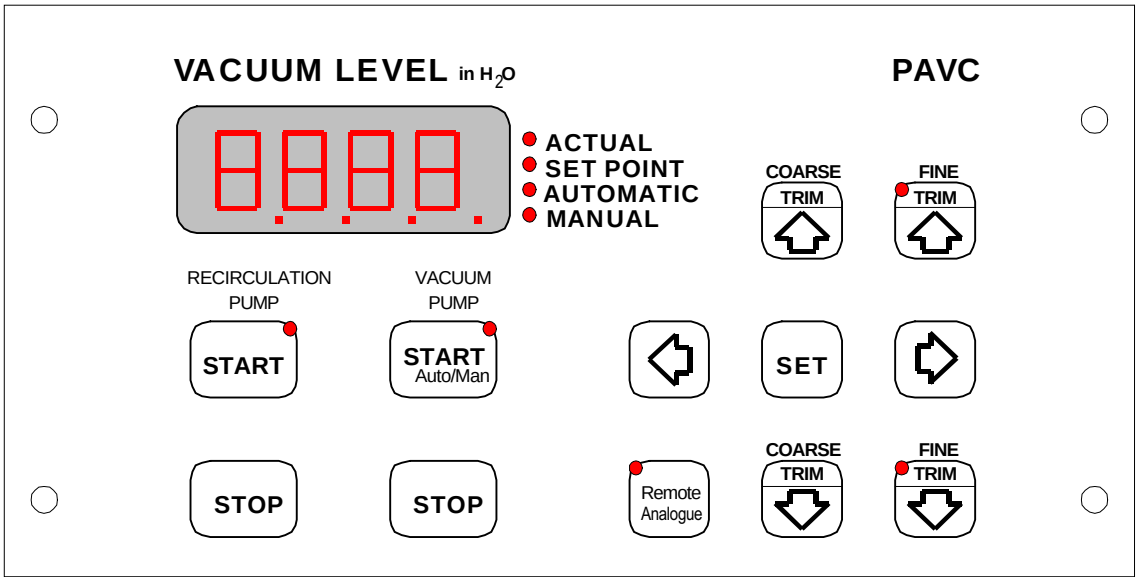
PAVC Instruction Manual

PAVC Vacuum Controller

Introduction

The Vacuum Controller is used with High Technology Vacuum Water Tanks to maintain a constant and precise vacuum pressure. External facilities are provided for automatic feedback control of the set point by X/Y laser scanners that monitor the product profile. The controller has Recirculation and Vacuum pump on/off control with input conditioning, and set-point adjustment via the fascia or via an external remote analogue source. The local set point can also be adjusted externally by digital scroll or through RS485 communications.

The "Vacuum Level" actual and set-point values are displayed on a four-digit display. A wide pressure range is possible as the PAVC controls a vent valve position and vacuum pump RPM.



Power Up Reset
When power is first applied to the Vacuum Controller all outputs are off. The display will initially show the EPROM version number, i.e. current program. Eventually the actual value will be shown with the "ACTUAL" and "MANUAL" LED's lit. The "REMOTE Analogue" function will be at the state prior to the previous power down.

Fascia Panel
The fascia is a flat membrane type consisting of a four-digit display, LED indicators and operator keypad switches. Primarily the display is used to show actual Vacuum pressure. Set point will be displayed when making trim adjustments in Automatic mode. Displays are large, 0.56" (14mm) high, Green Light Emitting Diodes (LED's) for clear and distant visibility.

Keys
A press of any key will cause a momentary beep to be heard from the built in buzzer. Some keys have no functions in certain modes, yet a beep will still indicate a response to the key press. A click will be felt as the key flexes.

