

OPERATING INSTRUCTIONS

EXPANDABLE VACUUM SYSTEMS

For Advantage D, Advantage X, Advantage L,
Advantage P, and Advantage C Systems

MAKE IT BECKER.



IMPORTANT: Please review all material pertaining to your system **BEFORE** commissioning, to prevent injury or damage to personnel and/or equipment.



IMPORTANT NOTES FOR THE USER OF THE OPERATING INSTRUCTIONS

- Becker Pumps Corp. reserve the right to make technical changes and additions to the operating instructions.
- No liability is accepted for the content, in particular for damage caused by existing, non-existing or incorrect information.
- Passing on these operating instructions is not permitted unless expressly authorized.

OPERATING INSTRUCTIONS VALID FOR

| | |
|---------------------|--|
| General Designation | Central Vacuum Systems |
| Product Type | Expandable Central Vacuum Systems |
| Model | Advantage D, Advantage X, Advantage L, Advantage P, Advantage C Systems |
| Manufacturer | Becker Pumps Corporation 100 East Ascot Lane Cuyahoga Falls, OH 44223 |

BECKER ADVANTAGE SYSTEMS

Becker Central Vacuum Advantage systems are available in three configurations: tank mounted, space saver or expandable. Tank mounted models are offered in two sizes, simplex or duplex. Space saver systems are duplex only, to maximize vacuum capability despite space limitations. Expandable systems range in size from duplex to sextuplex and are designed to be easily expandable from any smaller size option up to the largest size option (sextuplex). Each system includes:

- Automatic electrical controls to maintain vacuum between preset levels
- ASME coded receivers
- Inlet filters
- Check valves
- Isolation valves
- Vibration isolators
- Vacuum gauges

All Becker Advantage systems are given a specific suffix to identify their associated vacuum technology. Reference the table below to identify the vacuum technology associated with your system.

| SYSTEM NAME | VACUUM TECHNOLOGY |
|-------------|----------------------------|
| Advantage D | Dry Rotary Vane |
| Advantage X | Dry X-Vane |
| Advantage L | Oil-Lubricated Rotary Vane |
| Advantage P | Oil-Lubricated Purge |
| Advantage C | Hook & Claw |

SYSTEM COMMISSIONING

1. INSTALLATION

1.1 UNLOADING

Inspect the system carefully for any sign of damage incurred during transit. Becker ships all systems F.O.B., factory; therefore, damage is the responsibility of the carrier and all claims must be made with the carrier directly. Using a fork lift truck, carefully lift the system from the transport vehicle and place the components in the final location, leaving a minimum of 36" around the package for service and ventilation (see COMPONENT ASSEMBLY below for instructions regarding systems assembly).

1.2 LOCATION

Certain considerations should be given to the placement of the system.

- The package may be installed in any location that is level and will support its weight.
- Adequate ventilation is required, as the pumps are air-cooled.
- The ambient temperature should be between 35°F and 100°F.
- The system should be located as close as possible to the point of usage to prevent excessive loss of operating pressure due to pressure drop.

1.3 COMPONENT ASSEMBLY

The system is shipped as separate modular units to facilitate installation. Most bases will fit through a standard doorway, though some receiver units may need to be tipped slightly and the top module on pump bases stacked three high may need to be removed.

CAUTION: Vertically stacked systems may be top heavy. *Do not tip when moving.*

Inlet piping on the pump modules will require reconnection to the inlet manifold, using the pipe union attached to the flexible connector. Finally, connect the inlet and exhaust (if applicable) piping connections to the application.

1.4 ELECTRICAL REQUIREMENTS

**ENSURE THAT ALL POWER IS TURNED OFF
PRIOR TO PERFORMING ANY WORK ON THIS ELECTRICAL PANEL.**

The electrical controls for each system are wired at the factory and fully tested. Wiring between the pump motors and the control panel is disconnected for shipping.

1.4 ELECTRICAL REQUIREMENTS (CONTINUED)

Rewire each pump's power leads at the corresponding terminal block. Terminal block connections are labeled as a number (1-6) corresponding to the pump, the letter T, and a second number (1-3) to indicate the motor phase (i.e., Pump 1 connections are 1T1, 1T2, & 1T3). The motor wires are color coded to ensure the phases of each motor can be wired identically (red = 1, white = 2, blue = 3). Attach the main power line to the main power terminal block (indicated as PDB112) and ground line to the ground lug in the control panel. The main power line must be sufficient size to provide operation of a fully expanded panel (six pumps).

