Advantage-L

Series II

OPERATING INSTRUCTIONS

and

MAINTENANCE MANUAL

EXPANDABLE/MODULAR MODELS

(Version 7/07)

BECKER

CENTRAL VACUUM SYSTEMS

DESCRIPTION

The Becker Advantage-D and Advantage-L central vacuum systems are available as either tank mounted simplex or duplex, or as vertically expandable/modular duplex through sextuplex models. All include automatic electrical controls to maintain vacuum levels between preset points; ASME coded receivers; inlet filters; check valves; isolation valves; vibration isolators; flexible connectors; and vacuum gauges.

Advantage-D systems employ Becker 100% oil-less pumps, while Advantage-L systems employ Becker oil flooded models for operation at vacuum levels as high as 29.84"Hg (2 torr).

INSTALLATION

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 them.

Using a fork lift truck, carefully lift the system from the transport vehicle. Using the fork lift truck, place the components in the final location, leaving a minimum of 24" around the package for service and ventilation. (see: COMPONENT ASSEMBLY below for instructions regarding systems assembly)

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 since 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.

When selecting the location for the sysem, remember to keep in mind the requirements for service, such as, changing oil and cleaning filters.

Component Assembly

The system is shipped as separate units to facilitate installation. All bases are designed to fit through a standard 36" doorway, though some receiver modules may need to be tipped slightly, and the top module of some systems stacked three high may need to be removed (see Caution, below).

CAUTION:
On vertically stacked systems, the pump modules may be top-heavy. Do not tip when moving.

Next, connect the inlet piping on the pump module to the inlet manifold. This may be accomplished by reconnecting the pipe union attached to the flexible connector.

Electrical Requirements

BE SURE THAT ALL POWER IS TURNED OFF PRIOR TO PERFORMING ANY WORK ON THIS ELECTRICAL PANEL!

The electrical controls for the system were wired at the factory and were fully tested. The wiring at the motors have been disconnected for shipping purposes. Reconnect the wires in the motor starter.

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.

Attach the main power line to the main power terminal block and ground line to the ground lug in the control panel. On expandable models, the main power line must be of sufficient size to provide for operation of a fully expanded panel.

Vacuum Piping Connection

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. Piping should 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 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.

START-UP

Oil

Oil must be added to the pump through the oil fill port located at the top of the exhaust box. An exhaust pressure gauge is installed in the oil fill cap on U4.70SA and larger pumps, only; care must be taken not to damage the gauge when removing and replacing the cap. Add sufficient oil to bring the oil level to the the fill level as noted on the exhaust box casting. Non-detergent oil should always be used to prevent foaming and possible plugging of the exhaust filter elements.

NEVER ADD OIL THROUGH THE INLET OR EXHAUST PORTS OF THE PUMP.

Pump Rotation

Prior to actual operation, the pumps must be checked for correct rotation.

Using the Manual-Off-Auto switch on the door of the control panel, jog the motor of the specific pump that is to be checked by momentarily turning the switch to "manual" and back to "Off". By observing the cooling fan of the motor you can determine the rotation of the pump. U3...SA pumps, used in smaller Advantage-L systems, rotate in a clockcwise direction when viewed from the fan end of the motor. U4...SA pumps, used in the larger Advantage L systems, rotate in a counter-clockwise direction when viewed from the fan end of the motor.

If the pumps are rotating in the wrong direction, rotation can be reversed by switching any two ***main*** incoming power leads. Correct rotation should be confirmed in the previous manner.

General Operation

All Becker central vacuum systems are operated by a programmable logic controller. All employ cascading lead/lag methods of operation where pumps will turn on or off in succession to meet any changes in demand. Becker uses the following terms for the pumps used in these systems:

Lead: The pump carrying the main load. The first pump to turn on and first to shut off.

Lag_1: The second pump in a duplex or larger multiplex system.

Lag_2: The third pump in a triplex or larger multiplex system.

Lag_3: The fourth pump in a quadruplex or larger multiplex system.

Lag_4: The fifth pump in a pentaplex or larger multiplex system.