Functions
The available keys are Start / Stops for pump control, Remote on/off and edit keys.

will switch on the Recirculation Pump provided that the Recirculation condition input is closed (0-volts). The indicator in the START switch will light to show that START has been accepted. If the Recirculation condition input is open then the START function will be refused. Recirculation uses the Vacuum conditioning input for confirmation. This input is tested 0.5 seconds after a valid Recirculation Start. In the absence of confirmation the Recirculation output will switch off.

will switch on the Vacuum Pump provided the Vacuum conditioning input is closed (0-volts). The indicator in the START switch will light to show that START has been accepted. If the Vacuum condition input is open the START function will be refused. External logic is arranged so that the Recirculation Pump has to be on before the Vacuum Pump can be energized (this is done through machine wiring). In addition, it will not be possible to start the Vacuum Pump during the 0.5 second used to verify that Recirculation has responded. The set point is initially reset to zero when starting the vacuum pump.

The Vacuum Pump Start switch is also used to toggle between Automatic and Manual modes after the Vacuum Pump has been started.

will switch off the associated Pump. STOP is selected automatically after a power up condition or when its input conditioning signal is opened. Stopping the Recirculation pump will also stop the Vacuum pump.

has an alternating action (toggle) i.e. each press will select the opposite state, off to on, or on to off. The remote analogue input is active when the indicator (LED) inside the switch is lit. In this mode the vacuum pressure is compared to the analogue input voltage. The input voltage should range between 0 and 10 volts DC. A 10-volt reference is available at the rear of the controller that can be used to supply a 10K potentiometer. The display will show the actual vacuum pressure as monitored via the vacuum transducer.

When switching to remote there is a 5-second delay during which time the Remote LED flashes. This indicates that the system is in transition between local and external modes. In the transition period the local set point continues to be used. The delay is used to give the external analogue control system enough time to stabilize the analogue input to match any local changes that may have been made. High / low logic outputs provide information to the external analogue system so that it can correct its reference. An additional output called Remote switches on when in Remote Analogue mode.

When switching to local automatic mode from remote automatic mode the local set point is automatically set to the actual measured value. This provides a totally bump-less transition.

Edit Functions

Manual Mode - Initial Mode

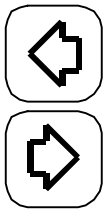
Starting the Vacuum pump initially places the PAVC in Manual mode and sets the set point to zero. The operator can use the up and down edit keys to adjust the vacuum. The vacuum pump RPM and the motorized valve position change as required. In this mode the operator would probably use the up and down keys while visually monitoring the extruded product. The display will monitor the actual vacuum pressure and the external scroll inputs are locked out. The trim values are not accurate in manual mode as the valve and pump are altered together.

Each press of this key will cause an approximate increase of 0.1 inches of water.

Each press of this key will cause an approximate decrease of 0.1 inches of water.

has a similar function to the fine trim up except that the preset changes by approximately 2.0 inches of water for each key press. Faster changes will occur after the key has been held down for more than two seconds.

has a similar function to the fine trim down except that the preset changes by approximately 2.0 inches of water for each key press. Faster changes will occur after the key has been held down for more than two seconds.



no function during manual mode.

no function during manual mode. Pressing the set key in this mode will signal an error message (displays - Err).

Automatic Mode

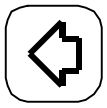
The vacuum pressure is initially set using Manual mode. Once the product dimensions are correct the Vacuum Start switch should be pressed again to toggle to Automatic mode. A bump-less transition is made by initially setting the Set point to the same value as the Actual value. The vent valve will now lock in this position (it does not move in automatic mode). The system will now use automatic correction routines to make fine variations to the vacuum pump RPM in order to keep Actual pressure steady. External scroll inputs are actived so that external systems (X/Y Scanners) may make fine adjustments to the Set Point.

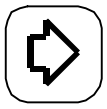
Fine Trim up. Each press of this key will cause an increase of 0.1 inches of water. The set point will appear in the display and the LED to the right of the display called "SET POINT" will light. Any further presses of the keypad will cause the whole display to count up (0.1 inches of water for each press). The display will return to show an actual "sensed" value after a short delay with the "ACTUAL" LED lit. A scroll up terminal is available at the rear of the controller. This has a similar action to the keypad except that the display will continue to show the actual value. Activity at the scroll up terminal will light the LED inside the TRIM up switch. This terminal is ignored when the "MANUAL" or "SET POINT" LED's are on.

