



**ZERO GRAVITY  
FILTERS  
Brighton, MI**

**Pneumatic Phoenix  
Operating and Maintenance Manual**

**PHOENIX  
Pneumatic Operation**

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**Standard and Limited Warranty**

Seller warrants that title to goods sold hereunder is unencumbered at time of sale. All other warranties are expressly disclaimed including, but not limited to, merchantability, fitness for purpose, and all other warranties, express or implied. Seller expressly disclaims any liability for damages, actual, consequential, incidental or otherwise, for injury to property of buyer, its agent or third persons in custody of goods sold hereunder. Seller may determine to repair or replace any defects in goods of its own manufacture, which arise from defective materials or workmanship during the twelve (12) months, or (60) months on the filter elements, following the date of tender of delivery to the end purchaser if buyer gives seller timely written notice with a description of the basis for claim. Seller may refund amounts paid by buyer without other liability to buyer. The buyer acknowledges and agrees that the limitations of warranty, liability and remedy are fair and not unconscionable and the sole and exclusive remedies afforded at law with all other statutory and common law remedies being hereby waived. A claim under the warranty by the buyer for repair or replacement of goods shall be timely filed with the seller in accordance with the written procedures of the seller in effect at the time of any such claim.

**PHOENIX**  
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**PACKING LIST**

**Contents:**

1. Stainless steel filter housing (Phoenix)
2. Top dog clutch and spring fitted to shaft, and two countersunk Philips head screws for securing cover to filter (packed in bag inside Phoenix control cover).
3. Control panel
4. Indexing actuator attached to cover assembly (see Exhibit 2, drawing ZG10013)
5. Six filter elements and corresponding O rings, and (18) stainless steel screws (packed in bag inside Phoenix control cover).
6. Operating manual & installation guide

Please read the accompanying “**Installation Guide**” provided before installing filter to system.

**PHOENIX**  
**Pneumatic Operation**  
**INSTALLATION GUIDE**

**POWER SUPPLY**

The filter requires 110 VAC, single-phase supply at 5 Amps. A cable gland is provided on the base of the control panel for the incoming power supply. The connecting terminals are located in the bottom left hand corner of the control panel. Power is connected directly to the 2 Amp miniature circuit breaker (MCB), connections for neutral and ground are located adjacent to the MCB (see drawing #ZG10146).

**CONTROL PANEL**

The control panel should be mounted as close to the filter assembly as possible while leaving sufficient room for easy access to the controls and opening of the panel door. The control panel should be mounted in a dry location.

**PNEUMATIC CONNECTIONS**

An 80 psi, clean and dry compressed air supply should be made to the 1/4" bulkhead connector (labeled #6) and a 1/4" bulkhead connection (labeled #5) is provided for exhaust.

Run 5/32" pneumatic airlines from the control panel bulkhead fittings to the filter. Connect in accordance with the following:

<u>Bulkhead fitting on Control Panel</u>	<u>Connection on Filter</u>
1	Indexer Actuator
2	Indexer Actuator
3	Backwash Valve Actuator
4	Backwash Valve Actuator
5	Exhaust from Control Panel
6	Air Supply to Control Panel

When making the pneumatic connections, ensure that the numbered tubing is connected to the corresponding number bulkhead connection on the bottom of the control panel. 5/32" straight connectors have been fitted to the tubing for ease of installation.

## DIFFERENTIAL PRESSURE (DP) SWITCH

The filter is supplied with a DP switch connected hydraulically to the filter, the operating range of this switch is from 2 to 45 psi (differential pressure). Should the differential pressure across the filter exceed 45 psi, damage may occur to the switch.

The differential pressure switch is connected electronically along with the Proximity Switch by means of a 8 pin plug and socket. This plug and socket is wired to a 6 core cable, 12 feet long which is then connected to the control panel. Additional lengths of cable are available; please contact Zero Gravity Filters for supply.

**NOTE:** On the dual indicator DP switch, the left set of terminals is related to the lower dial (backwash set point) and the right set of terminals is for the upper dial (high set point indication).

## PIPE CONNECTIONS

The filter inlet (bottom) and discharge (side) are 3 inch, 4 bolt flanges (ANSI 150 bolt hole pattern). The backwash connection is a  $\frac{3}{4}$ " NPT female which should be plumbed to a suitable drain or tank capable of handling the system's pressure. **To avoid excessive pressure drops, which could impair backwash effectiveness, do not run the backwash line more than 10 feet with the id of the line no less than  $\frac{3}{4}$ ".**

## FILTER SUPPORT

The filter can be either supported at the base of the six pods or at the inlet flange.

## DIMENSIONS AND WEIGHT

Weight:        Dry = 75 lbs excluding elements and 85 lbs including elements  
                  Wet = 110 lbs (assuming water)

## OPERATING REQUIREMENTS

The Phoenix filter requires a minimum working pressure of 40 psi. This pressure will ensure that there is a minimum of 30 psi on the outlet of the filter at time of backwash, e.g. 10 psi differential pressure at backwash. Correspondingly, if a higher DP set point is desired, then a higher inlet pressure is required.

## PUMP

To achieve the above pressure, it is imperative that the correct pump be chosen to deliver the required flow at the required pressure. Please contact Zero Gravity Filters for assistance in pump selection.

## REGULATING VALVE

**A regulating valve must be fitted on the discharge of the filter**, enabling the user to balance the filter's pressure and flow rate. At the same time, the regulating valve will ensure sufficient pressure for backwash, particularly important if the filter discharge is to atmosphere (i.e. an open tank). **Please note: Do not use a butterfly type valve for this purpose.**

## ISOLATING VALVES

It is recommended to fit inlet and discharge isolating valves to the filter for ease of maintenance.