Lag_5: The sixth pump in a sextuplex system.

Back-up: The usual term for the last pump in the system to turn on and the last to turn off (It is understood that the pump Becker terms the back-up, may not be a *true* back-up pump since some customers do not require one. It simply indicates the last pump in the sequence).

On the *initial* system start-up, when the system is below the set point for the minimum vacuum level, one pump will operate. To prevent excessively high inrush currents upon initial start-up, the PLC will start all additional pumps in the system in pre-established time increments, unless the minimum vacuum level has been reached first.

The vacuum level will start to rise. As the vacuum level reaches the set point for the maximum vacuum level, the lead pump will shut off (providing the minimum run timer has been satisfied). Any remaining pump(s) will continue to run until its minimum run timer has been satisfied, at which time it will shut off.

After the pumps shut off, the vacuum level will begin to drop, due to leakage and/or demand. When the system vacuum level reaches the minimum vacuum level set point, a pump will turn on, and will pump the system up to the maximum vacuum level set point, and the pump will stop (providing its minimum run timer has been satisfied). If the vacuum level continues to drop, due to a high demand, the PLC will check to see if the vacuum level is still at or below the minimum vacuum level set point. If it is, the PLC will start another pump. In this manner all pumps will work on a first on—first off sequence.

Occasionally, the lead pump does not have enough capacity on its own to raise the vacuum level to the maximum vacuum level set point. Under this condition, the pump will run continuously. To prevent the pump from accumulating significantly more hours than the other pumps, a timed alternation method is included in the PLC program that will alternate the lead/lag functions of the pumps on a timed basis. The standard period of alternation is four hours, but may be modified if the application requires. If the system does not alternate every 4 hours, contact the factory to determine the actual period of alternation.

Minimum run timers are programmed into the PLC to prevent motor damage due to heat from too many starts per hour. We use a ten minute minimum run timer. Should the vacuum switch contacts open, and the timer on the PLC not be finished timing out, the pump will keep running until the timer is satisfied, at which time it will stop, unless the vacuum level has dropped below the minimum vacuum level set point.

MAINTENANCE

Pumps

Each pump in the system is a Becker U Series model, which is an oil-flooded rotary vane vacuum pump. A separate operating manual for these pumps is included with this system.

It is recommended to change the oil every 500 hours, as determined by the hour meters on the door of the enclosure. See: Start-up; Oil on page 3.

Exhaust Pressure Gauge

Each pump, U4.70SA and larger, is equipped with an exhaust pressure gauge to indicate the condition of the exhaust filters that are located within the exhaust box, as back pressure. These filters are vital to the efficient separation of the oil aerosols present in the discharge airstream. The exhaust pressure gauge should be checked periodically.

NOTE: The exhaust pressure gauge must be read when the pump is operating at open flow (no vacuum).

The following procedure is suggested:

- Turn the pump H-O-A switch to the "Off" position.
- Close the pump isolation valve.
- Open the inlet bleed valve.
- Remove the inlet filter cover.
- Turn the pump H-O-A switch to the "Hand" position.
- Read the pressure on the exhaust pressure gauge.

If the pressure is at or beyond the red zone, the exhaust filter element must be changed.

Reverse the procedure to put the pump back on-line.

Inlet Filters

Each pump is equipped with a 5 micron inlet filter. It can be serviced by following these steps: first, close the isolation valve adjacent to the vertical manifold; second, open the vent valve located at the pipe elbow near the pump inlet (this vents the filter housing to atmospheric pressure); third, release the three clamps on the filter housing, and remove the filter cartridge. It is recommended that the filter be checked every week, initially. After experience is gained, the period for inspection may be altered.

The filter element may be cleaned by blowing with compressed air from the inside. Care must be taken not to use too much pressure, which could damage the element.