This switch complements the Fine Trim up switch.

has a similar function to the fine trim up except that the preset changes 2.0 inches of water for each key press. Faster changes will occur after the key has been held down for more than two seconds.

This switch complements the Coarse Trim up switch.





no function during normal running of the automatic mode.

has an alternating action while in Automatic mode. The initial press of the SET key displays the set point in an editable mode (one of the digits will be flashing). The operator can then use the edit keys to enter a value **(see Programming using the Set Key)**. A further press of the SET key is used to accept the new value.

Programming Set-Point using the Set Key

Step 1

The set point is displayed with one of the digits flashing. This display is ready for editing on a digit by digit basis. The set-able range is between 0 to 135.0 in. H_2O when fitted with a standard 5psi sensor (200.0 in. H_2O controls use a 15psi sensor). The full range may not be achievable depending on valve position and sensor offset. The LED's to the right of the display will change from showing "ACTUAL" to showing "SET POINT".

Step 2

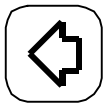
Use the following edit keys: -

or

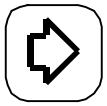
increases the flashing digit value by 1. Numbers step from 0 through 9 and then back to 0 with each key press.

or


decreases the flashing digit value by 1. Numbers step from 9 through 0 and then back to 9 with each key press.



selects the digit to the left of the flashing digit. This becomes the next editable digit and the previous digit stops flashing. Wrap around is used so that if the left-most digit was editable then the right-most digit will become the next editable digit.



This switch complements the Left arrow key.

Step 3

will accept the set point as displayed as long as it is not above maximum. Normal running is resumed. After a short delay the display will revert to showing the actual value sensed with the "ACTUAL" LED lit.

External Connections

Vacuum Port

This is a non-electrical connection for sensing the vacuum pressure of the tank. A length of 6mm o.d. tubing should be used (not 1/4").

Electrical

Power

Mains Supply

120 volts AC supply. Two terminals are provided labeled "Live" and "Neutral". A fuse is provided @ 250 milli-amps, connected in series between the transformer and the Live terminal.

Ground

Two terminals marked "Ground" are connected internally to the metal case and should be taken to the machine frame ground. A screw post ground is also available. Regulations suggest that it is not suitable to rely on the fixings alone to provide the suitable grounding so it is recommended to also ground the PAVC enclosure via this screw connection. A ground symbol is shown.

Logic Inputs - 5 pin

The following inputs all have similar characteristics. An internal load is connected to an internal 12 volts DC supply and draws about 10 milli-amps from the supply and through the external source. Inputs should be via normally open contacts referenced to the controller 0 volts. All inputs are active low.

Up (Scroll Up)

Each time this terminal is taken to 0 volts a Scroll Up request will be acknowledged. The LED inside the Fine Trim Up key will light when this terminal is at 0 volts. The Scroll function will be ignored during set-point adjustment and when in manual mode. It has a similar action to the Fine Trim Up key although an increase will also be made for each 0.5 second if it is kept closed.

Down (Scroll Down)

This input complements the Up (Scroll Up) input.

Recirc. (Recirculation Pump Enable)

With this terminal connected to 0 volts it is possible to start the recirculation pump. If this terminal is opened the recirculation pump will stop.

Vacuum (Vacuum Pump Enable)

This has the same action as the recirculation pump enable except that it affects the vacuum pump. It is also used to acknowledge a Recirculation Start. If this terminal is opened the recirculation and vacuum pumps will be stopped.

Logic Outputs - 8 pin
All logic outputs are active low. Loading should be restricted to keep currents below 20mA per channel except for Recirc. and Vacuum which can take up to 0.5 amps. Maximum switching voltage is 30 volts. An external 24 volts DC supply (preferred) should be fitted in the electrical enclosure to power any relays that are to be used. 0 volts of the DC supply should be connected to the 0 volts of the PAVC controller.

Recirc. (Recirculation Pump)
This output is used to drive an external 24-volt DC motor starter, which in turn is used to power the Recirculation pump.