NOTE: It may be necessary to switch two of the main power leads when performing start-up, if the pump rotation is in the wrong direction (see START-UP: PUMP ROTATION for more information).

1.5 PLUMBING CONNECTIONS

Before connecting any piping to the receiver, the plastic thread protector installed in the main receiver connection port must be removed. The main vacuum line to the receiver must never be reduced below that provided on the receiver. Long piping runs may need to be increased in size to minimize pressure drop. Improper line sizing may result in a loss of capacity. Ideally, piping should be constructed using long radius elbows and a minimum number of turns. Contact the factory for assistance in determining proper line size and piping layouts.

All secondary lines should be taken from the top or side of the main line to prevent any accumulated moisture from draining towards the pumps. All lines should slope away from the pumps. Any low points in the piping should be equipped with pipe drains or drip legs to remove accumulated moisture. If the vacuum system remains under vacuum, a three valve setup may be required in order to drain the piping. Contact the factory for assistance.

2. START-UP

2.1 PUMP IDENTIFICATION

Identify your specific pump type and review the pump specific operating manual enclosed with your order. Prepare each pump in the system for use according to the instructions given. Additionally, check the following:

- Correct ball valves are open between the pump, air receiver and your application
- Any and all exhaust shipping plugs are removed
- All electrical connections are secure and plumbing is free of major leakages
- Advantage L & P systems ONLY: adequate oil has been added to the pump

2.2 PUMP ROTATION

Prior to operation, *each pump* must be checked for correct rotation:

2.2 PUMP ROTATION (CONTINUED)

1. Identify the correct direction-of-rotation of the pump by locating the directional arrows cast into the pump frame or by referencing the pump's operating manual.
2. Using the Hand-Off-Auto switch on the door of the control panel, jog the motor of the pump momentarily by turning the switch to "HAND" and back to "OFF".
3. Observe the cooling fan of the motor while bumping power to the pump, and note the rotational direction of the fan.

NOTE: For three-phase systems, if *all* pumps are rotating in the wrong direction, rotation can be reversed by switching any two main incoming power leads. If some, but *not all*, pumps are rotating incorrectly, switch any two of the incorrect pumps' motor wires at their corresponding terminal block.

Correct rotation must be confirmed with this procedure, for every pump, before beginning normal operation.

2.3 MAINTENANCE

The required routine maintenance points for each system vary depending on the pump technology used. Please refer to your pump specific operation manual, included in your system packet, for information on routine maintenance requirements and correct procedures.

If your system uses external canister filters, in addition to the pump's integrated filters, be sure to regularly empty and check the filter canisters and elements so they do not become overloaded.

Additional maintenance documents may be available upon request.

3. GENERAL OPERATION

3.1 INITIAL START-UP

On initial start-up, when there is no vacuum in the system, one pump will start and all other pumps will remain off. If one pump alone cannot reach the low vacuum setpoint after 40 seconds, a second pump will start. Additional pumps may continue to start if the low vacuum setpoint is still not reached. After initial start-up, a 20 second waiting period follows the start of each pump to determine if the low vacuum setpoint can be met.

A pump will only turn off after the vacuum level has reached the high vacuum setpoint *and* the pump has met the minimum run time requirement, as determined by the minimum run timer. Once the pumps have shut off, they will not restart until the low vacuum setpoint has been reached. At this point the system has entered its normal operation.

3.2 PUMP ALTERNATION

Becker Expandable system controls utilize a lead/lag function to ensure equal run times are maintained between all pumps in the system. Each time the low vacuum setpoint is reached, the pump with the lowest run hours will start first. If more than one pump is required to overcome the low vacuum setpoint, additional pumps will start in order of run hours, from lowest to highest.

If the system's vacuum level remains between the high and low vacuum setpoints, meaning the low vacuum setpoint has been reached but the high vacuum setpoint has not, then the system will operate according to the following conditions until the high vacuum setpoint has been met.

- Any pump operating in this situation will continue to operate until the pump's maximum run timer has expired.
- The operating pump will shut off when its maximum run timer is met. Another pump in the system will turn on in its place.
- The pump that replaces the original operating pump will always be the pump with the lowest run hours.
- All pumps will continue to alternate upon termination of the corresponding maximum run timer until the high vacuum setpoint is reached.
- If there are no available pumps in the system, then all pumps will continue to operate until the high vacuum setpoint is reached.