Tank drain

The standard (on industrial systems only) tank drain consists of a manually operated, three valve tank assembly. This assembly allows draining of accumulated liquids while the system remains under vacuum. The drain tank assembly consists of a separate tank (approximately 2 gallons in capacity) which is connected to, and below, the receiver by a length of tubing. Between the receiver and the drain tank is a small ball-type isolation valve. The drain tank includes a sight glass to enable one to see the liquid level, and a drain valve and vent valve. The isolation valve is normally open, while the vent and drain valves are normally closed. To drain the liquid from the drain tank, one must close the isolation valve and open the drain and vent valves. When draining is complete, reverse the position of the three valves, closing the vent and drain valves first.

ELECTRICAL CONTROL PANEL

Description

The Becker electrical control panel is designed to control from two to six vacuum pumps, depending on type of system purchased. It includes a programmable controller, low voltage control transformer (115 volt secondary) with fused primary and secondary, an emergency stop button, a back-up pump alarm, a pressure transducer with a panel mounted process controller that has digital pressure indication, and the following for each pump: digital LCD hour meter, Hand-Off-Auto switch with pump run light, and motor starter with disconnect. All components are enclosed in a NEMA 4X enclosure.

Programmable Controller

The Programmable Logic Controller (PLC) receives a signal from the process controller and the selector switches and sends a signal to the motor starters. The hour meters and run lights receive their signal from the auxilliary contacts on the motor starters.

Status Indicators

On the face of the PLC, a number of LED's show the condition of inputs, outputs, and of the controller itself. The input LED's indicate when electrical power is applied to the corresponding input terminal. Inputs are located on the bottom of the controller and are 24 Volts DC

Input LED's numbered:

0-5—Indicate pumps one through six running in "AUTO" position.

6—Indicates the Minimum Vacuum Level Set Point. System vacuum level is above this point when lit.

7—Indicates the Maximum Vacuum Level Set Point. System vacuum level is above this point when lit.

8—Indicates the alarm is silenced. Lights when "Alarm Silence" button is depressed.

9—Indicates the Low Vacuum Alarm level. System vacuum level is above this point when lit.

NOTE: This alarm is intended for industrial use only.

For hopitals, NFPA 99-1999 (4-3.2.2.8 (b)) code requirements dictate that the hospital low vacuum alarm be sensed at a point upstream of the main system source (or isolation) valve, which may be independent of this Advantage-L system.

10-15—Indicate optional (low oil level, high temperature) alarms for pumps number one through six (i.e., 10 is for pump #1).

16—Spare

17-19—System configuration jumpers.

2 pump system: no LED lit
3 pump system: 17 only lit
4 pump system: 18 only lit
5 pump system: 17 and 18 lit
6 pump system: 19 only lit

20-21—Spare

24—Test jumper (located on top).

25—Industrial system jumper (located on top). Defeats Reserve-Pump-In-Use alarm.

Outputs are located on top and are relay outputs.

Output LED's numbered:

C0, 0—Remote low vacuum alarm (dry contact).

NOTE: This alarm is intended for industrial use only.

For hopitals, NFPA 99-1999 (4-3.2.2.8 (b)) code requirements dictate that the hospital low vacuum alarm be sensed at a point upstream of the main system source (or isolation) valve, which may be independent of this Advantage-L system.

C1, 1—Reserve-Pump-In-Use (all pumps running) alarm (dry contact).

2, 3—Spare
4-9—Pumps numbered one through six run (120V).
10—Alarm pilot light (120V).
11—Alarm horn (120V).

Also located on the PLC face near the right side are controller condition indicating LED's:

	LED On	LED Blinking
RUN STOP	PLC Running	PLC Stopped
CPU PROG	CPU Fault	Program Watchdog Fault
I/O MEM	I/O Fault	RAM Memory Fault
BATT	Battery Fault**	

** Battery fault will be lit when no battery is installed.

EEPROM Memory Module

The EEPROM memory module contains "read only memory". It is used to store the program for the control sequence. The EEPROM will retain its program even when power to the PLC is turned off.

CAUTION: Turn off power to the processor before removing or installing the EEPROM module. Equipment damage may result.

PLC Replacement

The control panel is wired to permit the pumps to operate manually when the PLC is removed for service, as long as the PLC terminal strip connections are left in place.