Vacuum (Vacuum Pump)
This output has the same characteristics as the Recirc. output. It should be connected to the drive input terminal "RUN/ENABLE". In addition 0 volts of the drive should be joined to 0 volts of the PAVC. Some pump controllers use a positive Run signal, in which case the Vacuum Output should be used to enable a 24 volt relay which in turn is used to operate the pump run terminal.

Remote
This output is active when in Remote analogue mode.

High
This output is available when in local automatic mode and for the 5 second duration when switching to remote analogue automatic mode. It is active when the analogue input is higher than the local set point.

Low
This output complements the High output. Both outputs are used together to guide an analogue controlling system to adjust its analogue control voltage to match the local setting.

Limit
When automatic mode is first entered the set point is noted and an approximate 6.25% upper limit is calculated. Variations will then be made normally by the automatic loop comparing set point with actual. The pump control will allow a certain amount of automatic adjustment but will limit at the upper 6.25% if it is reached. This ensures against runaway which can happen if the tank lid is opened or if the product falls under size. This output switches on to indicate that the upper limit has been reached.

Valve - 6 pin
The Motor + and Motor - terminals connect across the motor. The position of the valve is an analogue value developed across a potentiometer. The PAVC Controller supplies 0 and 12 volts to the potentiometer.

Analogue - 7 pin
10 Volts
This output is available as a reference, which can be used by an external 10K potentiometer to control the remote analogue input.

VDC in (Remote Analogue Input)
This input is used as a set point when the "REMOTE Analogue" mode is selected. The default voltage range is 0 to 10 volts. Jumper links are internally available to select an optional 0 to 5 volt, or ±5 volt range.

Vacuum Pump Speed Control
Ref.
Normally, this input is not used because the pump output is referenced to an internal 10-volt source. An internal jumper selection connects this input to the pump amplifier so that the pump controller can use its own reference voltage. The possible range would then be from 0 through to the reference voltage supplied. The Ref. voltage can range between ±11.5 volts.

Pump
This is an analogue output, which has been calibrated for a maximum output of 10 volts when using the internal reference. It should be connected to the pump controller "SPEED REFERENCE" input and 0 volts of both devices should be joined together.

An. Out (Trending)
This analogue output is derived from the vacuum sensor amplifier. This amplifier is internally calibrated for offset and gain so that the controller can measure the Actual vacuum pressure. The internal voltage is about +5 volts for 135 in. H_2O (when used with the standard 5 psi sensor). This voltage is then passed on to another amplifier with additional offset and gain adjustments. These adjustments are available at the rear of the controller so that the analogue value can be calibrated to suit the scale required. The offset gives approximately ±2.5 volts of variation, and the gain can be adjusted between x 2 to x 7.

RS485 Input/Output
The RS485 uses a 4-pin connector. Terminal A is the non-inverting input / output, and terminal B is the inverting input / output.

The PAVC Controller uses the following technique for serial communications: -

RS485 Multi Drop Ansi-X3.28-2.5-A4

Baud Rate	-	9600
Format	-	1 start, 7 data, 1 even parity, 1 stop
Address	-	00 to 99 (default is 25) (00 is normally reserved so should be avoided). (See section on Address Changing).

Officially, the standard allows for 32 drivers and 32 receivers using a maximum cable length of 4,000feet (1,200 meters). Ideally, a shorter cable length will be used because of the typical noisy environment. The communications device uses a reduced slew rate driver to minimize EMI (required for CE), and reduce reflections caused by improperly terminated cables. This does not affect our data transmission rates, as it is good for data rates up to 250kbps, as opposed to the possible 2.5Mbps of the standard RS485. The driver is short circuit protected.

To minimize reflections, the line should be terminated at both ends in its characteristic impedance, and stub lengths should be kept as short as possible. The total expected load for RS485 is 60R, usually made up of a 120R resistor at each end of the line. A 120R resistor is already fitted to the PAVC controller with one end connected to the B terminal, with the other end of the resistor brought out to the A Load terminal. This may be linked to the A terminal if the termination load is required.