3.3 ALARMS

The Becker Expandable system has two faults designed to trigger the system's alarm:

1. LOW VACUUM ALARM

The low vacuum alarm will sound when the vacuum level in the system is at or below the low vacuum alarm setting. This value is determined by the end user during purchase and is usually below the low vacuum setpoint. This alarm is used to alert the end user to an unacceptable level of vacuum within the system and may indicate a potential issue. If this fault is frequently triggered during the routine operation of your system, please contact the factory for assistance.

NOTE: On a cold start, the low vacuum alarm fault is inoperative until the low vacuum alarm and low vacuum setpoints have been exceeded.

2. ALL PUMPS RUNNING ALARM

The "All Pumps Running" alarm will sound when all active pumps in the system are currently in use. This alarm is used in *medical* systems only. The end user is alerted any time all pumps are running simultaneously, or if the only pump(s) not in use are unavailable, or inactive.

An *active* pump is any pump in the system that is ready for use in AUTO mode.

An *inactive* pump is any pump that is either not switched into AUTO mode or is unavailable for any other reason (ie. the motor starter has tripped, or pump is shut off for maintenance).

Alarms can be silenced at the HMI with the "SILENCE ALARM" button. Faults/alarms can be cleared using the "FAULT RESET" button after the faulting condition has been resolved.

3.4 RUN TIMERS

Two run timers are used within the controls of the Becker Expandable system:

1. MINIMUM RUN TIMER

This timer is used to determine the minimum time a pump must run before shut off is allowed. The purpose of this timer is to prevent motor damage to the pumps due to heat from too many starts per hour. The minimum run timer begins once the system vacuum level has reached the high vacuum setpoint.

NOTE: The vacuum level may exceed the high vacuum setpoint before the duration of the timer. Exceeding the high vacuum setpoint will not cause damage to the pumps if they are well maintained and operating correctly; however, caution is advised if the end-user's process cannot tolerate higher vacuum levels.

The factory setting for this timer is **ten minutes**.

2. MAXIMUM RUN TIMER

This timer is used to assist with proper pump alternation and the balancing of total run hours between all active pumps. It activates once the low vacuum setpoint is met and will deactivate if the high vacuum setpoint is reached.

The factory setting for this timer is **four hours**.

These timers are adjustable from the HMI Settings screen to best fit each end user's specific needs. Please contact the factory for assistance in selecting appropriate timer settings for your system.

3.5 PURGE CYCLE

The purge cycle is exclusive to *Advantage P* systems and allows the pump to rid itself of any ingested gases or chemicals. To purge a pump, the pump must be closed off from all other parts of the system and run with the pump's integrated gas ballast valve open. Advantage P systems are designed to purge each pump automatically. To achieve this, each pump is equipped with its own normally closed solenoid valve, wired into the control panel.

The automatic purge cycle operates as follows:

- Every time a pump enters HAND mode or enters an "on" or active state while in AUTO mode, the pump's solenoid valve will open, giving the pump access to the system.
- Every time a pump enters OFF mode or enters an "off" or inactive state while in AUTO mode, the solenoid valve will close.
- Once the valve closes the pump is closed off from the system and will begin purging. The pump will continue to purge until the purge run timer expires.
- Once the purge run timer expires, the purge cycle is complete.

The factory setting for the purge run timer is seven minutes. This timer is adjustable from the HMI Settings screen, please contact the factory for assistance.

3.5 PURGE CYCLE (CONTINUED)

NOTE: While purging, pumps are on and running, even when switched into OFF mode.

If at any time, a pump in the middle of its purge cycle is needed by the system to meet the low vacuum setpoint, that pump will exit the purge cycle and re-enter normal operation.

Please contact the factory with any questions relating to system operation.

4. ELECTRICAL CONTROL PANEL

4.1 DESCRIPTION

The Becker Expandable electrical control panel is designed to control up to six vacuum pumps and includes:

- a low voltage control transformer (115 volt secondary) with fused primary and secondary;
- a pressure transducer;
- a fault alarm horn;
- a programable logic controller (PLC);
- Hand-Off-Auto switches; and
- Smart motor starters.

All components are enclosed in a NEMA 3R, 4, & 12 enclosure.

4.2 KEY COMPONENTS

Standard equipment furnished with a Becker Expandable control panel have the following components:

1. PROGRAMABLE LOGIC CONTROLLER

The PLC receives a signal from the pressure transducer and the selector switches and sends a signal to the motor starters. The control panel is wired to permit the pumps to operate when the PLC is removed for service. This is achieved by placing the HOA switch(es) into the "Hand" position; all automatic features are bypassed.