Starter

The starter's magnetic coil will be energized when a 115 volt current passes through A1 and A2 terminals. When the starter coil is energized, the contacts between L1 to T1, L2 to T2 and L3 to T3 close (except when the yellow lock-out tab located at the top rear of the starter has been pulled up—I-32 starters only). If the starter coil is energized, the Auto indicator will be lit. This indicator (and that of the Reset indicator) is a fiber optic light pipe that uses ambient light and, therefore, requires no power. When the main circuit is tripped due to a short circuit, the Reset indicator will be visible. They may be checked by looking directly into the lens.

If the starter coil trips out, the cause may be determined by looking at the two light pipes labeled "AUTO" and "RESET". If the coil tripped due to overload, the "AUTO" light will be lit. If it tripped due to short circuit, the "RESET" light will be lit. The disconnect will be in the "TRIP" location. To reset the starter, first, locate the source of the trouble and rectify it, then, turn the disconnect counter-clockwise to the "OFF" position. Then turn it clockwise to the "Auto" position.

At the bottom front portion of the I-32 starter are two dials for amperage adjustments (the I-18 only has one). The right hand dial sets the running amperage limits. and should be set to that amperage stated on the motor nameplate. The left hand dial sets the inrush amperage limits, which are approximately 10 times that of the running amperage. The dial permits adjustment up to 12 times that of the running amperage.

Lock-out Tab

At the top of the I-32 starter, towards the rear, is a yellow tab. This tab is a lock-out tab that places a physical barrier between the main contacts of the starter, thereby preventing operation of the pump. In order to use this tab, the disconnect must be turned counter-clockwise to the "Off" position. The tab may be raised by inserting a small screwdriver blade in the groove at its left and pulling upwards.

Pressure Transducer & Process Controller

The Advantage-D system is supplied with a pressure transducer that senses the *absolute* pressure in the system and sends a 4-20 mA signal to the process controller. The process controller is equipped with a digital readout, which indicates *relative*—or *gauge*—pressure, and three relay outputs.

The process controller includes a digital readout, indicator lights, and controls on its faceplate.

The digital readout displays the current operating vacuum level. On the left side of the face plate are three lamps for set point outputs **AL1**, **AL2**, and **AL3**. **AL1** corresponds to the low operating vacuum level set point. **AL2** indicates the high operating vacuum level set point. **AL3** indicates the low vacuum alarm set point. On the right side of the face plate are the **MAX** and **MIN** lamps, indicating the actual maximum and minimum system vacuum level that has been reached. Along the bottom of the face plate are the ⋀ and ⋁ buttons, used for changing the set points; the **SET** indicator lamp, and the PGM button, used to program the process controller.

All settings are preset at the factory for optimum performance, and are determined by information supplied by the customer at the time of order placement. The settings are adjusted for the effects of altitude. All set points are field adjustable. We strongly recommend, in the event that a change must be made to either the high and low operating vacuum level settings, that you contact the factory.

Operation of, and adjustments to, the process controller can be made as follows:

Assure that power is supplied to the process controller. Note that at initial startup all three **AL** Output lamps will be out. This indicates that the vacuum level is **above** each set point. As the vacuum level increases, the lamps will light and flash as each respective vacuum level is reached.

The readout will show the *actual vacuum level in the receiver*; this may be zero if the system is just being installed and has not been evacuated to its normal operating vacuum level. By pushing the PGM button, you will scroll through two additional readouts:

- The first is the *maximum system vacuum level*, and is indicated by the **MAX.** indicator light to the right of the display. If set after the system has reached its normal operating vacuum level, this will indicate the maximum vacuum level the system has reached since the last setting. This may be useful to know due to the minimum run timer keeping the pumps running after the high set point has been reached. It is not harmful to the pumps if they exceed the high vacuum level set point, since they are equipped with vacuum relief valves to prevent them from operating at a higher vacuum level.
- The second is the minumum system vacuum level, as indicated by the **MIN.** indicator light to the right of the display. If set after the system has reached its normal operating vacuum level, this will indicate the minimum vacuum level the system has reached since the last setting. This may be useful to know if complaints are received that the vacuum level is too low.