Parameters

II #	Instrument Identifier	R/O	Hex returns >2500.
KY	Key Code	W/O	Hex (see Key Codes).
PV	Measured Value	R/O	
SP	Set-point	R/O	
SL	Set-point Local	R/W	
SW #	Status Word	R/W	Hex (see list).

Bit	**Name**	**Digit/bit**	**0**	**1**	**Type**
15	Auto/Manual	1/3	Auto	Manual	R/O
14	Local/Remote	1/2	Local	Rem. An.	R/O
13	not used	1/1			
12	not used	1/0			
11	not used	2/3			
10	not used	2/2			
9	not used	2/1			
8	not used	2/0			
7	Recirculation	3/3	off	on	R/O
6	Vacuum	3/2	off	on	R/O
5	Set point (SL) modified locally	3/1	no	yes	R/C
4	Limit	3/0	in range	limit	R/O
3	Checksum	4/3	OK	Error	R/O
2	Keys*	4/2	enabled	disabled	R/W
1	Key Buffer	4/1	empty	active	R/O
0	not used	4/0			

R/O	Read Only
R/W	Read and Write
R/C	Read then automatically Clear
W/O	Write Only

the first character after II and SW is “>” (ASCII-Hex 3E) indicating bit data follows. The next four hex characters are converted to ASCII 0 to 9 (30H to 39H), or A to F (41H to 46H). These should be translated back into hex at the receiving end.

* Keys - Stop buttons will still work if disable is selected.

Inquiries

1. All inquiries are initially made by the host computer using: -

EOT, GID, GID, UID, UID, P1, P2, ENQ.

EOT = ASCII - Hex 04, used to clear the line. All devices on the RS485 look at the next four characters to see if they are being addressed.

GID = Group Identifier (First part of Address - expects 0 to 9, ASCII - Hex 30 to 39). This is sent twice.

UID = Unit Identifier (Second part of Address). Also sent twice.

P1= First character of parameter required.

P2 = Second character of parameter required.

ENQ = ASCII - Hex 05.

After a communications link has been established (as notified by a valid response to the previous communication) it is possible to use a shorted inquiry using ACK and NAK (see later). The following is also valid: -

P1, P2, ENQ

2. If the address and parameter are recognized the PAVC will respond with: -

STX, P1, P2, D1, D2, D3, D4, D5, ETX, BCC

STX = ASCII - Hex 02

P1 and P2 = Parameter mnemonic

D1 to D5 = Data (Parameter Value) - in ASCII Form

ETX = ASCII - Hex 03

BCC = Checksum of characters P1 to ETX inclusive. This is found by using the Exclusive Or (XOR) logic function: -

P1 (XOR) P2 (XOR) D1 (XOR) D2 (XOR) D3 (XOR) D4 (XOR) D5 (XOR) ETX.

The host computer will check the BCC with the BCC that it internally calculates before accepting the data.

If the Address was recognized but the parameter was not the PAVC will respond with: -

STX, P1, P2, EOT

3. If the PAVC responded using the first method the host can now use the following simpler inquiries: -

NAK = ASCII - Hex 15. This requests that the same parameter be repeated. This may be required because the value was not understood or can provide a simple means to repeatedly monitor a value.

ACK = ASCII - Hex 06. This requests that the next parameter be returned.

Only PV, SP, SL and SW parameters are returned using these inquiries.

Sending Data from the Host Computer to the PAVC

1. All parameter updates are initially made by the host computer using: -

EOT, GID, GID, UID, UID, STX, P1, P2, D1, D2, D3, D4, D5, ETX, BCC.

After a communications link has been established (as notified by a valid response to the previous communication) it is possible to use the shorter update: -

STX, P1, P2, D1, D2, D3, D4, D5, ETX, BCC.

2. If the message was understood and the parameter within range the PAVC will respond with: -

ACK

If the parameter is out of range the response will be: -

NAK

No reply will be given if the address is not recognized or if a parity, framing or overrun error occurs.

3. The host computer may now use an ACK or NAK inquiry. If the parameter changed is SL or SW it can be echoed back using NAK.