2. HMI DISPLAY

The HMI display provides the end user access to various settings within the system. It also provides a visual display of the current vacuum level and each pump's status. See HMI DISPLAY on the following page for more information.

3. MOTOR MANAGEMENT SYSTEM

The motor management system is made up of motor starters with disconnect and ethernet motor controllers. This system provides standard short circuit protection as well as full monitoring, control, and protection of the motors. Additionally, motor settings and current trending are viewable on the HMI display.

4.2 KEY COMPONENTS (CONTINUED)

4. HAND / OFF / AUTO SWITCH

Each pump is equipped with an H/O/A switch. When the switch is in the Hand position, all program logic is bypassed and the pump will run continuously. In the Off position, the pump will not run. In the Auto position, the pump is connected to the system logic and will automatically come on and off as needed.

5. CONTROL VOLTAGE TRANSFORMER

All controls are operated at 115 volts AC single phase power, which is provided by the CVT. Both primary legs of the voltage as well as the secondary leg are fused. The transformer will accept 208, 230, or 460 volt input.

6. EMERGENCY STOP BUTTON

When depressed this button interrupts control voltage power to all devices, except transformer(s) and process controller, inside the panel. To reset this button, it must be rotated as indicated by the arrows on the button.

7. PRESSURE TRANSDUCER

Senses vacuum level in the receiver and sends a signal to the PLC.

8. ALARM HORN

Provides audible warning to alert users to system faults

9. ALARM RELAY

There are two alarm relays used for remote signaling, labeled CR457 and CR459. CR457 corresponds to the low vacuum alarm. CR459 corresponds to the "All Pumps Running" alarm. Please reference the wiring diagram included with the panel to determine which contacts are normally open/closed.







5. HMI DISPLAY

The HMI display utilizes various features to assist with the monitoring of the Becker Central Vacuum system. The following sections will explain the general operation of each HMI display screen.

5.1 GENERAL

Six buttons are displayed vertically along either side of the HMI screen. These are used to navigate throughout the various screens and functions of the HMI display. The following table identifies each of the six buttons and their corresponding screen or function.

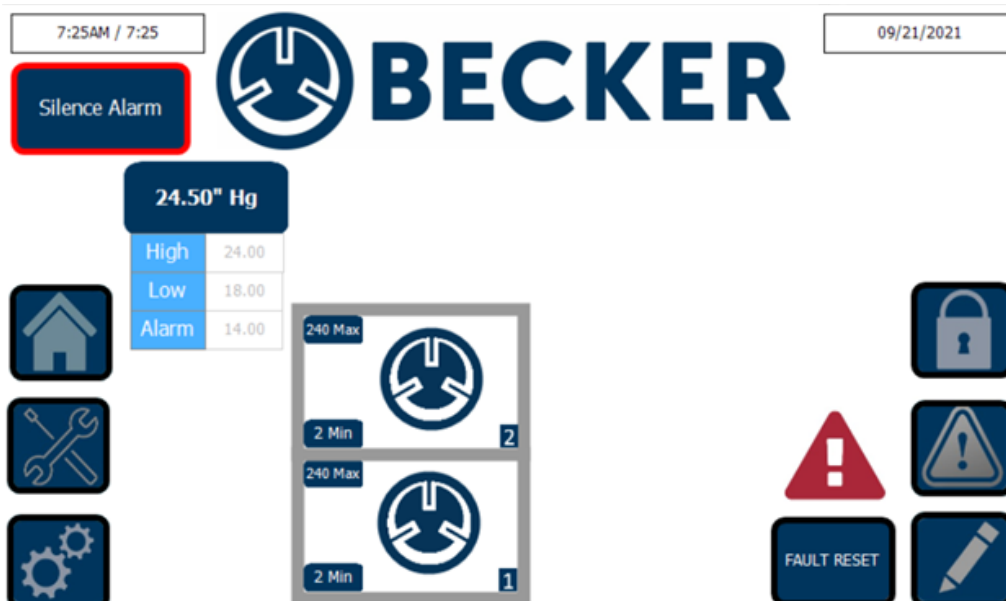
5.1 GENERAL

| ICON | NAME | DESCRIPTION |
|---|----------|--|
|  | Home | Returns user to the home page |
|  | Motor | Takes user to the motor settings page |
|  | Status | Takes user to the pump status page |
|  | Password | Prompts user to enter in a username and password |
|  | Faults | Takes user to the faults log page |
|  | Settings | Takes user to system settings |

The password button can be selected at anytime and will prompt for a username and password. There are two levels of password protection allowing users to change and edit various settings. Please contact the factory for username and password information, if needed.