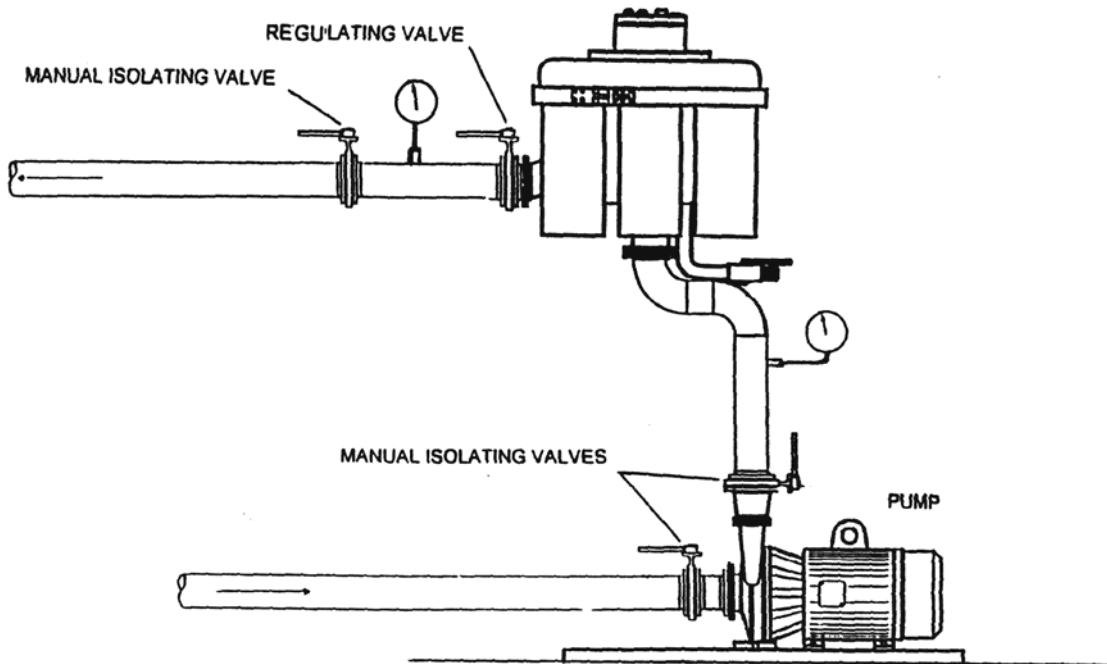
## PRESSURE GAUGES

Pressure gauges must be fitted to the system to monitor both the inlet and discharge pressure of the filter. Gauges may be fitted between the pump and filter inlet and between the filter discharge and regulating valve. Alternatively, there are blanked off ports on the filter's inlet to which a 1/4" gauge may be fitted. In addition, to monitor the filter's outlet pressure a gauge may be fitted on the bottom surface to where the pods are attached.

## INLET STRAINER

A coarse strainer must be fitted to the inlet side of the filter if particulates are greater than 1/4" in size.

## Example of Installation

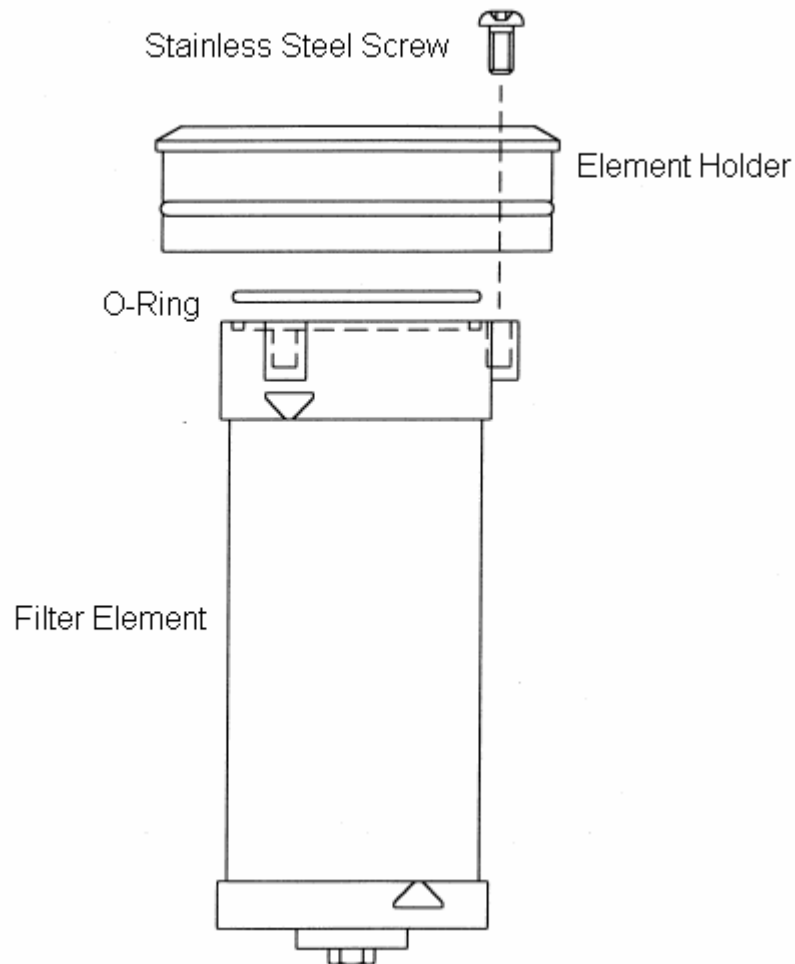


## FILTER ELEMENT INSTALLATION

Once the filter has been installed as per the Installation Guide and pressure tested, the filter elements can now be fitted. Please use the diagram on the following page for reference.

1. Remove the 6" filter cover retaining ring and red backing ring.
2. Remove "Clampco" ring clamp coupling from around doughnut shaped filter cover.
3. Remove doughnut shaped filter cover. If difficulty is experienced, gently insert a broad screwdriver under the outer edge of the filter cover to relieve the "O" seal suction. Insert the screwdriver more than  $\frac{1}{4}$ " to avoid damaging the large "O" ring inside the filter housing. You will now see six element holders and the common discharge port.
4. Remove each element holder in turn by gently lifting the element holder in each pod.
5. Remove the filter elements from their cardboard tubes taking care to ensure all packing is removed from the elements.

6. From the plastic bag, fit an “O” ring to the groove in the top of the filter element, fit the filter element to the underside of the element holder and using the screws provided secure the element to the holder. Repeat steps 5 & 6 for all six filter elements.
7. Lightly lubricate the “O” rings on the element holders with an approved lubricating grease and place the six filter elements into the pods.
8. Generously lubricate the neck “O” ring.
9. Check that the filter cover “O” ring is correctly located in its groove around the circumference of the filter body and replace doughnut shaped filter cover.
10. Replace “Clampco” ring clamp, red backing ring and 6” retaining ring.