NOTE:
Altitude affects the process controller readout. For this reason, we require that either the altitude or the local barometric pressure be given prior to the manufacture of the system. This data is entered in the process controller at the factory prior to system startup. At higher altitudes, failure to provide this data may mean that the lead pump will operate continuously. This is because it may be impossible to reach the high operating vacuum limit. For example: the high operating vacuum limit may have been set at 26"Hg. If the system is installed at Denver, CO, the lead pump will never shut off, because the maximum vacuum level attainable in Denver is 24.5"Hg. The vacuum switch must be reset at a lower vacuum level.

To review the actual set points, press the ⋀ button, and the PGM button, simultaneously, and hold until the lamp next to the **SET** indicator lights (about 3 seconds). If the lamp is lit with a steady light, you are in the Set Up mode; if the lamp is lit with a blinking light, you have held the buttons too long and have entered the Configuration mode. There is nothing pertinent in this mode, and you

need to exit it. Do this by pressing the ⋀ button and the PGM button at exactly the same time. This will take you back to the normal operating mode. Proceed with the instructions, as above, to get to the Set Up mode.

Pressing the PGM button will display the Low Operating Vacuum Level Set Point; it reads in inches of mercury ("Hg), as do all of the set point values. This value can be changed by pressing the ⋁ or ⋀ buttons.

NOTE: Changing any of the values beyond the manufacturers recommendations may void your warranty. Please, check with the factory before making changes to these values.

Pressing the PGM button again will display the Low Operating Vacuum Level Hysteresis, typically 0.5 "Hg.

Continued pressing of the PGM button will scroll through the remaining values as follows:

- High Operating Vacuum Level Set Point.
- High Operating Vacuum Level Hysteresis, typically 0.5 "Hg.
- Low Vacuum Alarm Set Point.
- Low Vacuum Alarm Hysteresis, typically 0.5 "Hg.
- Process Variable Offset (Do not change).
- Input Filter (Do not change).
- Decimal Position (usually set at 2)
- Engineering Units Low Scale Value: This is set for your local normal barometric pressure.
- Engineering Units High Scale Value: This is adjusted for altitude; do not change without factory authorization.
- Operation Mode Display (Do not change).

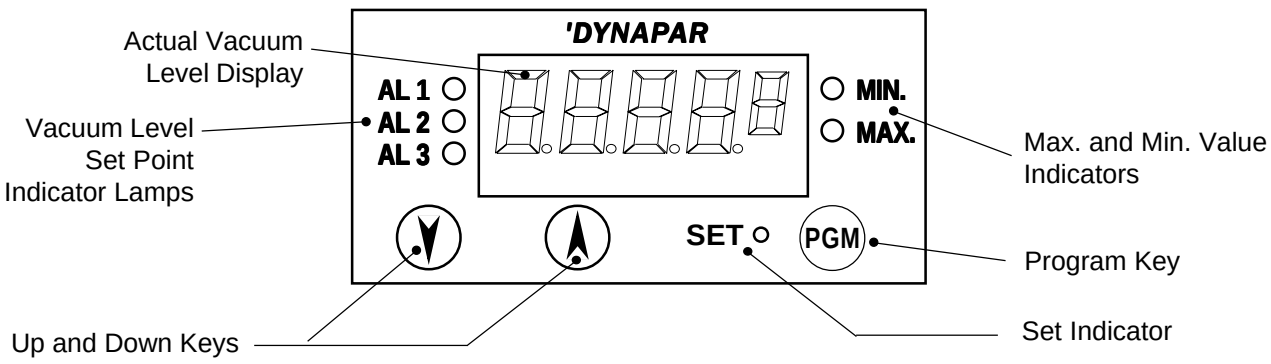
To exit the Set Up mode, press the ⋀ and PGM buttons at exactly the same time.