KY Key Codes
It is possible to operate five of the PAVC keys through the communications. The edit keys are not available for external use. The possible keys and their codes are: -

0 = Recirculation Pump Stop
1 = Recirculation Pump Start
2 = Vacuum Pump Stop
3 = Vacuum Pump Start
4 = Remote Analogue

Any other codes will select the Recirculation Pump Stop.

This parameter is a Write only and uses the sequence: -

STX, K, Y, >, D1, D2, D3, D4, ETX, BCC.

D2 to D4 are optional. If inserted the key routines will be operated one at a time until all key operations have been completed. The keyboard buffer can only accept new data when the buffer is empty. A flag in the Status Word register determines if the buffer is available (see SW codes). If key codes are transmitted while the buffer is in use a not available NAK will be returned.

Address changing
The default address is 25, but can be any value from 00 to 99. To change the address to a different value requires a special key sequence. While the PAVC is not in an edit mode (no digits are flashing), press the right shift button and keep it pressed. After five seconds the display will change to show Ad.## (where ## equals the current address). Using the edit keys it is possible to change the two-digit address to a new value. Pressing the Set key will accept the new address. Address 00 is normally reserved so should be avoided.

Calibration

The PAVC Controller controls a vacuum pump and DC motor driven valve to maintain a vacuum pressure at a presetable set point. Two modes are available known as manual and automatic. In manual mode the valve and vacuum pump are positioned by set-point adjustment. No error correction is made to the outputs to make actual equal the set point. Selection of automatic mode will start the error correction procedure. To create a bump-less transition the actual value is transferred to the set point and an error relative to the change in set point is calculated. Any tuning of the pressure will then take place solely on the vacuum pump with the valve left fixed in its current position. This ensures no conflict will occur if both change simultaneously.

The valve is adjusted in manual mode only, using positional feedback compared to the set point. When the set point is almost at zero the valve will be fully open and the pump will be running at a minimum speed (not zero). The voltage presented to the Vacuum Pump Controller will be almost zero volts.

With the set point at maximum the valve will be almost fully closed and the pump will be running at 90% of maximum speed. The voltage presented to the Vacuum Pump Controller will be about 9 volts. This allows a little headroom for the automatic control to bring about corrections.

The following procedures are used to find the minimum and maximum values, which should be entered into the Vacuum Pump Controller. These values do not have to be too precise, as the PID routines in the PAVC Controller will provide some automatic compensation.

PAVC - Set Up Procedure using a calibrated digital meter

- Set the Vacuum Pump Drive parameters according to previously defined parameter table.
- Set minimum initially to 3 Hz. Set maximum initially to 60 Hz.
- Connect a calibrated digital gauge into the vacuum tube using a tee piece.
- Hold down the left push button on the PAVC controller for 5 seconds while the tank lid is open. This will make the controller measure the initial offset - thus setting zero scale.
- Start the Recirculation Pump. Allow water to fill.
- Start the Vacuum Pump in manual mode. If the Vacuum Pump Controller has a local mode this will aid setting.
- Wind the Set Point up to maximum on the PAVC Controller. This will virtually close the valve and place 9 volts at the analog input to the Vacuum Pump Controller.

- If the vacuum pump is in local mode - adjust the Vacuum Pump HZ / RPM until the desired maximum reading is shown on the calibrated gauge. i.e. if the system is to run at a maximum of 100.0 In. H_20, adjust the pump HZ / RPM until the gauge reads 100.0 In. H_20. It should not matter if the exact maximum reading cannot be achieved. Setting slightly over should suffice and is preferred.

- If a local mode is not available keep adjusting the maximum until the required actual value is observed.

- Adjust the vacuum transducer amplifier gain inside the PAVC Controller until the display reads the same as the calibrated gauge. This preset is next to the vacuum transducer mounted on the display board.

- When the desired maximum reading has had chance to settle hold down the left push button on the PAVC Controller for 5 seconds. This will place the value shown on the Actual display into the Set Point so they both become the same. The analog output will automatically be adjusted for this span. This value will also be used as maximum so that an operator cannot attempt to set a higher value.