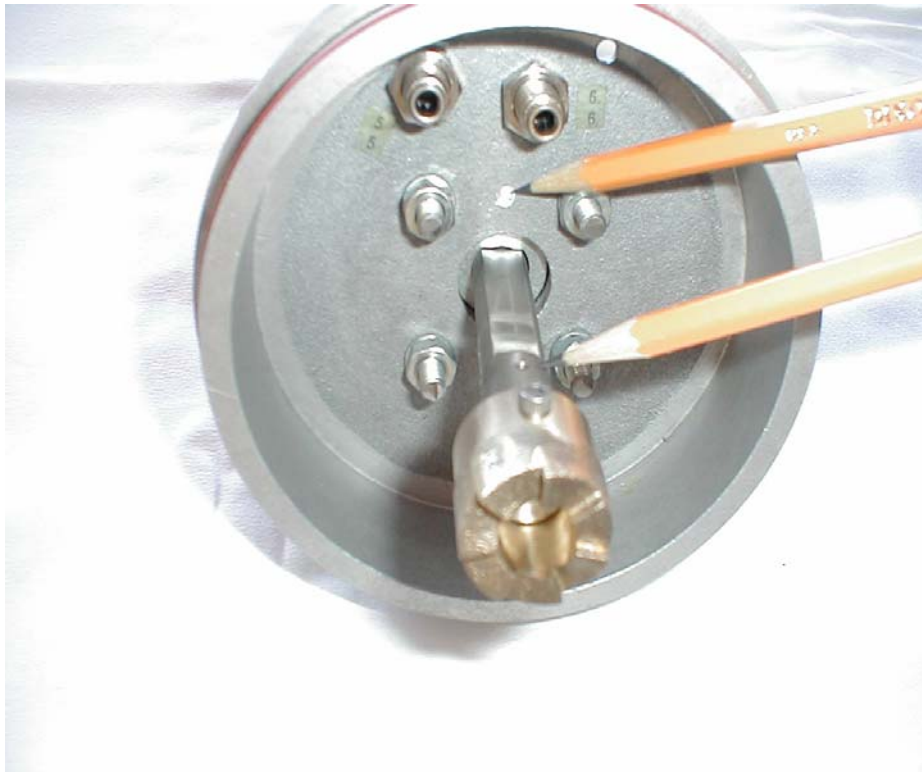


**CAUTION: WHEN FITTING ELEMENTS TO THE ELEMENT HOLDERS, THE ELEMENTS MUST BE HELD BY THE VERY TOP PORTION OF THE ELEMENT'S PLASTIC CAGE, ELSE DAMAGE MAY RESULT TO THE ELEMENT OR CAGE ASSEMBLY. ONCE FITTED, THE SCREWS MUST BE CHECKED FOR TIGHTNESS ONE HOUR AFTER OPERATION.**

## FITTING CONTROL COVER AND INDEXING ACTUATOR

Contained with the Phoenix filter is the control cover and indexing actuator (see Exhibit 2, drawing number ZG10013). For fitting the cover to the filter, follow the procedures below:

1. Remove cover from shipping board.
2. Remove top dog clutch and shaft, spring, and two screws from bag located inside Phoenix control cover.
3. Place top dog clutch with spring on lower dog, noting the small drill indent on the shaft above the dog clutch. Now align this indent with the same indent on the inside of the cover, see photo below.
4. Connect the two pneumatic airlines (numbered 1 and 2) to the two-way fittings located on the underside of the cover, ensuring the correct airline is connected to the proper fitting. Carefully tuck the airlines behind one of the stand-offs. This will ensure that the airlines do not come into contact with any of the moving parts.
5. Fit cover with indexer onto top shaft ensuring that small indent on the underside of the cover is aligned on the same side as the indent on the top shaft, as shown in the photo below.
6. Rotate cover to align the center punch marks on the cover to the center punch marks on the filter assembly.
7. Finally, fit the two holding down screws to the cover and secure.



**PHOENIX**  
**Pneumatic Operation**  
**OPERATING MANUAL**

**Description**

The Phoenix filter is a fully automatic backwashing filter, comprising six patented filter elements in separate pods surrounding a central inlet chamber. The discharge from each pod is collected in a common area under the “doughnut” shaped filter cover before leaving via a common discharge port. The central inlet chamber contains a proprietary *indexing valve* which operates the filter’s backwash. Backwash is controlled by a PLC which operates an *indexing actuator*. This actuator rotates the Indexing Valve while sequentially backwashing each pod. A *pneumatic backwash valve* opens and closes with each indexing position.

**Operating Parameters**

Power Supply:	110 VAC, 2 Amp supply
Controls Supply:	24 VDC
Minimum Operating Pressure:	40 psi
Maximum Operating Pressure:	120 psi
Maximum Differential Pressure:	40 psi
Static Test Pressure:	230 psi
Maximum Operating Temperature:	135° F (higher temperature ratings available)
Flow Rate:	see flow chart (Exhibit 1)
Micron Ratings:	25, 50, 75, 125, 200 and 400 micron.
Minimum Air Pressure:	80 psi
Maximum Air Pressure:	120 psi

**Materials Composition**

Filter Material

Filter Housing:	Stainless steel 304L
Control Cover:	Aluminum (non-wetted part)
Filter Elements:	Stainless steel 304L, DTD 734 with glass filled polypropylene cages, stainless steel cages recommended for higher pressure and temperature applications.
Element Holders:	Glass filled polypropylene, stainless steel screws
Indexing Valve:	Stainless steel 304 with Buna, EPDM, or Viton ‘O’ rings and polyacetal shoe.
Backwash Valve:	Chrome plated, brass body, stainless steel 316 ball with PTFE seats and double acting actuator.
DP Switch:	One micro switch, brass wetted parts, fitted with visual setting indicator and nitrile seals. Two micro switches and stainless steel wetted parts with Viton seals available.
‘O’ Rings:	Viton standard throughout, Buna and EPDM available.
Indexing Actuator:	Double acting actuator.

## **1.0 COMPONENTS**

### **1.1 FILTER BODY**

Manufactured from stainless steel, the filter body consists of six pods each containing a filter element and joined by a common inlet and outlet. Also connected to the central chamber of the filter is the backwash pipe. The inlet and outlet connections are 3" flange, ANSI 150 bolthole pattern, and the backwash connection is a 3/4" NPT female pneumatically operated Backwash Valve.

### **1.2 INDEXING ACTUATOR (INDEXER)**

The Indexer is fitted on top of the filter. The Indexer rotates the backwash Indexing Valve 360° while backwashing each pod in sequence.

### **1.3 INDEXING VALVE**

The Indexing Valve is situated in the central inlet chamber. The Indexing Actuator drives this valve. During backwash, the Indexing Valve rotates to close off the inlet to each pod in sequence while simultaneously providing access to the 3/4" backwash port. Fitted on the backwash line is a Backwash Valve that opens and closes with each index position. The opening of the Backwash Valve allows a reverse flow of clean liquid to open each element in sequence while flushing the accumulated debris from the filter element to drain.

### **1.4 PROXIMITY SWITCH**

A Proximity Switch is mounted on a plate located in the control cavity. Upon initiation of a backwash the drive shaft will rotate. Situated on the drive shaft is the Home Screw. Once the filter has completed its backwash, the Home Screw will have rotated 360° and will enter the sensing range of the Proximity Switch which provides an input to the control system that the backwash sequence is complete and to stop indexing. If the input is not received in a certain time 'T' (usually 1 minute) the filter control panel will indicate an alarm condition (please refer to Section 5.0 for Filter Faults and Remedies).

### **1.5 BACKWASH VALVE**

The Backwash Valve is pneumatically operated. In the filter position, the valve is closed and prevents liquid loss from the backwash line. During backwash, the valve opens and closes with each index position. If there is a fault with the filter (see Section 5), the backwash valve will automatically close.