Notes on Initial Start-Up of System:

Upon first powering up the panel when initially installing the vacuum system, and before any vacuum is drawn on the system, the readout should indicate a vacuum level of *about* 0.00 "Hg. The actual number may be slightly above or below 0.00 "Hg. This is because of normal barometric variations, since the transducer reads *absolute* pressure. When the system is at its operating vacuum level, the readout will indicate the proper vacuum level with greater accuracy than the usual bourdon tube-type vacuum gauges typically found on vacuum systems.

After bringing the vacuum system up to its normal range of operation–that is, between its high and low operating vacuum level–it is important to reset the **MAX** and **MIN** System Vacuum Level Indicator Set Points. Press the PGM button until the **MAX** lamp is lit; then, press and hold the ⋀ button for about 5 seconds until you get a line comprising 4 dashes (– – – –). Release the button. Press the PGM button until the **MIN** lamp is lit, then repeat the above steps. This resets the High and Low operating vacuum level indicators. In the future, pressing the PGM button 3 times will cycle through these readings one at a time, returning to the current operating vacuum level.

If the digital readout displays the word **OPEN**, it indicates that there is no signal going to the process controller. Check to see that the Emergency Shutoff Switch is not pushed in. If that does not solve the problem, an electrical connection may have come loose.



Process Controller

CONTROL PANEL COMPONENT DESCRIPTION

Standard equipment furnished with the Becker expandable control panel is as follows:

Emergency Stop Push 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 shown by the arrows on the button.

Run Lamp — Lights to indicate electrical power is present in the control panel.

Alarm Buzzer — Provides audible warning for alarm conditions.

Alarm Light — Provides visual warning for alarm conditions.

Silence Alarm Push Button — When an alarm situation exists, both the audible and visual warnings will occur. Depressing the Silence Alarm button will stop the audible warning; the visual warning remains lit until the cause for the warning has been corrected.

Hour Meters — Each pump is equipped with an hour meter to monitor total running time. The meter runs any time the pump is running. The external reset buttons on these units have been disconnected to avoid accidental reset.

Illuminated Hand/Off/Auto Switch — Each pump is equipped with an illuminated H/O/A switch. The switch lights whenever that pump is running. When the switch is in the Run 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.

Control Voltage Transformer(s) — 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. Dual, redundant, transformers with transfer relay are provided for hospital systems to meet NFPA 99 requirements.

Pressure Transducer — Senses absolute pressure in the receiver.

Process Controller — Provides set points for low vacuum level alarm, low operating vacuum level, and high operating vacuum level. Has digital LED readouts on the face for set points, and actual system operating vacuum level (gauge pressure).

Starters — Starters provide short circuit and thermal overload protection as well as lockable branch circuit disconnects for each motor circuit. These starters meet all requirements of UL 508, Category E, for self-protected combination starters.

Programmable Controller — The primary function of the controller is to insure that the system operating vacuum level remains in the range between the high and low vacuum limit settings. When the system vacuum level drops below the low setpoint, one pump is started; if necessary, additional pumps are brought on-line until the low set point is exceeded. Conversely, when the maximum set point is exceeded, one pump is stopped; if necessary, additional pumps are taken off-line until the system vacuum level drops below the high set point.

