - PCS external features

3.3 INTERNAL COMPONENTS

The electronic components used in a particular PCS panel depend primarily on the pumps. Their motor current requirements dictate the size of contactor or soft starter needed (Sec. 3.5, p. 11). Some PCS configurations might be hybridized with one soft starter and one contactor. Some small pump motors have internal thermal overload protection. Others require external monitoring which the PCS can provide (Sec. 3.7, p. 13). Pump motors which run on 440-480 VAC or 380-415 VAC may have 240 VAC electric cooling fans which require a separate, transformered fan circuit (Sec. 3.8, p. 13).

Below is a general illustration identifying the main components that may be included in any PCS. Because it is built to your requirements, your PCS panel may not have some of the components shown, or may look a bit different than the illustration.

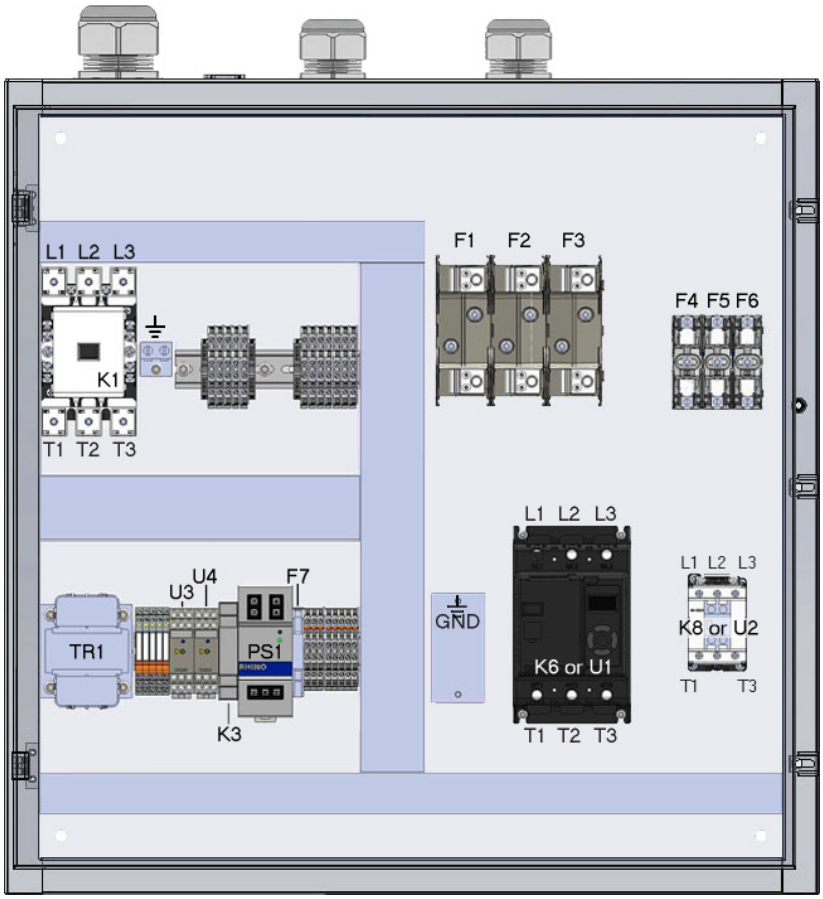


Figure 5 - PCS electronic components

Item	Description
F1-F3	Fuses for K6 (contactor) or U1 (soft starter)
F4-F6	Fuses for K8 (contactor) or U2 (soft starter)
F7	Fuse for low voltage components
K1	Main power input contactor
K3	Time delay relay (adjustable) (sequences pump 1 and pump 2)
K6	Pump 1 contactor
K8	Pump 2 contactor
L1-L3	3-phase line inputs to contactors or soft starters
PS1	24 VAC power supply
T1-T3	3-phase line outputs from contactors or soft starters
TR1	Transformer (240 VAC secondary) for pumps with motor electrical cooling fan
U3-U4	Relays for pumps with CTP (PTC) type overtemp feature

Table 2 - PCS external features

3.4 ELECTRICAL REQUIREMENTS

The PCS can be built for 208-240 VAC, 380-415 VAC, or 440-480 VAC, 3-phase pumps, and is designed to run on either 50 or 60 Hz. Importantly, both pumps must be wired for the same voltage.

The PCS is capable of running one or two pumps with up to a maximum combined rating of 88 full load amps (FLA). The full load amps of the PCS required is simply the sum of the FLAs on each of the pump motor's nameplates at the desired voltage. The maximum current draw for any single pump may be no greater than 65 amps.

In a typical pump/blower package, the rotary pump (pump 1) draws considerably more current than the blower (pump 2). Accordingly, the contactor or soft starter required to power pump 1 is typically of a larger capacity than that for pump 2.

It may be desirable in some applications for a matched pair of pumps to be driven by the PCS (ex:, to maximize pump down speed). Here, both contactors or soft starters will be identical. The maximum FLA of either pump could be no more than 44 amps.

3.5 CONTACTORS AND SOFT STARTERS

Input power from the facility breaker or disconnect is connected to the main magnetic contactor in the PCS. From there, power is distributed within the panel. Magnetic contactors, soft starters, or one of each are used to make and break power to the pumps. The PCS I/O option can be used to remotely switch contactors or soft starters on and off by energizing their low voltage (24 VAC) coils (Sec. 3.6, p. 12).

Contactors are relatively simple, compact, and inexpensive, but lack overload protection, do not limit inrush current to motors, and do not have the ability to provide feedback to the user.

Soft Starters are more costly and complicated devices that consist of a contactor, overload circuits, and other circuitry and features. They are desirable to use for motors with high inertial loads (i.e., pump motors and blowers) which require large inrush currents. Heavily loaded motors are susceptible to overheating and mechanical stress on the motor windings during startup. Unlike a contactor which supplies instantaneous full voltage to the motor, a soft starter gradually and smoothly ramps up voltage and therefore motor speed over a few seconds, thereby decreasing large inrush currents and mechanical stress. Soft starters eliminate power surges to the grid, exhibitied by flickering lights upon motor starts, nuisance tripping of breakers, reduce maintenance and extend motor life. These devices also have the ability to supply real time data via the optional RS-485 serial connection which can be used to control pump speed (Sec. 3.6, p. 12).

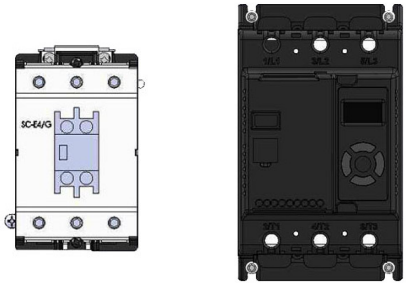


Figure 6 - Example of a contactor (left) and soft starter (right)

3.6 RS-485 AND I/O COMMUNICATIONS (OPTION)

The PCS can be configured with an RS-485 serial communication port if the PCS has soft starters (Figure 4, item 2, p. 9). An RJ-45 (ethernet type) connector is used. The RS-485 serial option allows a user to connect to the PCS from a remote computer or instrument using serial terminal software or MODBUS and obtain real time data from the soft starter. The user can then control the pump motor via the soft starter. Please see the Stellar SR35 soft starter user manual on the included USB flash drive for the available commands.

Note that the RS-485 option cannot be used to remotely turn the PCS, or the pumps, on and off.

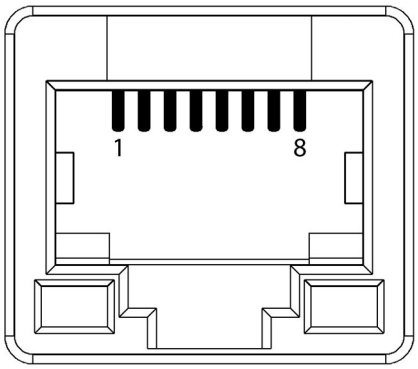


Figure 7 - RJ-45 serial connector

Pin	Signal
4	TXD1 - B
5	TXD0 - A
8	G8 - Ground

Table 3 - RJ-45 I/O connector pinouts

The PCS can be configured with a DB-15 I/O port in any contactor/soft starter configuration. Using simple switfching, this option allows the user to remotely turn on and off main PCS power as well as the individual pumps. It also allows the user to monitor the powered state of the PCS and pumps. Note that the PCS logic does not allow pumps to be turned on out of sequence or if the PCS isn't on.