- Observe the Vacuum Pump frequency in Hz. It will be necessary to re-adjust the maximum HZ / RPM to this value + 10% to allow a 10% headroom for the PID routine.

- Adjust the PAVC Controller set point to zero. This will fully open the valve and place 0 volts at the analog input of the Vacuum Pump Controller. With the Vacuum Pump still in local mode adjust the RPM until the gauge just begins to show a vacuum. Observe the Vacuum Pump Frequency and enter a value slightly less than this into the minimum preset.

- If local mode is not available on the drive keep adjusting the minimum preset until the actual display just begins to show a reading and then use a value slightly less.

- Place the Vacuum Pump in remote mode. Spot-check at various settings making sure to occasionally select manual mode in order to give new positioning to the valve.

- Remove the calibrated gauge and tee piece.

PAVC - Set Up Procedure (without calibrated digital meter)

The amplifier in the PAVC Controller will already be calibrated prior to dispatch so should not require any further adjustments. A calibrated gauge should not be necessary. Use the following procedure instead. Zero scale has also been set.

- Set the Vacuum Pump Controller according to the previously defined parameter table. Set the value at minimum initially to 3 Hz. Set the value at maximum initially to 60 Hz.

- Start the Recirculation Pump. Allow water to fill the tank.

- Start the Vacuum Pump in manual mode. If the Vacuum Pump Controller has a local mode this will aid setting.

- Wind the Set Point up to Maximum on the PAVC Controller. This will virtually close the valve and place 9 volts at the analog input to the Vacuum Pump Controller.

- If the vacuum pump is in local mode - adjust the Vacuum Pump HZ / RPM until the desired maximum reading is shown on the PAVC Controller display. i.e. if the system is to run at a maximum of 100.0 In. H_20, adjust the pump HZ / RPM until the gauge reads 100.0 In. H_20. It should not matter if the exact maximum reading cannot be achieved. Setting slightly over should suffice and is preferred.

- If local mode is not available keep adjusting the maximum until the required actual value is observed.

- When the desired maximum reading has had chance to settle hold down the left push button on the PAVC Controller for 5 seconds. This will place the value shown on the Actual display into the Set Point so they both become the same. The analog output will automatically be adjusted for this span. This value will also be used as maximum so that an operator cannot attempt to set a higher value.

- Observe the Vacuum Pump frequency in Hz. It will be necessary to re-adjust the maximum HZ / RPM to this value + 10% to allow a 10% headroom for the PID routine.

- Adjust the PAVC Controller set point to zero. This will fully open the valve and place 0 volts at the analog input of the Vacuum Pump Controller. With the Vacuum Pump still in local mode adjust the RPM until the gauge just begins to show a vacuum. Observe the Vacuum Pump Frequency and enter a value slightly less than this into the minimum preset.

- If a local mode is not available keep adjusting the minimum preset until the actual display just begins to show a reading and then use a value slightly less.

- Place the Vacuum Pump in remote mode. Spot-check at various settings making sure to occasionally select manual mode in order to give new positioning to the valve.

On some drives local speed control will not be available. In addition, to set the maximum and minimum parameters it may be necessary to stop the pump each time. This could prove a bothersome process. To assist finding the suitable maximum and minimum values it may be beneficial to go through the procedure using a potentiometer wired to the analogue speed control. This can then be removed once the parameters are known and programmed.

Valve Maintenance

The Valve assembly used with the PAVC Control has moving parts in it, which may need occasional cleaning. Air flows through this adjustable vent so dust may collect inside the valve and around the moving disc.

New software routines have been added to the PAVC to indicate when there is a severe valve problem needing immediate attention. The routines monitor the change in position when a change is expected and indicates an error when this change is not sufficient in the time allowed (56 milliseconds). Two types of problems could cause valve errors: -

- The moving parts could stall due to dirt. Typical causes - valve stuck, bad motor, bad gearbox, bad coupling and transistor failure.