### **1.6 FILTER ELEMENTS**

The filter elements are manufactured from stainless steel 304 and are made to different micron specifications. Element selection is dependent on the nature of the contaminant in the fluid to be filtered. As can be seen from the flowchart in Exhibit 1, the smaller the micron size the lower the flow rate through the filter. Correspondingly, this will also directly affect the clean differential pressure across the filter.

## 1.7 DISCHARGE REGULATING VALVE

It is essential to fit a regulating valve on the discharge of the filter for two reasons:

1. To ensure the correct flow rate through the filter, and
2. to provide the necessary head pressure on the filter's discharge for efficient backwashing.

## 1.8 CONTROL PANEL

The filter's controls are contained in a separate wall mounted enclosure. The principal components of the control system are a Siemens PLC and 24 VDC transformer, Parker air solenoid valves, terminals, Allen-Bradley lamps and buttons, and a backwash counter. Connections between the panel and filter include pneumatic air lines and a 6 core cable for the differential pressure switch and Proximity Switch.

Fitted with the control panel are the following:

1. The Power Lamp (green) indicates that the 24VDC supply is connected to the PLC.
2. The Backwash Lamp (yellow) indicates that a backwash cycle is in progress.
3. The Fault Lamp (red) indicates an error has occurred, see Sections 2.5.2 and 5.0.
4. The Backwash Button initiates a manual backwash.
5. The MCB (miniature circuit breaker) is provided to allow the power supply to the PLC to be switched off and on easily and to break at any load exceeding 2 Amps. **Ensure that power is disconnected elsewhere before working on the panel.** The MCB is located in the bottom of the control panel (refer to drawing ZG10146).
6. The Backwash Counter counts the total number of backwash cycles and is not resettable. (Note that the counter advances 1 digit after a complete backwash of both filter elements).

## 2.0 OPERATING GUIDELINES

Before operating the filter, ensure that it has been installed per the INSTALLATION GUIDE provided. Failure to do so could affect the filter's performance and void the filter's warranty.

### 2.1 FILTER OPERATION

The DP switch monitors the difference in pressure between the pod's inlet and outlet, and upon reaching a user determined DP set-point, an electrical signal will be sent from the DP switch to the control panel.

The Phoenix filter has two pneumatic actuators. On top of the Phoenix filter is a pneumatic 'Indexer', which rotates the filter's internal valve through 360/7 degrees at each step during the backwash process. (The filter has 6 filter element positions and 1 home position). A small proximity switch located in the top of the filter tells the control system that the backwash cycle has been completed and stops any further advancing of the indexer. An electrical signal from the proximity switch is sent to the PLC within the control panel to indicate that the diverting valve is in the home position. Fitted on the backwash outlet is a pneumatically operated 3/4" backwash valve. This valve opens and closes six times throughout the backwash process, once for each element, thereby allowing uninterrupted flow during the backwash process.

During backwash, the pneumatic indexer advances and moves the internal diverting valve 51° (360/7) so that the 'shoe' is positioned over the inlet to pod 1, thereby shutting off its inlet. After a pause of 0.5 seconds, the pneumatic backwash valve opens. By opening the backwash valve to atmosphere, a portion of clean filtered liquid is allowed to travel in a reverse direction from the inside to the outside of the filter element. This reverse supply of clean liquid will cause the filter element to open along its entire length while vibrating at the same time.

In this way, all debris is removed from the outside of the filter element, even debris that may be lodged on the surface of the filter element. This results in a very efficient backwash with very little fluid required. The backwash sequence to clean each pod is normally 2 seconds (adjustable depending on system pressure). When one pod has been backwashed, the next pod is then selected and so on until all six pods have been backwashed. Once the backwash has been completed, the filter will return to its clean differential pressure every time.

### 2.2 DIFFERENTIAL PRESSURE (DP) SWITCH

The difference in pressure between the filter's inlet and discharge operates a diaphragm, which in turn will open the normally closed electrical contacts within the switch. This in turn provides a signal to the control system which then initiates a backwash.

The DP set point may be adjusted by turning the adjusting nut located inside the switch cover on the left-hand side of the switch (when looking at the switch). The adjusting nut for the high DP set-point (alarm indication) is located on the right-hand side of the switch.

Turning this nut will alter the setting on the indicator located on the outside of the switch. This indicator is for reference only. The actual differential pressure at which the switch operates is determined by calculating the difference between the inlet and outlet pressure gauges.

It is imperative that the clean DP of the filter is ascertained prior to setting the backwash set point on the switch. To set the DP set point, determine the maximum acceptable DP that the filter can impose on the overall system and set the switch accordingly. Note, the closer the backwash set point is to the filter's clean DP, the more frequent the filter will backwash. It is usually necessary to try a number of settings until the best compromise is reached. **Maximum setting for the DP switch is 40 psi.**

The DP switch is factory set at approximately 10 psi. **Note: The filter requires a minimum of 30 psi on the discharge side of the filter for an efficient backwash.**

### **2.3 BACKWASH DURATION TIMER**

The backwash duration is the amount of time that the pneumatic Backwash Valve stays open to backwash each pod before closing. This is how adjustments are made to achieve optimum backwash efficiency. The backwash duration can be set as low as 1 second without hindering backwash efficiency. The longer the duration, the longer the remaining five elements are "on line" before they are cleaned. Therefore, at some point, a full cleaning of the filtering elements will be impaired.

The objective when setting the backwash duration is to find the optimum balance between low backwash wastewater and full element cleaning. Full element cleaning is demonstrated when the filter returns to a clean DP as evidenced by comparing the inlet and discharge gauge pressures.

To alter the backwash duration, see section 1.9.

### **2.4 BACKWASH INTERVAL TIMER**

The Phoenix filter is recommended to be operated with the DP switch provided. This ensures that backwashing follows the contaminant load on the filter, which will often be variable. The Phoenix filter has an additional advanced facility which takes over from the DP switch at times of low contaminant loading. This feature is called the backwash interval timer and is already connected via a link between terminals 3 and 4 and is factory set to ten hours. This ensures that the filter does not spend excessive amounts of time inactive during conditions of low contaminant loading. This facility avoids the problems frequently encountered with mechanical equipment which remains static for long periods of time.

To alter the interval time, see section 1.9.

**Note:** Adjustments to both timers must be done when in filtration mode and not during a backwash. Therefore, it is advisable to initiate a manual backwash immediately after any alterations are made to ensure that the new settings have been registered in the PLC.