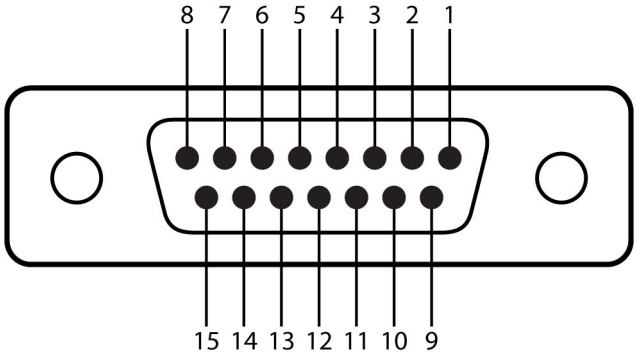


Figure 8 - DB-15 I/O connector

Pin	Type	Functionality
1	Output	If = 1, PCS power is on if = 0, PCS power is off
2	Input	PCS power on
3	Input	PCS power off
4	Input	Start pump 1
5	Input	Stop pump 1
6	Output	Pump 1 is powered on
7	Output	Pump 2 is ready to turn on (pump 1 is on, delay is over)
8	Input	Stop pump 2
9	Input	Start pump 2
10	Output	Pump 2 is powered on
11	Output	Pump 1 overtemp
12	Output	Pump 2 overtemp
13	NC	
14	Output	24 V, 1 Amp max
15	Com	0 V power return

Table 4 - DB-15 I/O connector pinout

3.7 OVERTEMPERATURE PROTECTION (OPTION)

Most 3-phase motors on vacuum pumps, particularly those 1 Hp and greater, do not normally have internal themal overload devices which can turn off the motor if it overheats. They do, however, usually have some form of thermal switch or sensor embedded in the motor windings which can be wired to the associated low voltage contactor or soft starter coil. If the motor overheats, the coil is deenergized and motor power is interrupted. The motor will not restart automatically without user intervention, even when the motor cools to an acceptable level.

The PCS has two motor overtemperature protection options. Closed loop overtemperature protection is for motors that have an internal themal switch. Some motors employ contact temperature probes (CTPs) in their windings (ex: Leybold SV rotary vane pumps and WSU blowers). These use positive temperature coefficient thermistors (PTCs), a more accurate, but more expensive protection method. CTPs require separate 2.5V overload relays (Figure 5, items U3 & U4, p. 10).

With either closed loop themal switches or CTPs, if the motor of pump 1 overheats, both pumps 1 and 2 turn off. If the motor of pump 2 overheats, only pump 2 is turned off.

The datasheet included with your PCS indicates if either of these options is part of the build.

3.8 ELECTRICAL FAN CIRCUIT (OPTION)

A few pumps (i.e., Leybold WSU blowers running at 440-480 VAC) have electrically operated cooling fans that are driven by a separate 240 VAC single phase motor. In this case, the PCS has a separate circuit with transformer to drive the fan motor.

Note that on pumps with this configuration, connecting the fan directly to the terminals of the pump motor is not allowed. Also, the direction of the fan motor is independent of the pump and doesn't change if the pump motor phases are interchanged. Therefore, the fan motor cannot reliably be used to determine the rotational direction of the pump (Chap. 5, p. 19).

The datasheet included with your PCS indicates if the electrical fan circuit is part of the build.

3.9 UL CERTIFICIATION (OPTION)

Ideal Vacuum is a UL 508A certified panel shop. Some customers may require that the PCS panel be UL certified. PCSs are always built with all UL listed components and with adherance to all National electrical code wiring and safety specifications. More strict standards are required for all a UL certified PCS panel. When this option is ordered, the PCS is built to those rigorous standards and a serialized UL sticker is prominently affixed to the panel.

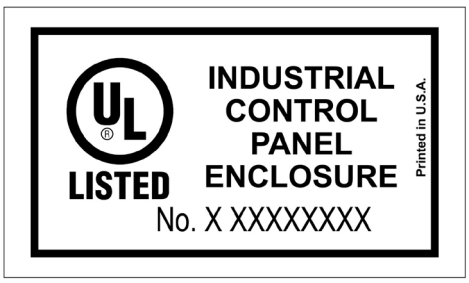


Figure 9 - UL certification sticker

4. ELECTRICAL CONNECTIONS

DANGER

Electrical hookup of this equipment must be performed by a licensed, qualified electrician. All wiring must be completed in accordance with national and local codes.

NOTICE

USE COPPER CONDUCTORS ONLY.

Verify the supply voltage. Energizing the system at a higher voltage than the system rating will cause damage and void the warranty.

DANGER

Connect power cable to the facility service only after all system connections are made.

DANGER

De-energize, lockout and tagout facility disconnect before opening the PCS panel. Always test for voltage inside the panel before making or changing any connections.

The PCS may have three types of cable connections. They are communications, low current (for overtemperature and electrical fans), and pump power.

If your PCS includes an overtemperature or electrical fan option, these connections are completed first. If either of these options is present, it will be indicated on the datasheet included with the PCS panel.

Power cables between the PCS and pump motors are connected next.

Next, the input power cable is connected to the PCS. Only then it may be connected to the facility disconnect and the PCS energized.

The pumps must be tested to ensure they spin in the correct direction before the PCS is fully operational (Chap. 5).

After the pumps have been checked, communication (RS-485 and I/O) communication cables are connected and the PCS is ready to operate.

Please refer to your pump user manuals for the locations of overtemperature, fan, and power connections, as well as the proper torque settings for terminals.

Always make connections to the pumps first, then to the PCS. Follow the instructions in this chapter, in order, to make electrical connections inside the PCS.

4.1 CABLE GAUGE SELECTION

Wiring glands of the correct size are preinstalled in the top of the PCS for cable entry and exit (Figure 4, p. 9). Minimum wire gauge sizes for power input, pumps, and options are listed on the datasheet included with your PCS. Below is a table of recommended cables with basic specifications and part numbers. These cables are manufactured by Helukabel®. in the TrayControl® 600 line. TrayControl 600 cables have thinner insulation than SOOW cable yet are still UL rated to 600V. Cabling is available by the foot.

Power Cables			
Max Current (Amps)	**Conductors X AWG**	**Cable Diameter (mm)**	**Part Number**
15	4 x 14	10.1	62947
20	4 x 12	11.2	62960
30	4 x 10	14.4	62972
50	4 x 8	19.2	62978
60	4 x 6	22.3	62981
80	4 x 4	26.9	62984
115	4 x 2	31.4	62987
Overtemp & Electrical Fan Cables			
15	2 x 14	8.8	62945

Table 5 - Recommended cables: Helukabel TrayControl 600, UL rated 600V

4.2 CONNECT OVERTEMPERATURE CABLES

Connect the overtemperature cables from the motor through the gland on the top of the PCS (Fig. 4, items 5 & 7, p. 9). The figure below illustrates the location of the (non-polarized) overtemp connection terminals. The same terminals are used for either thermal switch or CTP type.

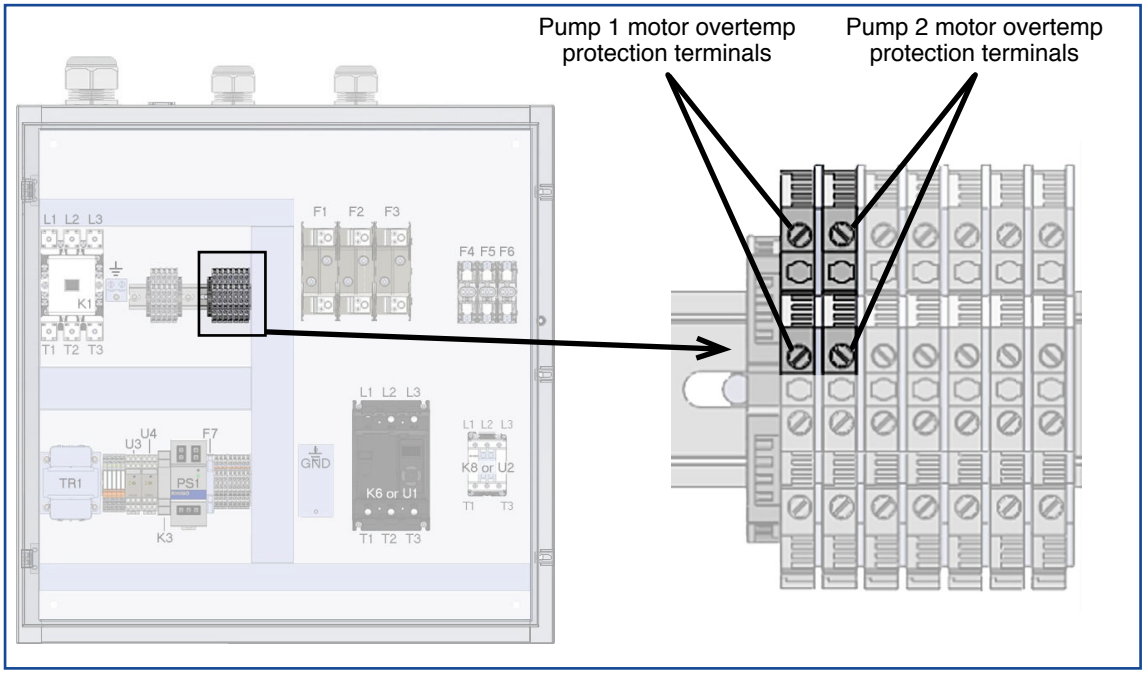


Figure 10 - Location of terminals for overtemperature protection connections

4.3 CONNECT ELECTRICAL FAN CABLES

Connect the fan cable from the pump through the gland on top of the PCS (Fig. 4, item 8, p. 9). The figure below illustrates the location of the (non-polarized) fan connection terminals.