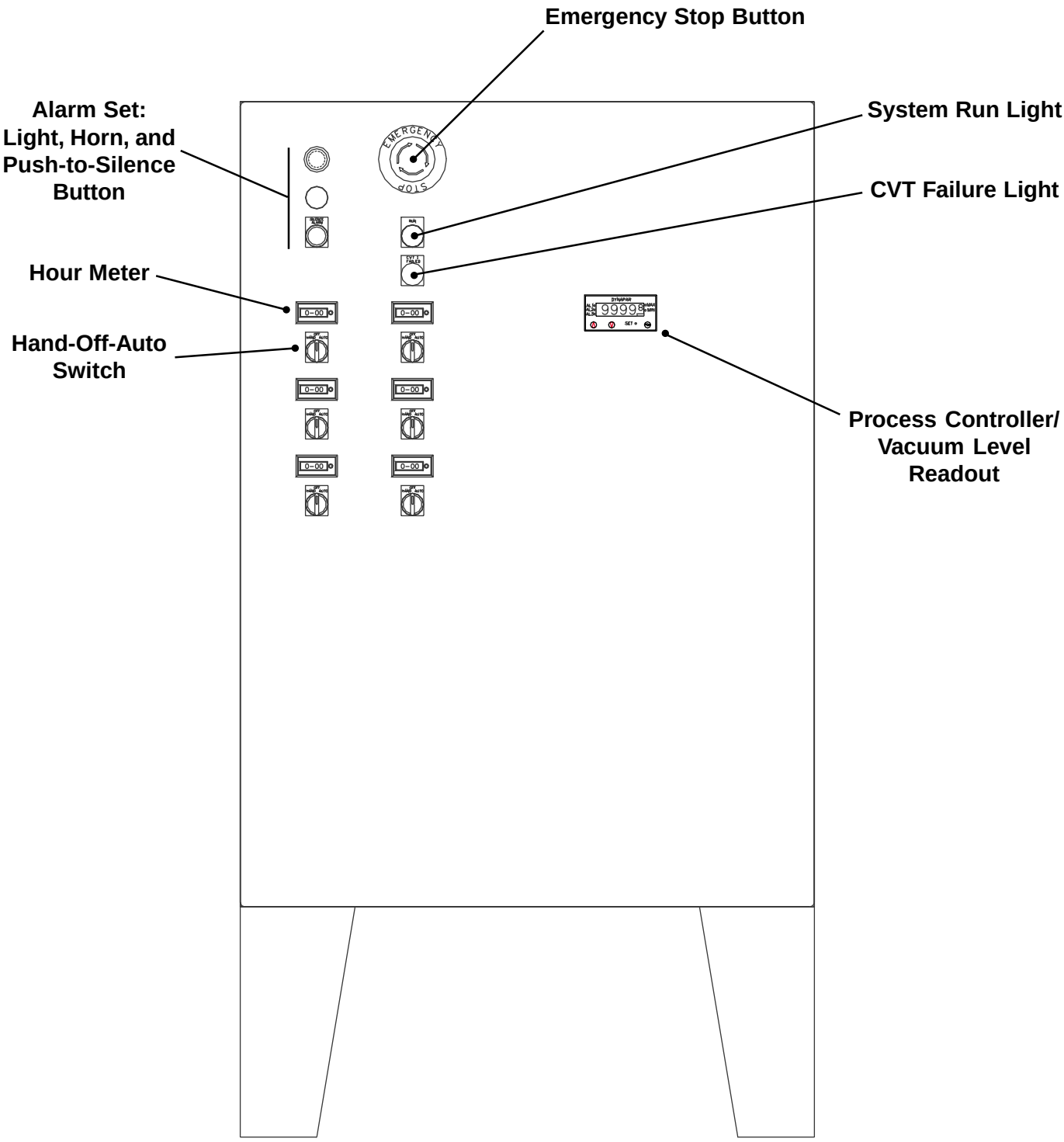
Each time a pump is turned on, it becomes the last pump in the operating sequence and will not be restarted until all other pumps in the system have been run. This ensures approximately equal operating time on all units regardless of the total quantity of pumps in the system.

When a constant demand situation causes one or more pumps to run continuously for a period of four hours, the pump which has been running the longest will shut off and the pump which has been idle the longest will come on to replace it. This insures a constant vacuum flow while still providing equal run time for all pumps.