Time and date settings can be adjusted at any time by pressing the time or date display in either of the top corners of the screen.



5.2 HOME PAGE



5.2 HOME PAGE (CONTINUED)

The home page displays the current status of each pump as well as a real-time reading of the vacuum level in the system. Below the vacuum level reading are the current vacuum setpoints of the system. Within each pump's box, the pump's minimum and maximum run timers are shown (values listed in minutes).

Each pump and its corresponding data are grouped into boxes. Pumps entered into the system are represented by the pump symbol and can be matched to the correct pump by the identification number shown. The status of each pump is indicated by the color of the pump symbol, as represented in the table below.

| COLOR | PUMP STATUS |
|---|----------------------|
|  | Off / Ready |
|  | Running |
|  | Running in HAND |
|  | Faulted |
|  | Maintenance Required |
|  | Purge Cycle |
|  | Service Mode |

PROCEDURE: To remove a pump for maintenance/service, enter the password and locate the correct pump on the home screen. Press the pump symbol and follow the on screen prompts. While in service mode, the pump is removed from the PLC's lead/lag sequence. Additionally, an electrician or other qualified personnel may carefully switch off the pump's motor disconnect. Select the pump symbol again to remove the pump from service mode.

The home page also features the "SILENCE ALARM" and "FAULT RESET" buttons, as well as the fault indicator icon.

5.3 MOTOR SETTINGS PAGE

The motor settings page displays the current settings for the motor starters for each pump, such as the motor FLA and overload class. These settings are preset at the factory before shipping. If any adjustments are required, the user must first enter the correct username and password.

5.3 MOTOR SETTINGS PAGE



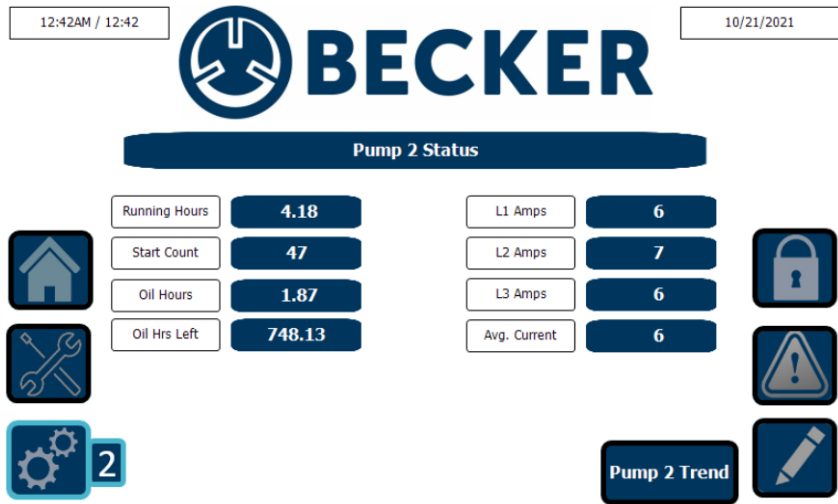
This page allows for settings to be read from or written to the motor starters. Tap the switch icon to toggle between Read Mode and Edit Mode. Edit Mode must be activated to make changes.

WARNING: Selecting improper motor settings could pose a risk to personnel and equipment. Please contact the factory before making changes.

5.4 PUMP STATUS PAGE

Upon selecting the Status button, the user will be prompted to select a specific pump to view. After selecting, you will be brought to that pump's status page.

From this page users can view pump run hours and start counter.



Additionally, maintenance points for the pump will be displayed with the time remaining until maintenance is required. Once maintenance has been performed, maintenance run hours can be reset.

NOTE: Users must be logged in to reset maintenance hours or adjust total run hours.

5.4 PUMP STATUS PAGE (CONTINUED)

Users are also able to view the pump's amperage readings on the right side of the page. Both the average current, and amperage of each power line to the pump is displayed.

Selecting the "PUMP # TREND" button will take you to the amperage trend page. This page features a real time graph of each pump's current. Users can view one pump at a time, or all pumps in the system simultaneously by selecting the various option buttons at the bottom of the screen. The trend page stores up to 11 hours of data. *To return to the Status Page, select the Becker logo at the top of the screen.*

5.5 FAULT LOG PAGE

The faults log page is used to track and identify any faults that have been found in the system. Current faults are displayed under "ACTIVE ALARM", while stored faults are displayed under "ALARM HISTORY".