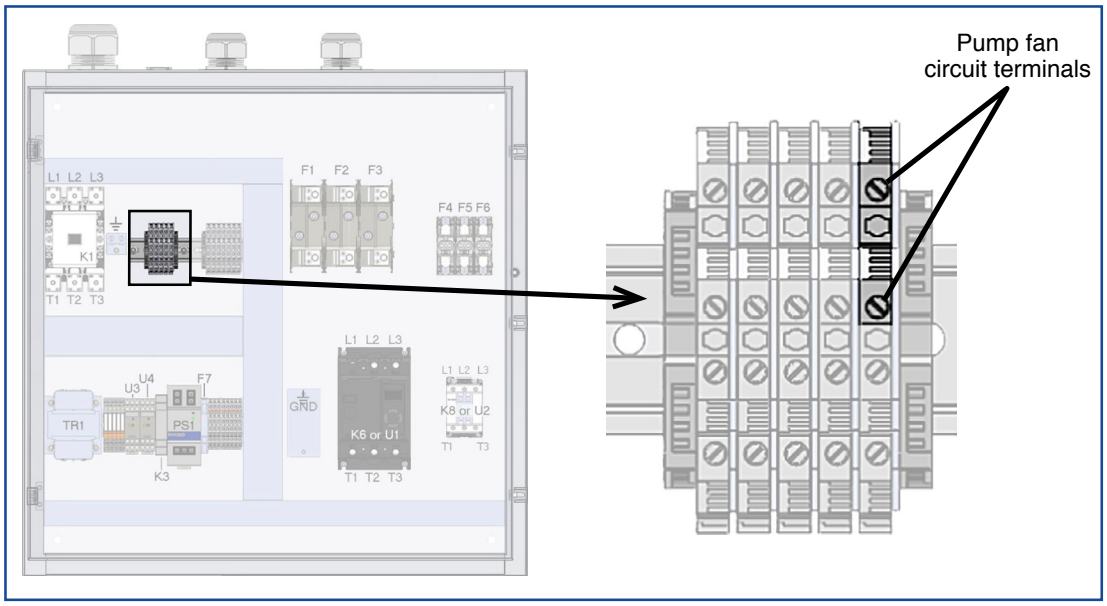


Figure 11 - Location of terminals for separately powered fan motor connections

4.4 CONNECT PUMP POWER CABLES TO PCS - SMALLER PUMPS

Pump motors with full load amps (FLA) less than 30 amps (10 awg wire or smaller) are wired to terminals in the upper left terminal block to the right of the main power contactor. Connect the pump motor power cables from the motor through the gland on top of the PCS (Fig. 4, items 4 & 6, p. 9). Connect power and ground wires as shown in the figure below.

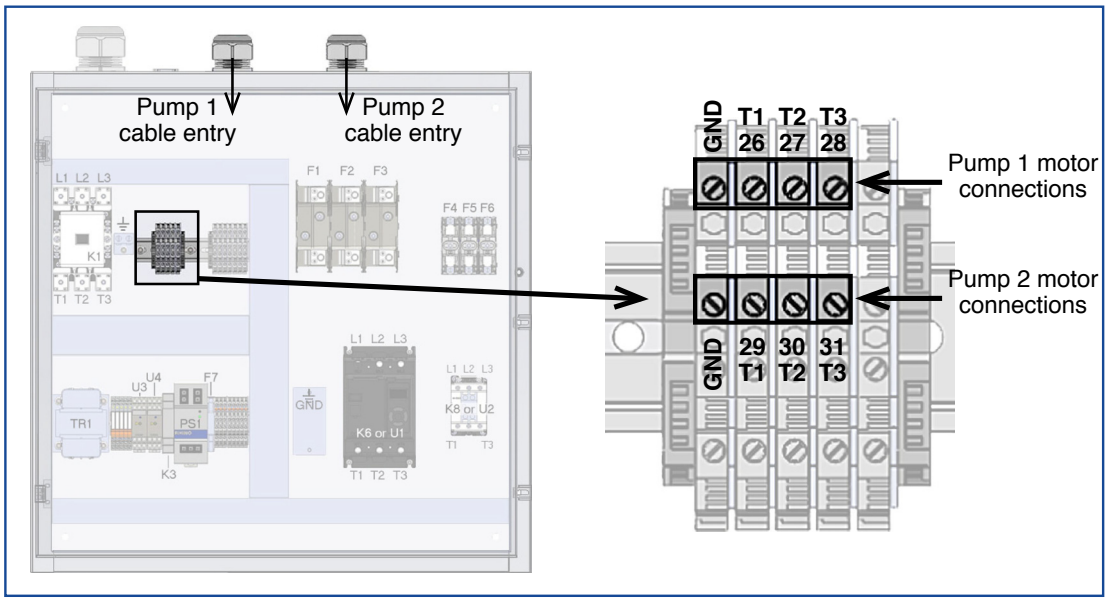


Figure 12 - Terminal connections for pump motors less than 30 Amps

4.5 CONNECT PUMP POWER CABLES TO PCS - LARGER PUMPS

Pumps with full load amps (FLA) greater than 30 amps (wire larger than 10 awg) are wired directly to terminals on the pump contactors or soft starters as illustrated in the figure below.

Connect the pump motor power cables from the motor through the glands on top of the PCS (Fig. 4, items 4 & 6, p. 9).

The power cable from the pump 1 motor is connected to the T1, T2, and T3 terminals of the K6 (contactor) or U1 (soft starter).

The power cable from the pump 2 motor is connected to the T1, T2, and T3 terminals of the K8 (contactor) or U2 (soft starter).

Ground wires are connected to the ground plate to the left of the K6 or U1 contactor/soft starter.

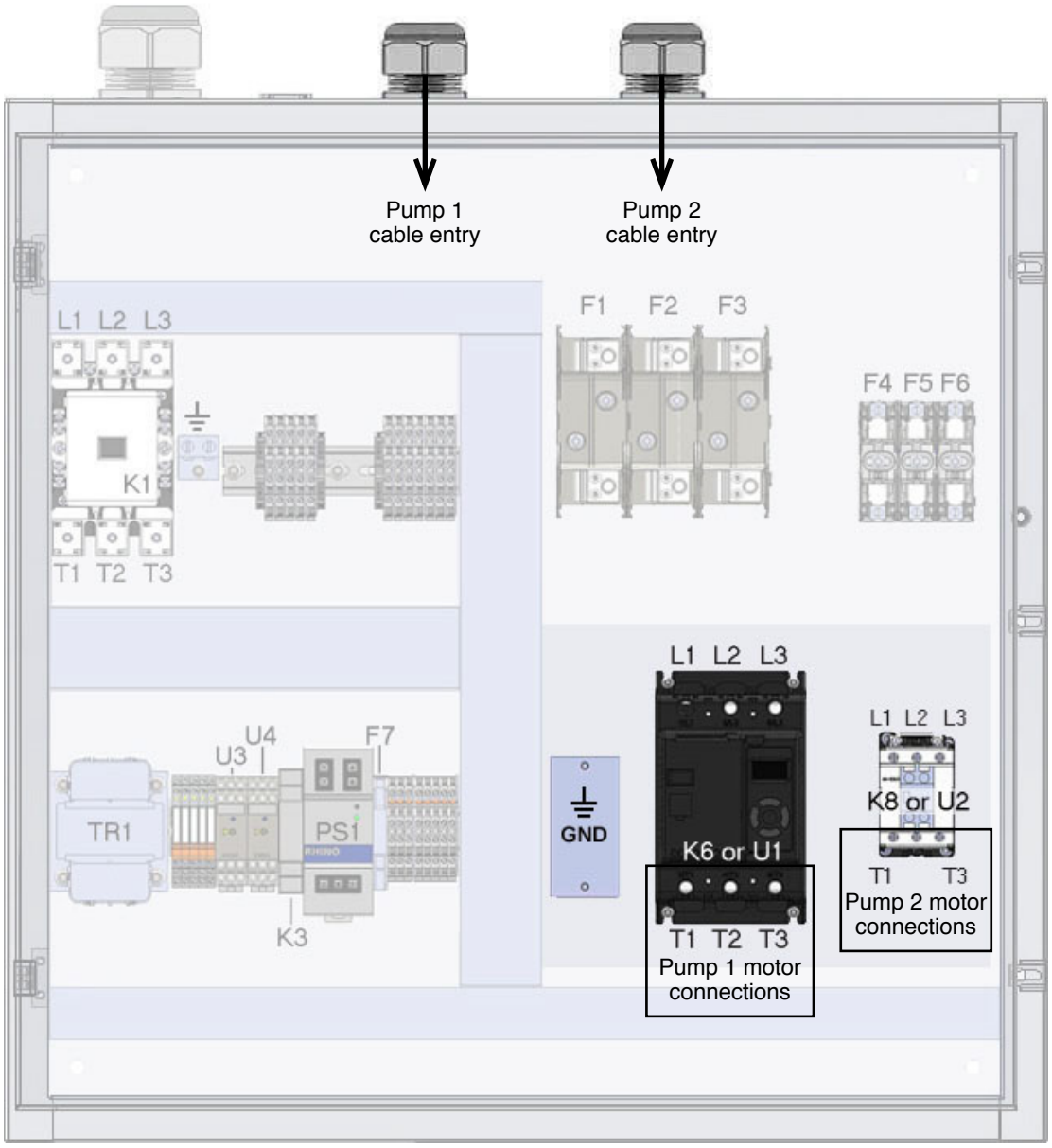


Figure 13 - Terminal connections for pump motors greater than 30 Amps

4.6 CONNECT INPUT POWER CABLE

Run the 4 wire (3 hot plus ground) power input cable of the correct gauge through the power input gland on top of the PCS.