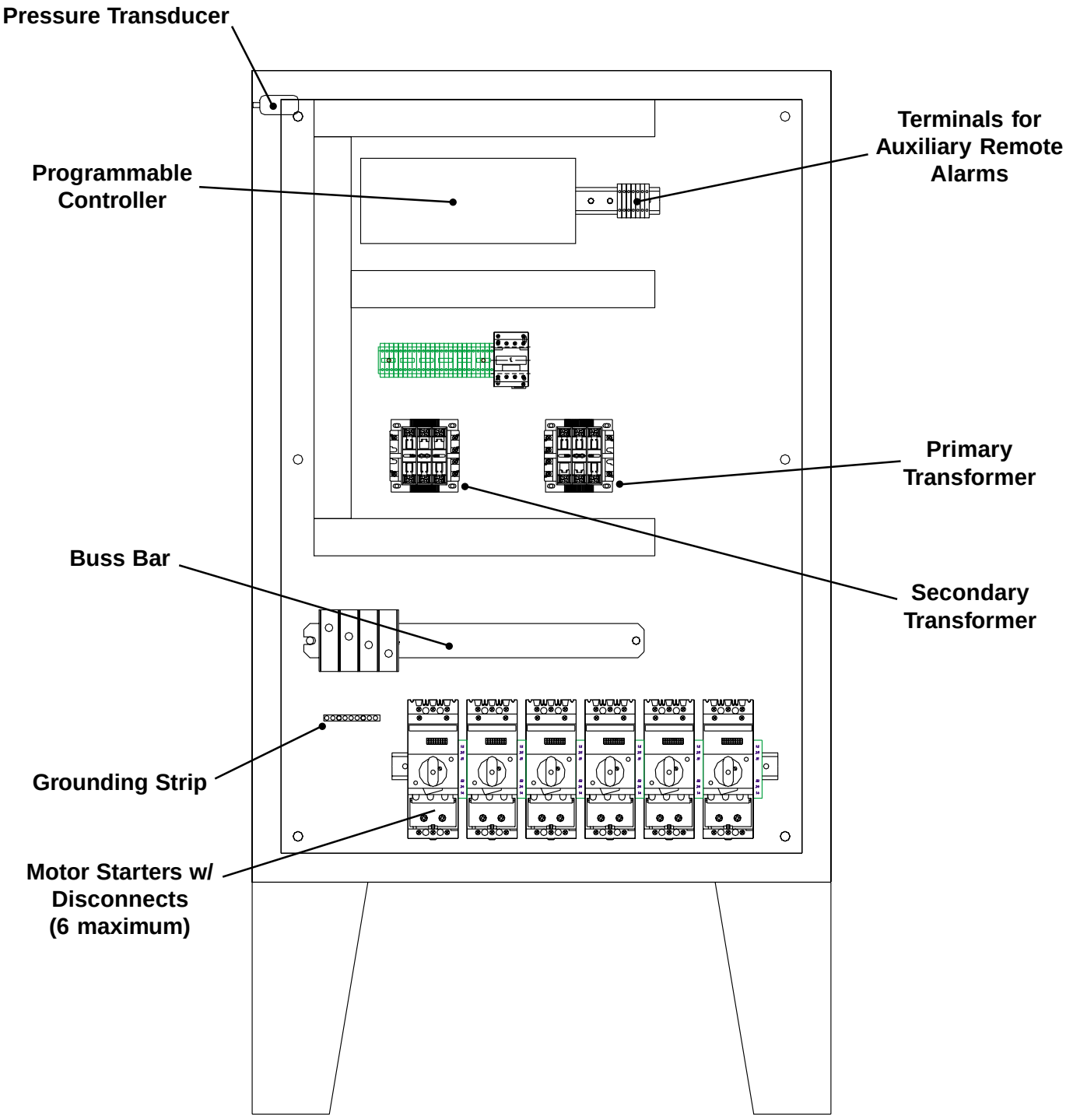
Each time a pump is started, a minimum run timer will keep the unit running for a preset time interval (10 minutes). This keeps the number of start/stop cycles down in the event of widely fluctuating system requirements, thus preventing possible motor damage

The controller also monitors optional safety devices, such as oil level and temperature switches. Individual units will be shut down and the alarm will sound with an intermittent sound.

Dry Contacts — A set of dry contacts for remote alarm are provided as an option on all NFPA 99 compliant systems. The contacts may be either normally closed or normally open, depending on the specification at the time of order.



Control Panel Cover Arrangement



Control Panel Interior Arrangement