- The signal could be lost due to open circuit. Typical causes - break in wiring or connections, and bad potentiometer.

Both errors will immediately disable the valve and the PAVC will display the error detected. For a stall condition the PAVC will display “VALV” (there are four digits available - this means valve problem). A wire break would typically make the feedback voltage drop to 0 volts or rise to 12 volts. On this occasion the PAVC will display “oPEn”.

The message will latch in the display until the SET key is used to clear it. However, the valve will stay disabled until power is cycled, after which the system will try the valve again. All PAVC functions will continue to work as normal except for the valve movement. This may allow the machine to function sufficiently until the valve problem is fixed.

When a large vacuum is required but the valve is stuck in the fully open position it may be necessary to remove and block the vent hose. Likewise, if a small vacuum is being sought with the valve stuck in the fully closed position it might be beneficial to remove the pipe from the valve.

Cleaning
In order to properly clean out the valve it will be necessary to dismantle it.

- Remove 2 x M6 nylon insert nuts plus washers, which retain the bracket.
- Remove 4 x M6 hex screws.
- The nylon parts of the valve can now be separated.
- If necessary, remove the metal disc section. This is retained to the gearbox shaft by a M4 x 4mm setscrew. This screw does not need to be removed. Loosen it a little so that it sits below the diameter of the disc shaft this will give enough clearance for the shaft to slide out. It may be necessary to power the valve motor to bring the screw head into an accessible position. (The motor may be rotated with a 12 volt DC supply applied to the motor terminals).
- Clean parts with a mild detergent
- Assembly is the reverse of above.
- Check the potentiometer retaining screw is tight before fitting back into the machine.

It should not be necessary to remove the motor assembly.

Valve Disc Positioning
The large hole in the disc should be visible when the set point is at zero and virtually fully blocked when the set point is at maximum (small hole showing). If this is not the case the position can easily be tuned by hand. This can be achieved using either zero or maximum set point while in the manual mode with the PAVC powered on.

To do this adjust the set point as required and then loosen the potentiometer retaining screw (do not remove).

Turn the potentiometer **slowly** by hand clockwise or counter clockwise as required. The PAVC will energize the motor to follow your movement.

Once the position is correct lock the potentiometer screw.

The position of the valve is given by the potentiometer, which is powered from a 12 volt DC source. The PAVC recognizes voltages between 0 and 10 volts DC and works in the 2 to 8 volt area. From 10 to 12 volts the PAVC will think the potentiometer is not moving so will give an error. For this reason, do not turn the potentiometer too erratically so that it enters this unsuable area. If the valve does get moved to this position it will be necessary to use an external 12 volt DC source to bring the rotor back into the correct range.

PAVC KIT

Leaks

The pneumatic connection on the PAVC is for 6millimeter OD tube not ¼ inch. By forcing ¼" tube in to this connection it is highly likely that a leak will occur. The kit now includes a 3-meter length of 6m.m. OD tube to assist with assembly. The end that fits into the connector should be cut squarely.

The PAVC is tested and calibrated using a small vacuum generating hand pump. Operation of the hand pump is used to bring the vacuum pressure up to around 100" H_2O to assist in calibration of the PAVC. It is then pumped up to around 350" H_2O and left for a 10-minute leak test. The small chamber of the hand pump cannot maintain a vacuum pressure if a leak is present.

Snubber Networks

These are supplied for fitting to the Recirculation Pump motor starter (contactor). The inductive load creates electrical flashes across the contacts when switching on or off. The EMC and EMF generated should be eliminated or reduced by fitting these devices. They are preferred over MOVs as they "round off" the high frequency element and reduce harmonics. The MOV chops off (zeners) a high frequency spike at the rated voltage threshold and absorbs the energy. However, the high frequency content is still present and the noise harmonics generated are extended further into the MHz spectrum by the zenering action.

One leg of each snubber should be connected to each motor phase, i.e. motor starter terminals 2, 4 and 6. The other ends of each snubber should be joined together and taken to ground or to an isolated terminal to form a virtual ground. Maximum voltage rating of the snubber is 250 volts.