Connect the L1, L2, and L3 supply wires to the L1, L2, and L3 terminals of the K1 main power input contactor. L2 is the wild leg in 3-phase delta systems.

Connect the ground wire to the ground terminal block to the right of the K1 contactor.

Close and padlock the PCS panel door.

Connect the input power cable to the facility service.

DO NOT energize the system or power the pumps yet! The pumps must be tested to ensure they operate in the correct rotational direction (Chap. 5, next page).

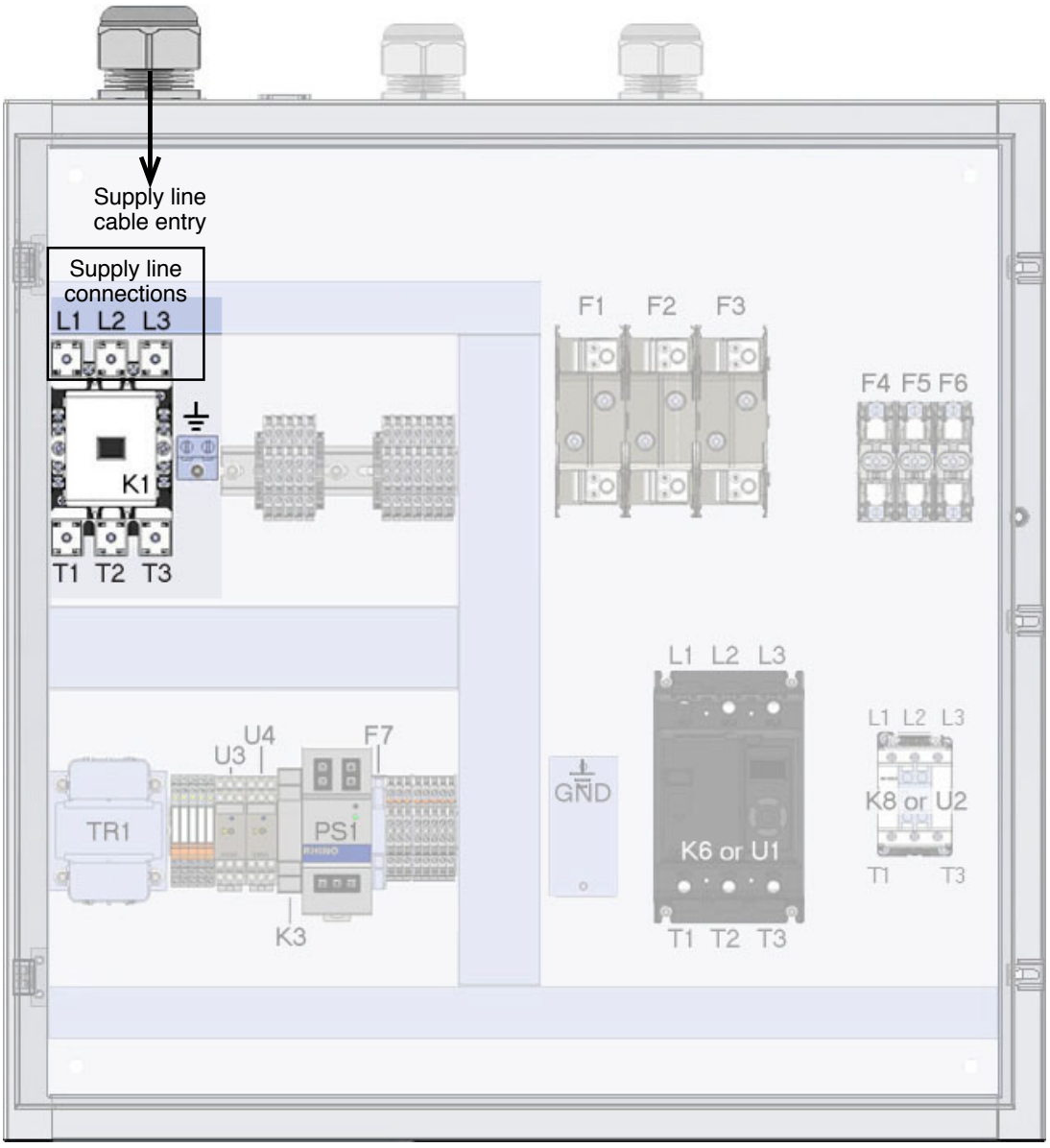


Figure 14 - Supply power connections to K1 main power input contactor

5. TESTING AND CORRECTING PUMP ROTATION

The pumps must be powered and individually tested to ensure they turn in the correct direction. This is because the motor's L1, L2, and L3 windings may be out of phase with the L1, L2, and L3 facility power wires.

If the pumps do not rotate in the proper direction they will not pump and damage could occur. The test requires two people, and only takes a few minutes. One person operates the PCS controls, the helper checks the pump's rotational direction.

Pump rotation tests are performed before the vacuum line is connected to the pump inlet.

There are two methods to test pump rotational direction. The first is to check for vacuum at the pump's inlet. This method is easiest to use for testing the pump 1 direction on pump/blower packages, or for systems that have two rotary vane type pumps. The second method is best used for blowers (pump 2). This method compares the pump motor's rotational direction to the directional arrow marked on the pump.

Using the first method, the pump is run momentarily and the pump inlet is checked for vacuum. If there is vacuum at the inlet, the pump is running correctly. Otherwise it is not. This method works well on rotary vane pumps and can be used to test the rotary pump (pump 1) in a pump/blower package.

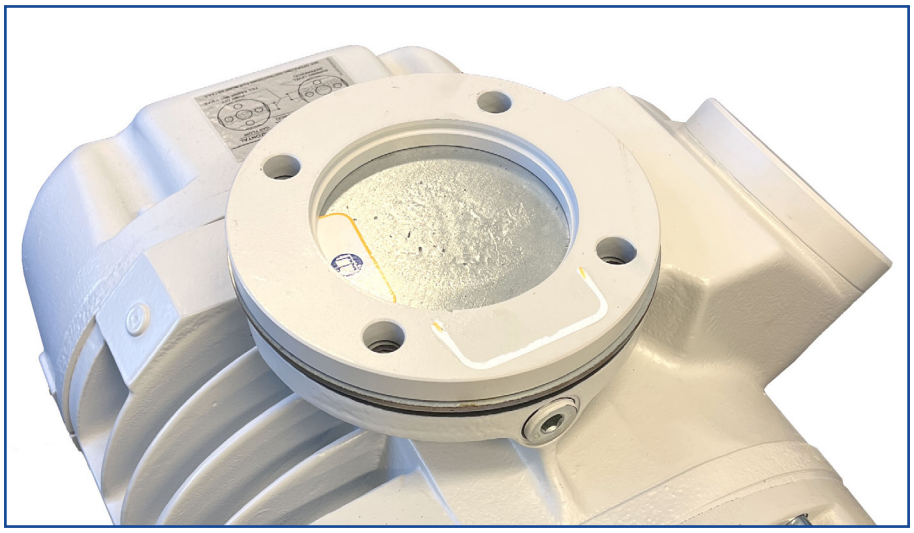
The second method (visual inspection) can be used for blowers in pump/blower packages. One can either watch the direction of rotor rotation through the blower inlet when it first starts, or watch the direction of the pump motor when it is started and compare it to the direction of the arrow marked on the pump near the motor. If the motor direction is the same as the arrow, the pump is running in the correct direction. Otherwise it is not.

Read all the test directions before performing any test.