## 2.5 CONTROL SYSTEM

### EXPLANATION OF TERMS

PLC	Programmable Logic Controller. A Siemens LOGO! 24RC and expansion module are provided and is supplied from the 24VDC power supply within the panel. The power supply to the panel is an 110VAC supply. To determine the program version that is installed on the PLC, depress the reset button three seconds and view the PLC's display.
Input	24VDC signals fed into the PLC from switches, buttons etc. The 24RCL has the capacity for 8 inputs with an additional 4 inputs from the expansion module. These inputs can be seen by pressing the Right Arrow Key.
Output	Information in the form of 24VDC signals which can power indicator lamps, solenoid valves, counters, and factory DCS feedback (i.e. Honeywell System). The 24RC has the capacity for 4 outputs with an additional 4 outputs with the expansion module. These outputs can be seen by using the Left Arrow Key.

### I/O LIST

I <sub>1</sub>	Proximity switch
I <sub>2</sub>	Backwash button
I <sub>3</sub>	Differential Pressure switch contacts – Backwash set point
I <sub>4</sub>	Backwash Interval timer. (Allows the user to instigate a backwash after a preset time interval (set to 10 hours as default))
I <sub>5</sub>	High Differential Pressure switch contacts – High set point
I <sub>6</sub>	Not Used
I <sub>7</sub>	Not Used
I <sub>8</sub>	Not Used
I <sub>9</sub>	Not Used
I <sub>10</sub>	Not Used
I <sub>11</sub>	Not Used
I <sub>12</sub>	Reset Button
Q <sub>1</sub>	Indexer
Q <sub>2</sub>	Backwash Valve
Q <sub>3</sub>	Not Used
Q <sub>4</sub>	Not Used
Q <sub>5</sub>	Common Fault (customer feedback) Volt free contacts
Q <sub>6</sub>	Backwash in progress (customer feedback) Volt free contacts
Q <sub>7</sub>	Backwash Lamp and Counter
Q <sub>8</sub>	Fault lamp

## 2.5.1 PROGRAM ADJUSTMENTS

The LOGO! program is simply a series of control statements contained within program segments or “Boxes”. Adjustments to timers within the program are made by gaining access to the appropriate box and changing the setting.

Most variables within the program are set at start up and should not be altered without reference to Zero Gravity Filters. Certain variables are adjustable at any time by the user and are outlined below.

<b>Box No.</b>	<b>Customer Variable</b>	<b>Function</b>	<b>Default</b>
B02	Yes	Delay from close of Backwash Valve to next Index	
B06	Yes	DP Debounce Time. Sets time for which DP switch contacts must remain open before backwash starts.	3.0 sec
B08	Yes	Backwash Interval Time. Sets interval between backwashes.	8.00 Hr
B14	Yes	Backwash Duration. Sets time for which backwash valve remains open for each pod (and determines the amount of fluid used).	3.0 sec
B15	Yes	Delay from Index forward to open Backwash Valve	
B19	Yes	Used for a pause between filters during backwash sequence. This is used on filter B only	
B20	Yes	Service Interval. Sets number of backwashes after which service interval is notified.	20,000
B28	Yes	Time allowed for Indexer to move back before drive forward	
B48	Yes	High DP Debounce Time. Sets time for which High DP switch contacts must remain open before alarm indication.	10.0 sec

Adjustments are made by following the sequence described below:

- Step 1 Press the blue ESC key on the front of the LOGO! Controller.
- Step 2 Select “Parameterize” option and press OK.
- Step 3 Use the up and down keys to arrive at the required box.
- Step 4 When the desired box has been located, press OK.
- Step 5 Use the left and right arrow keys to position the cursor over the required digit, and then use the up and down keys to change the value.
- Step 6 Once the correct value can be read, press OK. The up and down keys can be used to change another box if required. Finally, press ESC twice to return to the running program.

The time/date can be altered at step 2 above by selecting “Set Clock” and following similar steps as above. Also the program title can be accessed by using step 2.

Note:

- T = actual time set
- Ta = this facility allows the actual value of any particular timer to be observed while the program is running. This feature is useful in finding the optimum value for a setting.
- Lim = the number value set
- Cnt = the actual count reached

## **BACKWASH SEQUENCE**

Once a backwash (self cleaning cycle) is initiated the following sequence takes place:

1. Indexer ratchets back and advances the Indexing Valve Shoe to pod 1
2. Pause time of 1.5 seconds
3. Backwash Valve opens
4. Backwash Time elapses for user-defined period (default of 3.0 seconds)
5. Backwash Valve closes
6. Pause time of 1.0 second
7. Indexer ratchets back & advances Indexing Valve Shoe to pod 2 and so on
8. Cycle ends after all six elements are cleaned and the home screw enters the sensing range of the proximity switch

### **2.5.2 FAULT CONDITIONS**

**DP Switch Contacts Still Open.** When the backwash is initiated by the differential pressure (DP) switch, the DP switch contacts will open to start the backwash. The contacts should close upon completion of the backwash cycle to indicate that the cleaning process is complete. If this is not the case and the DP contacts remain open, the fault lamp will illuminate red and output Q5 will be energized. Also an error message will be displayed on the PLC stating:

**Continuous Backwash  
Condition  
See manual**

To reset the fault lamp once the fault has been cleared, press the reset button on the front of the control panel. If the DP switch contacts have subsequently closed, then the fault lamp will turn off. If the fault lamp remains illuminated, then check for possible faults (see Section 5.0).

**High DP Switch Contacts Open.** A second set of contacts are supplied to monitor the differential pressure across the filter and indicate an alarm condition if the DP exceeds the 'high' set point. This should be set at least 15 psi above the backwash set-point to avoid false alarm conditions.

In normal operation, as the filter gets dirty the differential pressure across the filter will increase and will initiate a backwash at the user-defined set point. Upon initiation of the backwash, the differential pressure across the filter should continually decrease throughout the backwash sequence. However, if the differential pressure continues to increase, this may indicate a potential problem with the cleaning process.

The high DP set point is user-defined and if the DP across the filter reaches this set point for ten (10) consecutive seconds, then the contacts will open and the fault lamp will illuminate red (see Section 5.0). Also output Q5 will be energized and an error message will be displayed on the PLC stating:

**High DP Condition  
Reached  
See manual**

To reset the fault lamp once the fault has been cleared, press the reset button on the front of the control panel. If the DP switch contacts have subsequently closed, then the fault lamp will turn off. If the fault lamp remains illuminated, then check for possible faults (see Section 5.0).

**Proximity Switch Not Home.** If the home screw does not return to the sensing range of the Proximity Switch within 1 minute, this indicates that the Indexing Valve has not returned to the home position upon completion of the backwash (see section 5.0). If this occurs the red fault lamp will light, output Q5 will become energized (as indicated on the PLC), the backwash valve will close, and no further backwashing will be attempted until the fault is remedied. An error message will be displayed on the PLC stating:

**Proximity Switch  
Not home  
See manual**

To reset the fault lamp once the fault has been cleared, the control panel MCB must be switched off and then back on. If the valve has not reached the home position because of an air failure, and air has subsequently been restored, then hold the backwash button for three seconds until the backwash light is illuminated. The filter will then complete its backwash, and once reaching the home position the fault lamp can be cleared by pressing the reset button.