12:44AM / 12:44



10/21/2021





| | DATE/TIME | ACTIVE ALARM |
|---|-----------------------|------------------------|
| 1 | 12:39:51 : 10/21/2021 | Pump 3 Low Oil/Hi Temp |
| 2 | 12:39:51 : 10/21/2021 | Pump 1 Off |
| 3 | 12:39:51 : 10/21/2021 | Pump 3 Off |
| 4 | 12:39:51 : 10/21/2021 | Pump 3 in Service Mode |
| 5 | | |

| | DATE/TIME | ALARM HISTORY |
|---|-----------------------|------------------------|
| 1 | 12:39:50 : 10/21/2021 | Low Vacuum Pressure |
| 2 | 12:39:46 : 10/21/2021 | Pump 2 Off |
| 3 | 12:39:40 : 10/21/2021 | Pump 1 Off |
| 4 | 12:39:16 : 10/21/2021 | Pump 3 in Service Mode |
| 5 | 12:35:44 : 10/21/2021 | Pump 3 Off |
| 6 | 12:31:01 : 10/21/2021 | Pump 3 Off |
| 7 | 12:31:01 : 10/21/2021 | Pump 3 Low Oil/Hi Temp |
| 8 | | |





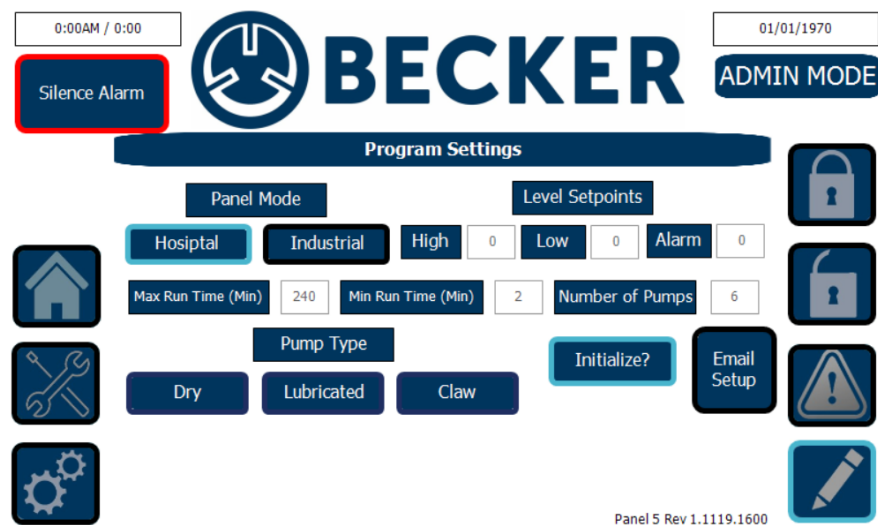
Fault history can be cleared by selecting the "CLEAR HISTORY" button.

5.6 SETTINGS PAGE

The settings page is used to adjusted the main system settings. Users will *not* be able to access any features on this page without the correct username and password.

WARNING: All settings are preset at the factory. Any changes to these settings could affect the function of your system. Please contact the factory before making changes.

5.6 SETTINGS PAGE (CONTINUED)



To adjust any of the vacuum setpoints or run timers, simply press the value currently displayed next to the setting you wish to adjust. Once the number pad appears, enter the new value and select “OK”. If you do not wish to change the value of the selected setting, select “ESC” to return to the settings page.

To adjust the system type settings, simply select the type from the displayed options. The options highlighted in light blue are the current selections for your system.

Pressing the “Initialize?” button activates the cold start sequence on the next power cycle of the system. The “Number of Pumps” setting should only be adjusted on expandable systems and only when needed to expand the system as outlined in the following chapter.

6. EXPANSION PROCEDURE

To increase the number of pumps used in an existing Expandable system, please note the following procedure:

1. After the additional pumps and required accessories have been purchased, install the new pumps and plumbing. This can be done without interrupting the normal operation of the system.
2. Before wiring the new pumps to the control panel and installing the Expansion Kit, enter the correct username and password on the HMI display. Then, navigate to the settings page and adjust the “Number of Pumps” setting to reflect the new total number of pumps in your system.
3. Completely shut off power to the panel and install the Expansion Kit per the wiring diagram. Wire the new pumps to the panel.
4. Power the panel on, the new pumps should appear on the home page. Briefly bump power to the new pumps to check rotation before switching the pumps into AUTO mode.

If you require any assistance while expanding your system, please call the factory.



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