5.1 TEST PUMP 1 ROTATIONAL DIRECTION USING VACUUM METHOD

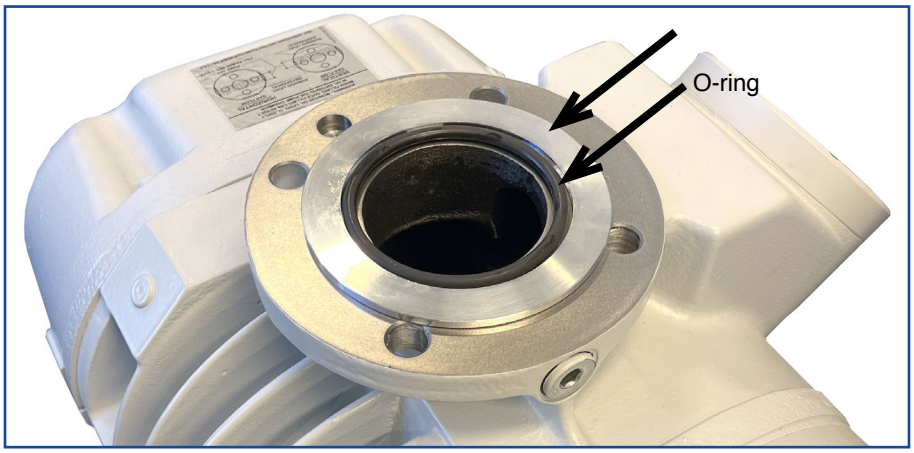
This example shows how to perform the test on a pump/blower package. It is also effective on a single rotary pump.

1. Open the pump inlet. Remove the inlet bolts and remove the blanking plate.

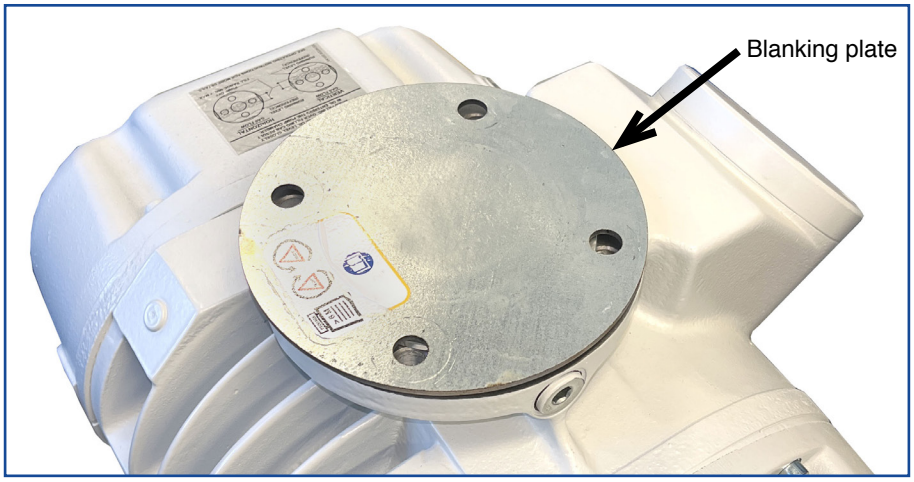


2. Get a centering ring and O-ring of the correct size. They may be supplied with the pump.

   Place them on the inlet.

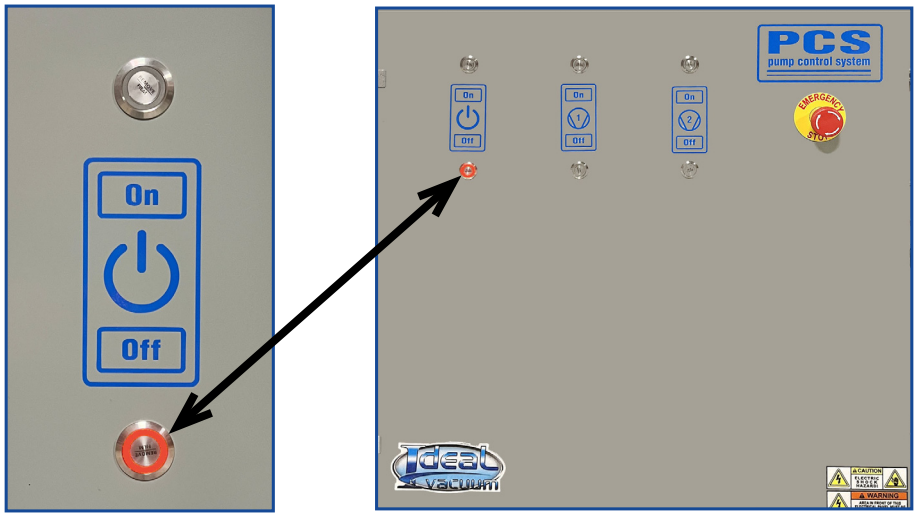


3. Place the blanking plate onto the pump inlet.



4. Energize the PCS panel by engaging the facility disconnect.

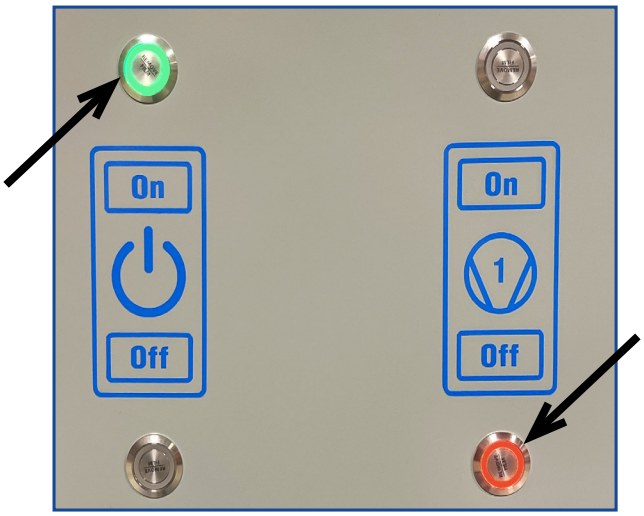
   On the front of the PCS, the red power off switch illuminates.



5. Press the power on switch.

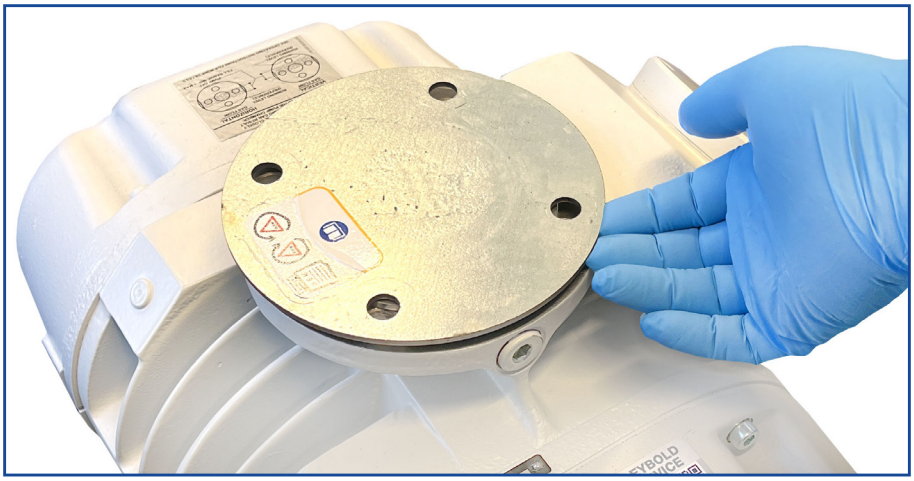
   The green power on switch and the red pump 1 power off button illuminate.

   If the power switch is not on (green), check the emergency stop switch.



6. Press the pump 1 on button.After one second, press the pump 1 off button.

7. Have the helper try to lift off the plate.



8. If pump 1 rotates in the correct direction the pump makes vacuum, the plate is held by suction, and is then somewhat difficult to remove.

   If pump 1 is rotating correctly, skip to pump 2 testing (Sec. 5.3, Step 13, p. 23).

9. If pump 1 rotates in the wrong direction when pump 1 is turned on, the pump will not make vacuum, the blanking plate will not be held by suction, and it may vibrate on top of the inlet.