**Proximity Switch Still Home.** Upon initiation of a backwash, the Indexer will rotate the Indexing Valve, and the Home Screw located on the shaft. Once this shaft rotates, it should move the Home Screw from the sensing range of the Proximity Switch. If the Home Screw stays within the sensing range of the Proximity Switch for more than five seconds, then a fault condition is signaled. Output Q5 will be energized and the fault lamp will illuminate red, and an error message will be displayed on the PLC stating:

**Proximity Switch  
Still made  
Realign**

Once realigned, pressing the reset button will clear the fault. If the fault lamp does not turn off, refer to Section 5.0.

**Service Required.** An internal counter totals all backwashes and gives a signal once a set point is reached. This counter is factory set at 20,000 cycles or backwashes. This is a useful facility to indicate that the filter should be serviced. When this set point is reached, the fault lamp will light and the PLC display will read:

**Service Required**

Once lit, please contact your local Representative or Zero Gravity Filters for spare part information (see Section 6.0). To clear this indication, press and hold the reset button for thirty seconds.

### **3.0 FILTER START-UP**

**Before filter start up, if a pause is required between each filter when in backwash, then Box 19 must be used on filter 'B' before operation. See section 2.5.1**

Once the filter has been properly installed and after reviewing the filter's control system, the filter may be started by following the procedure below.

1. With inlet, discharge, and backwash valves closed, start any pumps serving the filter. Slowly open the inlet valve. Check and correct for any possible leaks. Bleed air from the filter body using the bleed cock on the underside of the filter.
2. Ensure that power is to the filter in accordance with the Installation Guide (the green LED should be illuminated). Ensure air to the control panel is at least 80 psi.
3. The discharge may now be slowly opened and the regulating valve adjusted to give the desired flow rate and pressure combination.
4. A final, on-line backwash check should be performed. Manually initiate a backwash by depressing the manual backwash button, check that the backwash counter advances, backwash LED illuminates yellow, and the indicators on the 'Indexer' and Backwash Valve moves according to filter operation outlined in section 1.3 and 1.5.

## **4.0 RECOMMENDED MAINTENANCE**

Depending on the application, the filter elements may require to be removed for cleaning at regular intervals. In any case, the following preventative maintenance program should be followed (see section 6.0 for spare parts listing):

### **Every Six Months**

1. Visually inspect the following:
  - a. No leaking around 'Clampco' ring clamp
  - b. No leaking from backwash ball valve
  - c. No leaking from indexing valve weep hole. If 'O'Rings on indexing valve need replacing, fluid will weep from a small weep hole located on the central inlet pipe between pods 1 and 2 if counting clockwise from the inlet.
  - d. Illumination of GREEN power lamp
2. Push manual backwash button and observe the following:
  - a. Illumination of YELLOW backwash lamp
  - b. Movement of Indexing Valve as indicated by rotation of indicator on indexing actuator.
  - c. Opening and closing of backwash valve as indicated by rotation of indicator on backwash actuator.
3. Record backwash count.

### **Every Twelve Months**

1. Renew all O Rings
2. Visually inspect filter elements
3. Inspect dog clutches, dog pins, shafts, and indexing valve shoe for wear, see Section 4.3 for removal of indexing valve.

## **4.1 REMOVAL, INSPECTION AND CLEANING OF FILTER ELEMENTS**

To remove the filter elements from the filter, perform the following procedure:

1. Take filter off-line, isolate, drain, and disconnect power and air from filter.
2. Carry out the procedure in section "Filter Element Installation" within the attached "Installation Guide" to gain access to the filter elements.
3. Remove each filter element in turn by gently lifting the element holder in each pod.

Once the filter elements are removed, perform the following cleaning procedure:

1. If the contaminant is loose, then a simple shaking motion in water will suffice.
2. If light scale has formed, then any proprietary stainless steel cleaner will clean the elements to a like new condition. Always follow-up by running water down the center of the filter element to ensure that no debris is lodged between the turns of the coil.
3. If the filter elements are heavily scaled, use a mild industrial acid and follow the product's safety precautions. Always follow-up by running water down the center of the filter element to ensure that no debris is lodged between the turns of the coil.

Once the elements are clean, examine closely for any damage to the filter elements and the support cage inside each element, finally check tightness of mounting screws. Refer to Section 4.2 for instructions on replacing filter elements. Please refer to Section 6.0 for "O" ring part numbers.

## 4.2 REPLACEMENT OF FILTER ELEMENTS

To replace the filter elements, follow the procedure below:

1. Lightly lubricate the “O” ring on each element holder with an appropriate lubricant. Ensure that each “O” ring is fitted properly within the groove on the element holder.
2. Insert filter elements into each pod.
3. Examine the “O” rings on the ID and OD of the doughnut cover. If any damage is found, then replace “O” ring.
4. Generously lubricate the ID doughnut “O” ring.
5. Check that the filter cover OD “O” ring is correctly located in its groove around the circumference of the filter body and that the groove is free of debris.
6. Replace doughnut shaped filter cover.
7. Replace “Clampco” ring clamp, red backing ring, and 6” retaining ring.
8. Put filter back on-line. Check filter performance.

## 4.3 REMOVAL OF INDEXING VALVE

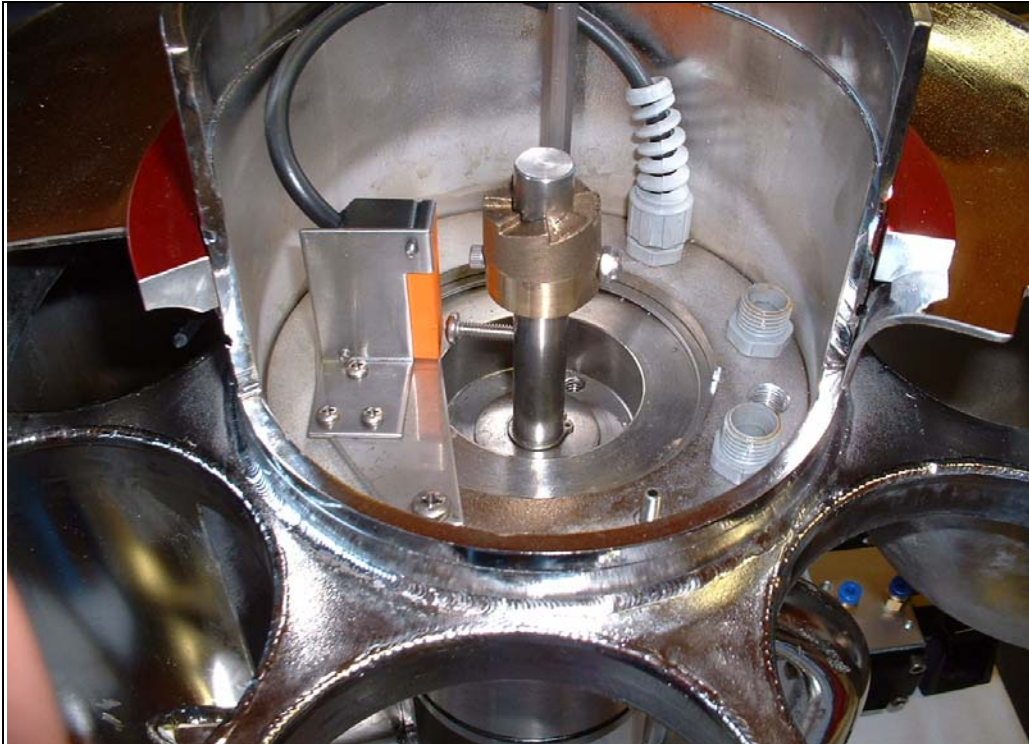
To remove the Indexing Valve, follow the procedure below.