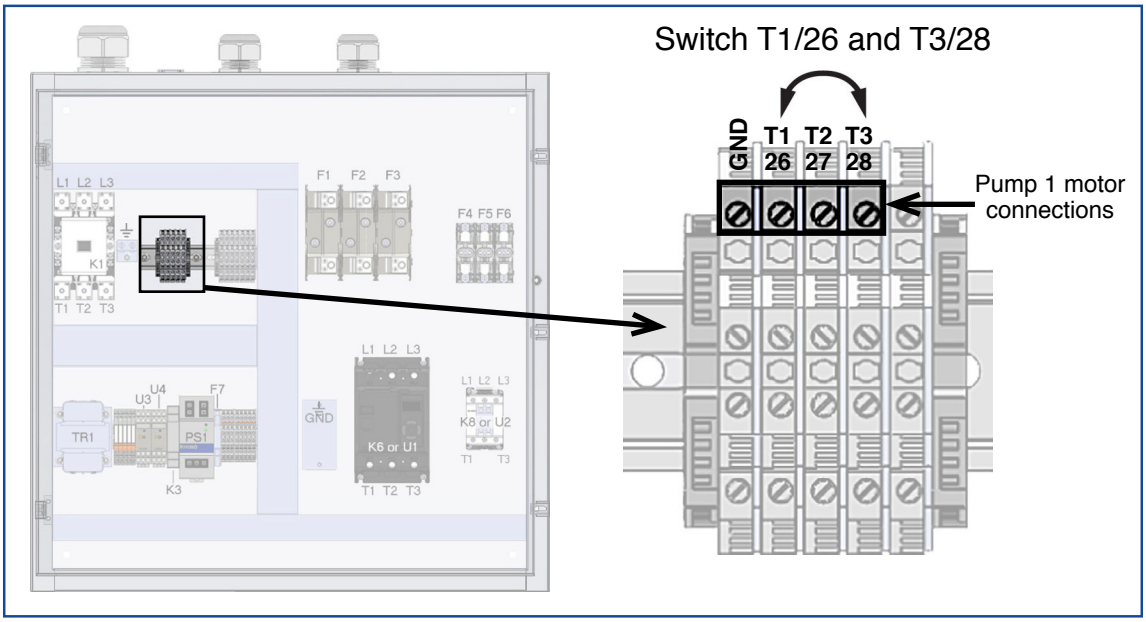
   If pump 1 is running in reverse, proceed to Sec. 5.2, next page).

5.2 REVERSING PUMP 1 DIRECTION

1. If pump 1 is rotating backwards, denergize and lockout/tagout the PCS.

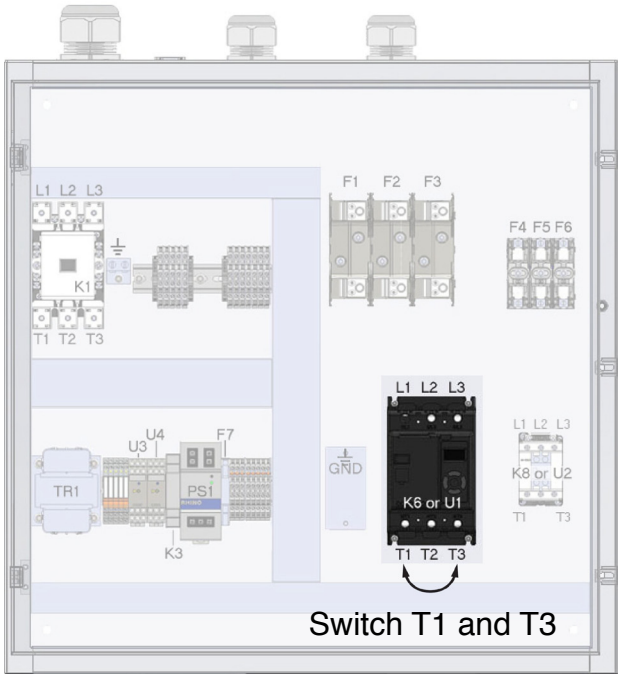
   Unlock the PCS padlock and open the door.

2. For smaller pumps, whose power connects to the terminal block close to the main power contactor, switch legs T1/26 and T3/28 to reverse the motor's direction of rotation.



3. For larger pumps, switch legs T1 and T3 to the K6 contactor or U1 soft starter to reverse the pump's direction.

4. Close and padlock the PCS. Retest pump 1 for correct rotation (repeat the steps in Sec. 5.1). Then, proceed to test pump 2 (Sec. 5.3, next page).



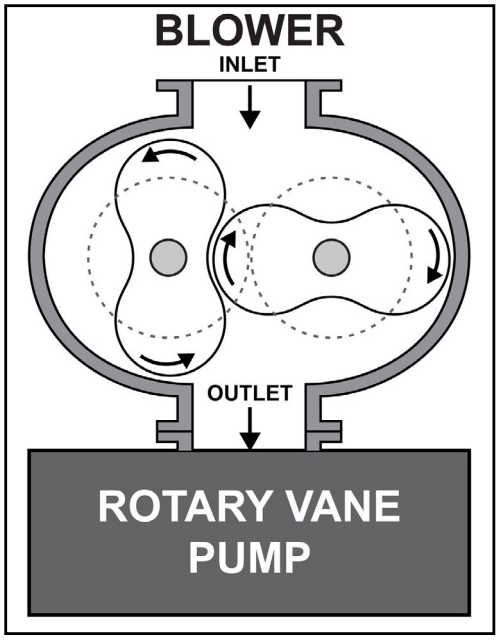
5.3 TEST PUMP 2 ROTATIONAL DIRECTION USING VISUAL INSPECTION

Testing the rotational direction of pump 2 requires pump 1 to be running. Therefore, the visual inspection method must be used to check a blower's direction in a pump/blower package. If pump 1 is spinning in the correct direction, it makes vacuum at the blower's inlet. When the blower is turned on (pump 2), even if it is spinning in the wrong direction (not pumping), there will still be vacuum at the blower's inlet. So, it is not possible to determine from a vauum test if the blower is rotating in the proper direction.

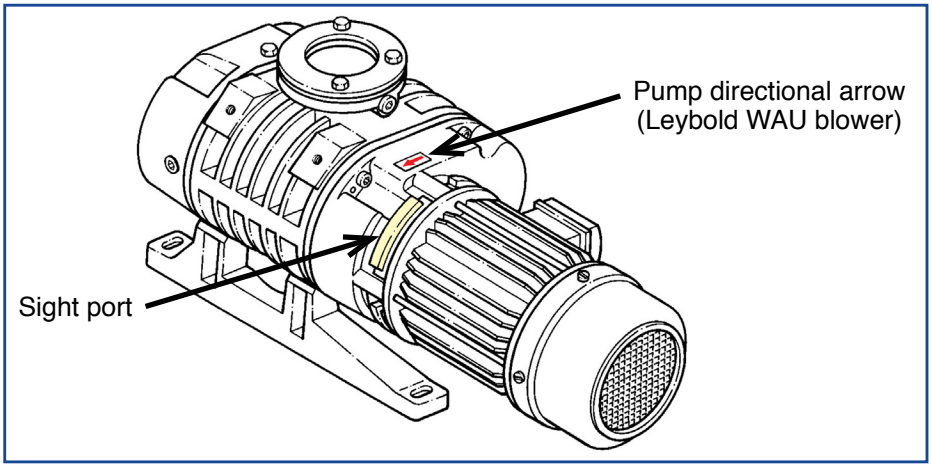
There are two ways to visually check a blower's rotation. The first is to look down into the blower's inlet (wearing safety glasses!) and notice the direction that the blower rotors move upon startup. The rotors should spin outwardly from the center if the blower is rotating correctly.

⚠ CAUTION

This procedure requires safety glasses.



The second way is to observe the pump's direction through the sight port near the motor and see if it is rotating in the same direction as the directional arrow marker on the pump housing. If it is, the pump is rotating in the correct direction. Otherwise it is not.

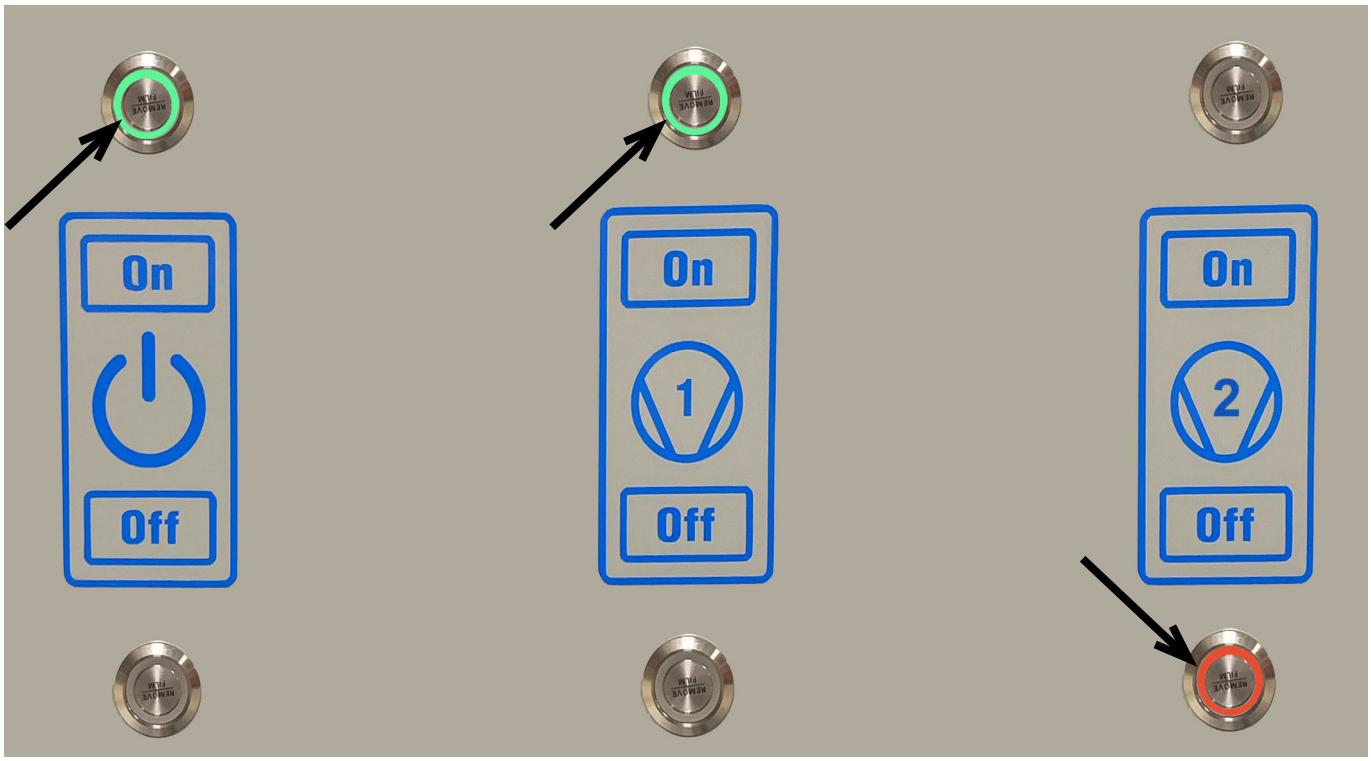


Note that for systems with a pair of similar rotary vane pumps, rather than a pump/blower package, repeat the vacuum test procedure described in Sec. 5.1 for the second pump.

1. For testing the blower on pump/blower systems, start with the PCS energized, the power switch on (green), and the pump 1 switch off (red).

2. Press the pump 1 on switch. Pump 1 starts and the pump 1 switch illuminates green.

   The pump 2 power switch is now illuminated red (off).



3. With the helper observing the pump direction through the blower's sight port, press the pump 2 on button. After one second, press the pump 2 off button.

4. If pump 2 is rotating in the same direction as the directional arrow marker on the pump, the pump is rotating correctly and is pumping.

   Pump testing is complete. Go to Chap. 6, Operation, p. 26.

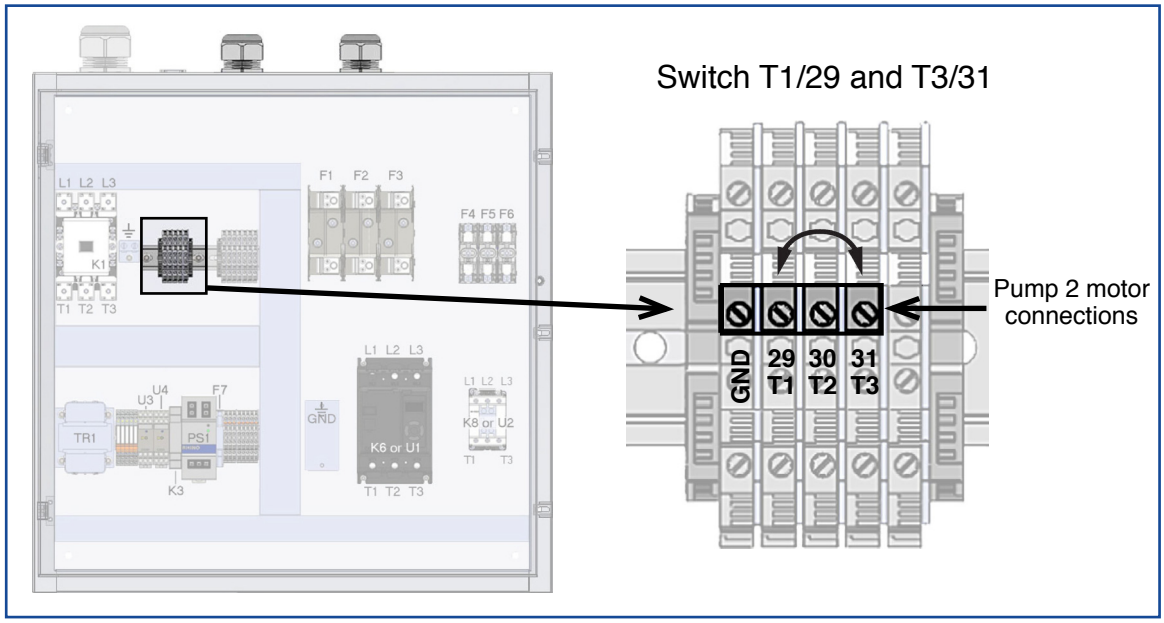
5. If pump 2 is rotating backwards, proceed to Sec. 5.4, next page).

5.4 REVERSING PUMP 2 DIRECTION

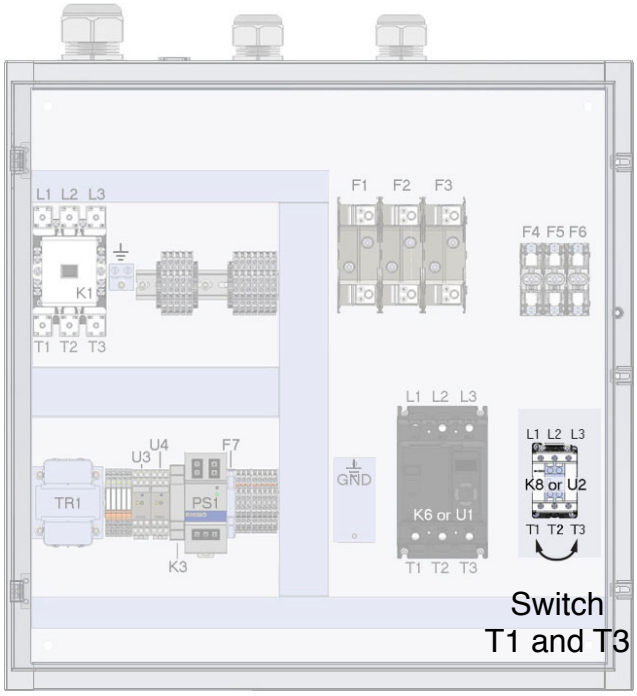
1. If pump 2 is rotating backwards, denergize and lockout/tagout the PCS.

   Unlock the PCS padlock and open the door.

2. For smaller pumps, whose power connects to the terminal block close to the main power contactor, switch legs T1/29 and T3/31 to reverse the motor's direction of rotation.



3. For larger pumps, switch legs T1 and T3 on the K8 contactor or the U2 soft starter to reverse the pump's direction.



4. Close and padlock the PCS. Retest pump 2 for correct rotation (repeat the steps in Sec. 5.3). Then, go to Chap. 6, Operation, next page.

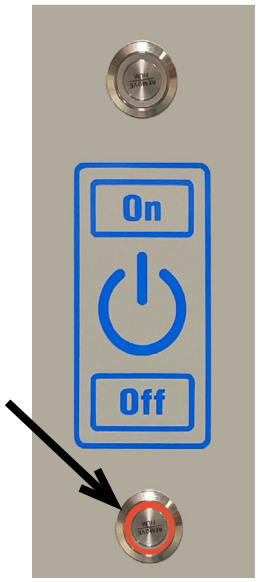
6. OPERATION

Once the system is installed and the pumps tested, the PCS is commissioned and may be used normally.

The RS-485 and I/O communications cabling may now be connected and used to operate and monitor the system.