First, isolate filter from system and drain, disconnect power and air from panel. Then remove the two countersunk Philips head screws situated on each side of the actuator (as shown below). Note the center pot lines opposite each screw connecting the cover to the filter body. This line will assist in aligning the screw holes when securing the cover back to the filter.



Once the screws have been removed, follow in order the procedure below:

1. Gently raise the cover from the filter. You will now see two pneumatic airlines each connected to a two-way pneumatic fitting. Each airline is numbered as well as the two-way fitting.
2. Disconnect the pneumatic airlines from each fitting by pushing the collar towards the fitting and at the same time pulling on the tube. Note the position of each airline to ensure that the airlines are fitted correctly when reassembling the filter.
3. Remove the top drive shaft and spring.
4. Remove the two screws securing the Proximity Switch assembly (see photo below) including the mounting plate. These screws must not be confused with the three smaller screws holding the Proximity Switch to the mounting plate.
5. The Indexing Valve assembly, as shown below with bottom dog clutch and its drive shaft is now visible. Remove the retaining ring holding the valve assembly into the filter housing.

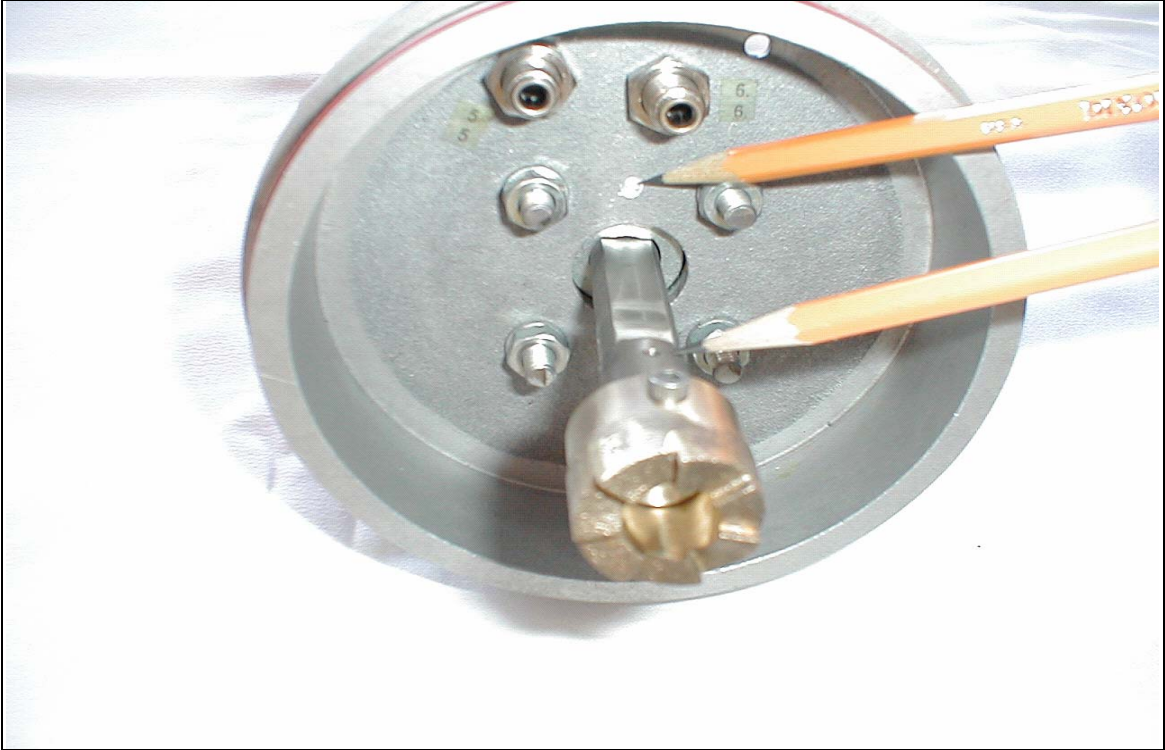


6. Screw in the two 6"  $\frac{1}{4}$  UNC bolts of the Phoenix Extraction Tool, approximately  $\frac{1}{2}$ ", see Section 6.0 for part number.
7. Carefully extract the valve assembly from the filter by pulling straight up on the Phoenix Extraction Tool. If difficulty is experienced in removing the valve assembly, then lever the square section cross bar of the Phoenix Extraction Tool against the control housing using a flat bar.
8. Once removed, examine the valve assembly for any heavy scoring on the valve shoe. Should the valve assembly be heavily damaged in any way it is recommended that the complete assembly be exchanged for a reconditioned unit.

#### 4.4 REPLACEMENT OF INDEXING VALVE

Before replacing the valve assembly, examine the “O” rings on the valve assembly and replace if necessary.

1. By looking down the length of the valve body, align the vertical opening in the backwash shoe with the dowel pin located on the top circumference of the Indexing Valve body. This will ensure that the valve is in the filter position.
2. Lubricate the three “O” seals and insert valve assembly into the inlet chamber. Take care to align the dowel pin with its recess in the inlet chamber, and not to move the valve shaft.
3. **Replace retaining ring and ensure correct fit into recess.**
4. Replace Proximity Switch assembly by tightening the two screws to the filter housing. **Ensure that there is a clearance between the Proximity switch and its positioning screw but no greater than 1/16”**. This will ensure that the screw will not make contact with the switch when the shaft is rotated, but will provide indication when the shaft is in the home position (filter position).
5. Place top dog clutch with spring on lower dog, noting the small indent on the shaft above the dog clutch, see photo below.
6. Replace two pneumatic airlines to the two-way fittings located on the underside of the cover, ensuring the correct airline is connected to the proper fitting. Carefully tuck the airlines behind one of the stand-offs. This will ensure that the airlines do not come into contact with any of the moving parts.
7. Fit cover with indexer onto top shaft ensuring that small indent on the underside of the cover is aligned on the same side as the indent on the top shaft, as shown in the photo on the next page.
8. Rotate cover to align the center pot lines on the cover to the center pot lines on the filter assembly.
9. Finally, fit the two holding down screws to the cover and secure.
10. Initiate a manual backwash and check operation of filter.
11. Put filter back on-line and check for correct operation.