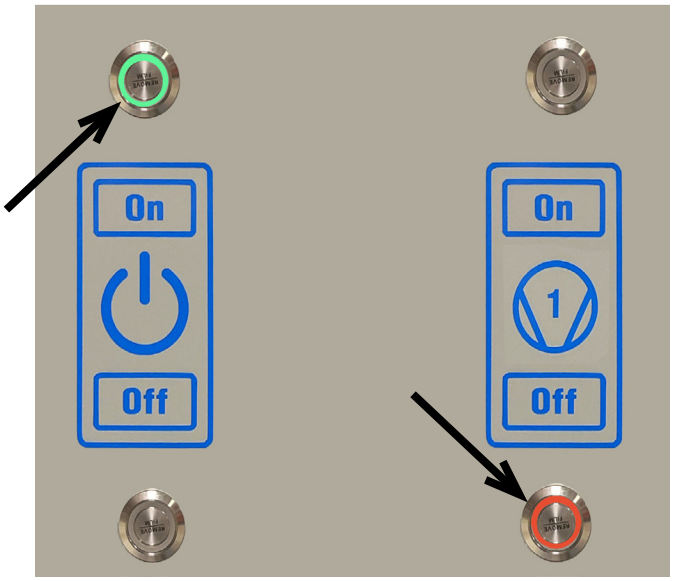
6.1 TURNING ON THE PUMPS MANUALLY

1. Once the PCS has power, the power switch is off (illuminated red).



2. Press the power on switch. It illuminates green.

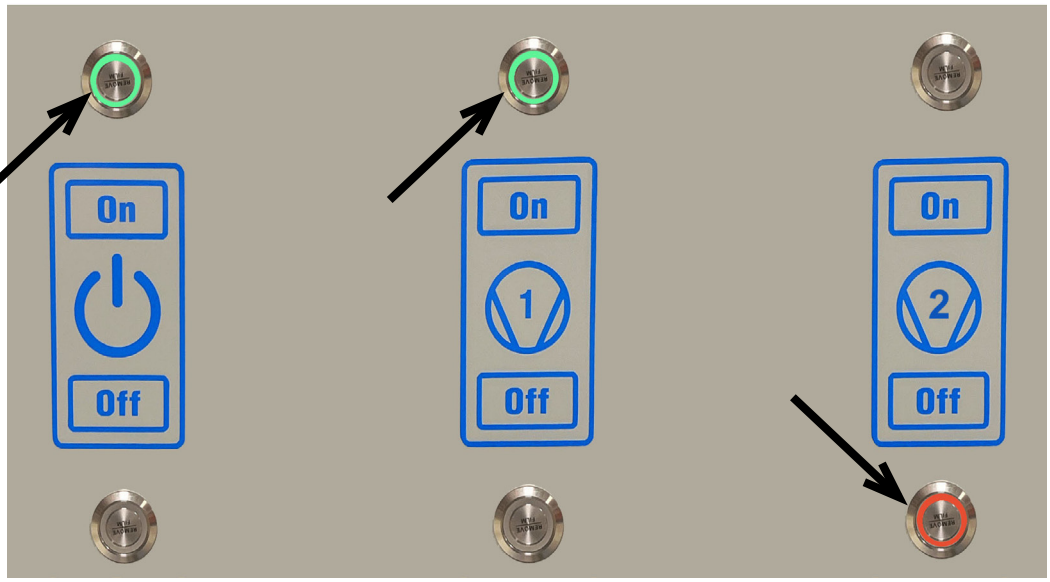
   The pump 1 switch is off (red).



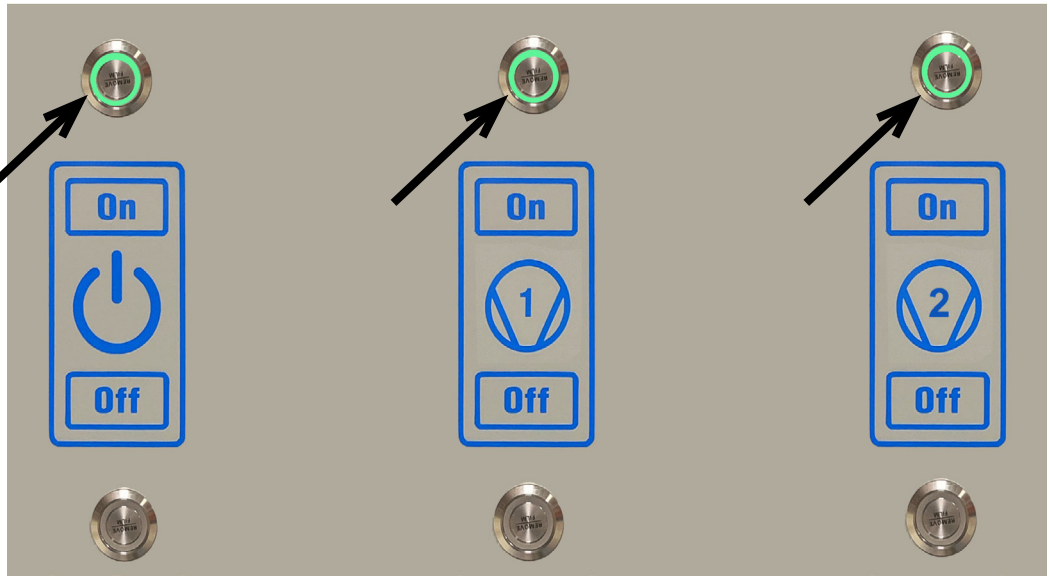
3. Press the pump 1 on switch. It illuminates green (next page).

   The PCS has a delay to protect the pumps and to limit inrush current of both pumps being turned on at once. It is preset to a 15 second delay before pump 2 may be turned on. This delay can be varied according to the user's requirements (Sec. 6.3, p. 28).

   After 15 seconds, the pump 2 off switch illuminates red. Pump 2 is on standby and may be turned on at will.



4. Press the pump 2 switch on. It illuminates green.



6.2 TURNING OFF THE PUMPS MANUALLY

The pumps can be turned off individually in reverse order to starting them.

- When the pump 2 off switch is pressed, pump 2 will shut off. Pump 1 will remain on.
- When the pump 1 off switch is pressed AND pump 2 is also on, both pumps 1 and 2 will shut off.
- When the power off switch is pressed, both pumps 1 and 2 will shut off.

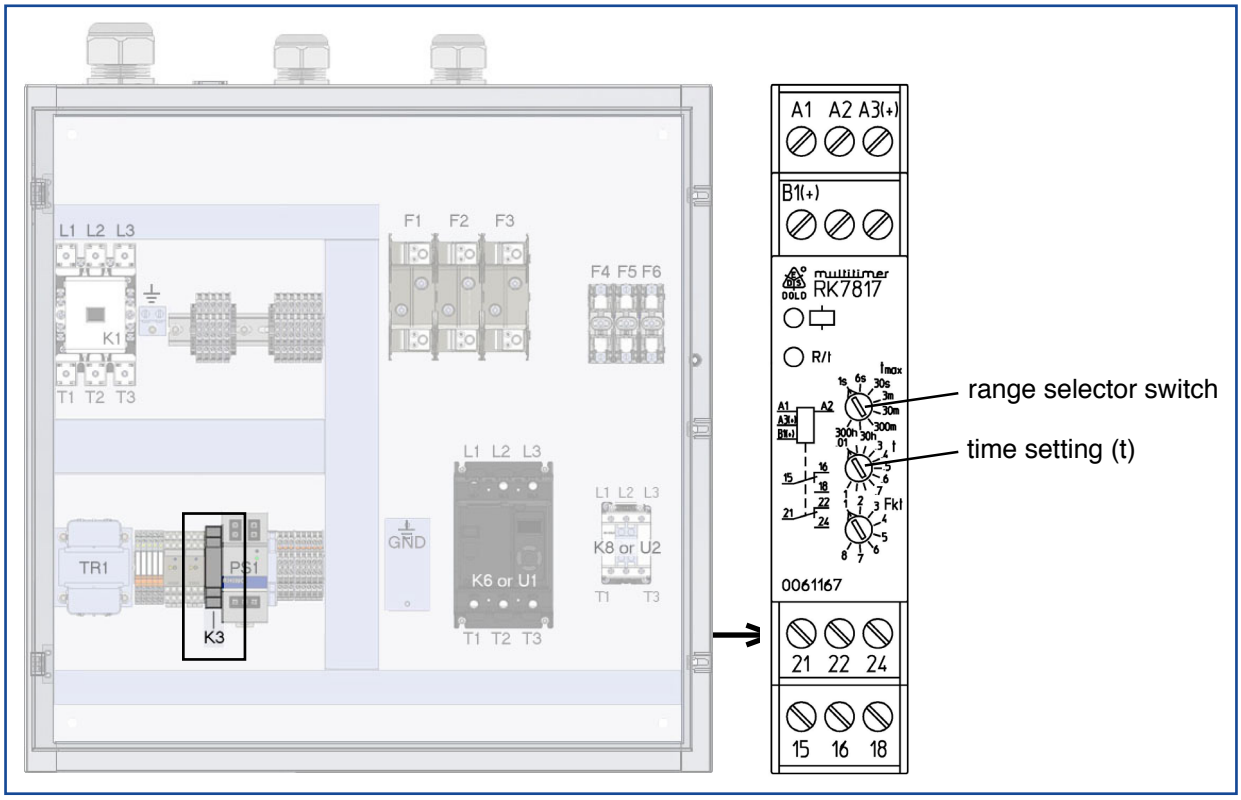
The PCS does not have its own system power switch. It must be deenergized from the facility disconnect.

6.3 ADJUSTING PUMP 2 DELAY

The delay between turning on pump 1 and when pump 2 may be turned on is adjustable from the K3 time delay relay (multitimer multifunction relay). The factory setting is 15 seconds. The delay time may be changed with the range selector and time setting rotary switches.

If the delay time is set too short, there is risk of nuisance tripping of the facility breaker.

Do not change any other settings on the K3 relay.



6.4 EMERGENCY STOP SWITCH

The emergency stop switch behaves like the power off switch. When engaged, power to both pumps is immediately cut. The emnergency stop latches closed and must be truned and pulled out to allow pumps to be turned back on. When re-engaged, the PCS acts normally. Pumps will not restart without user action.

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