## 5.0 FILTER DIAGNOSTICS

### 5.1 FAULT INDICATION

Listed below is the action required for the following faults indicated on the control panel.

INDICATION	REASON	ACTION
Fault lamp solid red and error message Continuous Backwash Condition	DP switch contacts still open.	<p>Check operation of switch and pressure lines are clear.</p> <p>Check electrical connection between switch and panel.</p> <p>DP switch set point set to low.</p> <p>Check actual DP across the filter. If too high after a backwash the filter elements may need manual cleaning or backwash duration time extended (see sections 2.2 and 4.1)</p>
Fault lamp solid red and error message High DP Condition Reached	High DP switch contacts still open.	<p>Check operation of switch and pressure lines are clear.</p> <p>Check electrical connection between switch and panel.</p> <p>High DP switch set point set to low.</p> <p>Check air supply is on and all pneumatic lines are intact.</p> <p>Check if flow rate or contaminate loading on filter has increased, if so, reduce flow rate, or consider coarser elements</p>
Fault lamp solid red and error message Proximity Switch Not Found	Proximity Switch not home (within 60 seconds)	<p>Check operation of Indexer actuator.</p> <p>Check continuity between Proximity Switch and control panel.</p> <p>Check plug and socket that is in-line between Proximity Sensor and control panel and ensure connection is made to bulkhead connector on panel.</p> <p>Check that input I<sub>1</sub> is being received at the PLC from the Proximity Switch.</p> <p>A large object has prevented the valve shoe from turning. Follow the Indexing Valve removal procedure in section 4.3.</p> <p>Once the fault has been cleared, the fault lamp will automatically reset once the Proximity Switch (Input1) is made by switching the PLC off and on at the MCB within the panel.</p> <p>If the fault persists, check that the Indexer is free to rotate and service if necessary.</p> <p>Check that the drive train from the Indexer through to the valve is intact, including the Dog Clutches, Shafts and Drive Pins.</p>
Fault lamp solid red and error message Proximity Switch Still Made	Proximity Switch still home (after 5 seconds)	<p>A large object has prevented the valve shoe from turning. Follow the Indexing Valve removal procedure in section 4.3.</p> <p>Check air supply to control panel and Indexing Actuator.</p> <p>Check operation of Indexing Actuator and air solenoid valve inside panel.</p>
Fault lamp flashes and message appears	Service interval has been reached.	Call supplier and arrange filter service and reorder supplies, see Section 6.0 for part numbers.

## 5.2 FAULT FINDING

Listed below is a guide to commonly asked questions regarding filter performance.

FAULT	POSSIBLE CAUSE	REMEDY
Excessive Backwash Frequency	Filter elements blocked or excessively fouled.	Clean and replace filter elements, see Section 4.1 and 4.2.
	DP switch set too low.	Raise DP switch set point, see Section 2.1.
	Flow rate has increased.	Check and regulate.
	Contamination has increased.	Check, and if possible, increase DP switch set point. If contamination load cannot be corrected, coarser elements may be required, see Section 1.6 and 2.1.
Continuous Backwash	Backwash interval timer too low.	Reset, see Section 2.3.
	See Excessive Backwash Frequency faults and remedies.	
Upon completion of backwash, DP is higher than clean DP	DP switch has failed.	Verify by removing the DP switch's electrical cover and check that contacts are being switched on rise and fall of DP. Replace switch if necessary.
	Proximity Switch not made	See section 5.1.
	Filter elements blocked or excessively fouled.	Clean and replace filter elements, see Section 4.1 and 4.2.
Fluid flows from backwash line after end of backwash cycle	System pressure too low for effective backwash.	Check and regulate.
	Backwash duration set too low to give thorough clean.	Increase backwash duration time setting, see Section 2.2.
	DP switch set point set too high causing excessive blinding of elements.	Check and regulate, see Section 2.1.
	Backwash valve is failing to close or seat properly	Check that the valve is being instructed to close (Look for Q2 at the PLC)  Check air supply to actuator.  If valve is still passing, dismantle and check for an object jamming the ball valve or damaged seats. Call supplier for service kit or replacement.
Filter Leaking	"O" seals failed, worn, or missing.	Check and replace as necessary. See Spare Parts List, Section 6, for part numbers.
Water leaking from weep hole between pods on Inlet pipe	'O' seals failed on outer body of Indexing valve.	Remove valve and replace all 'O' seals.

## 6.0 SPARE PARTS

Recommended spare parts for the Pneumatic Phoenix are as follows. Please call either your local Representative or Zero Gravity Filters for pricing.

<u>Part Description</u>	<u>Part Number</u>
Filter Element - Plastic Cage Assembly	681***-1
Filter Element – Stainless Steel 304 Cage Assembly	681***-2
Filter Element – Stainless Steel 316 Cage Assembly	681***-3
Element Holder – Glass Filled Polypropylene, 6mm	9032-001
Element Holder – Stainless Steel 304, 6mm	9032-002
Element Holder – Stainless Steel 316, 6mm	9032-003
Indexing Spring	5002-000
Stand Off, Stainless Steel	5125-000
Dogs – Matched Set, with Nut and Bolt	5122-000
Both Drive Shafts	5505-001
Proximity Switch Assembly	5112-003
Siemens LOGO PLC – 24 VDC, with Program	3000-001
EPROM with Program	3010-001
24 VDC Siemens 1.3 A Transformer	3002-001
Norgren Air Solenoid Valve	3100-001
Home Pressure Switch	5504-001
DP Switch, visual indicator, 1 micro, brass	3200-001
DP Switch, visual indicator, 1 micro, stainless steel	3200-002
DP Switch, visual indicator, 2 micro, brass	3200-003
DP Switch, visual indicator, 2 micro, stainless steel	3200-004
Large Retaining Ring – Cover	9008-000
Small Retaining Ring – Valve	9034-000
Backing Ring	9009-001
Over-Center, V-band clamp	9006-000
Complete Diverting Valve	9202-002
Diverting Valve Shoe	9018-002
Extraction Tool (Valve Puller)	9099-000
Indexing Actuator-063	5500-001
Indexing Actuator-048	5500-002
Backwash Valve and Actuator	5501-001
Cover Complete with Indexing Actuator	5506-001
Complete Set of O rings – Buna	3301-001
Complete Set of O rings – EPDM	3301-002
Complete Set of O rings – Viton	3301-003

\*\*\* micron designation

# Exhibit 1

## Phoenix Pressure/Flow Curve

