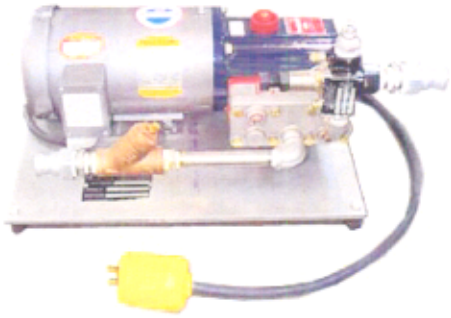
APPENDIX B

Operations Manual and System Components for VSEP Unit

5 .SYSTEM COMPONENTS

A. PUMP STATION

The standard Series L/P shipment includes a feed pump that can be used with a wide variety of fluids. The standard pump station consists of a "Hydra-Cell", hydraulically balanced, diaphragm pump directly driven by a 2 HP motor. Included is a "Y-trap" strainer at the pump inlet, and a "bypass valve" at the pump outlet. Please refer to the **Specifications** and **Pump Information** sections.



B. FEED TANK

Also, included as part of a complete system ready package is a 15 gallon Feed Tank made of Polypropylene. The tank is supported by steel stand-off legs and includes a Teflon ball valve at the outlet. All of the hoses necessary to system installation are also included. Standard hose and fittings are clear polyvinyl with aluminum fittings. Other hoses are available when chemical resistance is required.

C. V✧SEP UNIT

The main component is the **V✧SEP** Unit itself. This is made up of a cabinet which encloses the vibration drive system and filter pack. The cabinet is also used to mount plumbing and electrical parts. This unit is self contained and has wheels for easy movement.

The combination of the **V✧SEP** unit, Feed Pump, and Feed Tank make up all the key ingredients to an operational pilot system for testing purposes.

C. V✧SEP UNIT

5.1 Cabinet Exterior View

Figures 1A and 1B are front exterior views of the Series L/P cabinet.
1A shows the unit configured for "L mode operation.
1B shows the unit configured for "P mode" operation.

— The motor controls (Vibration Drive and Feed Pump) are located on the front door of the unit.

— The Vibration Drive Motor Speed Controller is an AC Inverter that supplies variable frequency and voltage to control the motor speed. The vibration amplitude is controlled by controlling the motor speed.

— The START-STOP switches are located next to the inverter.

— The Viewing Window allows observation of the Filter Pack assembly. This allows operating adjustments (vibration amplitude) to be made without compromising the safety provided by the cabinet.

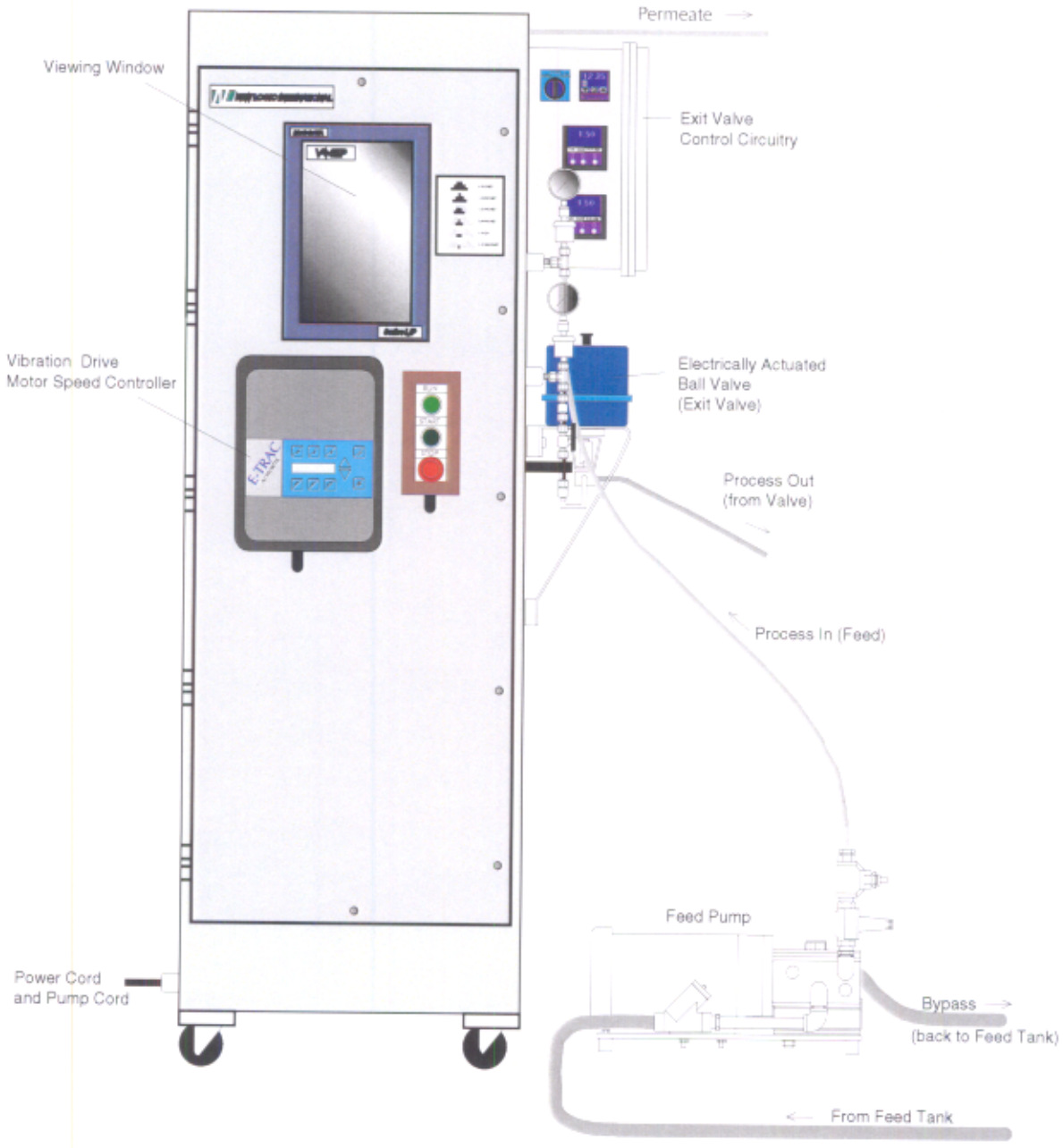
— The control circuitry for the Exit Valve is located in a separate enclosure at the top right side of the **V✧SEP** cabinet.

— At the right side and top of the cabinet are the fluid connections to the **V✧SEP** unit.

"L mode" : The three process ports,"Process In" (Feed), "Process Out" (Concentrated Feed) and "Permeate" (Filtrate) are located at the right side of the unit.
Pressure Gauges are included on the "Process In" and "Process Out" ports.
An Electrically Actuated Ball Valve is located on the "Process Out" pipe.
This valve is not used for "L Mode", **it must remain in the open position**.

"P mode" :

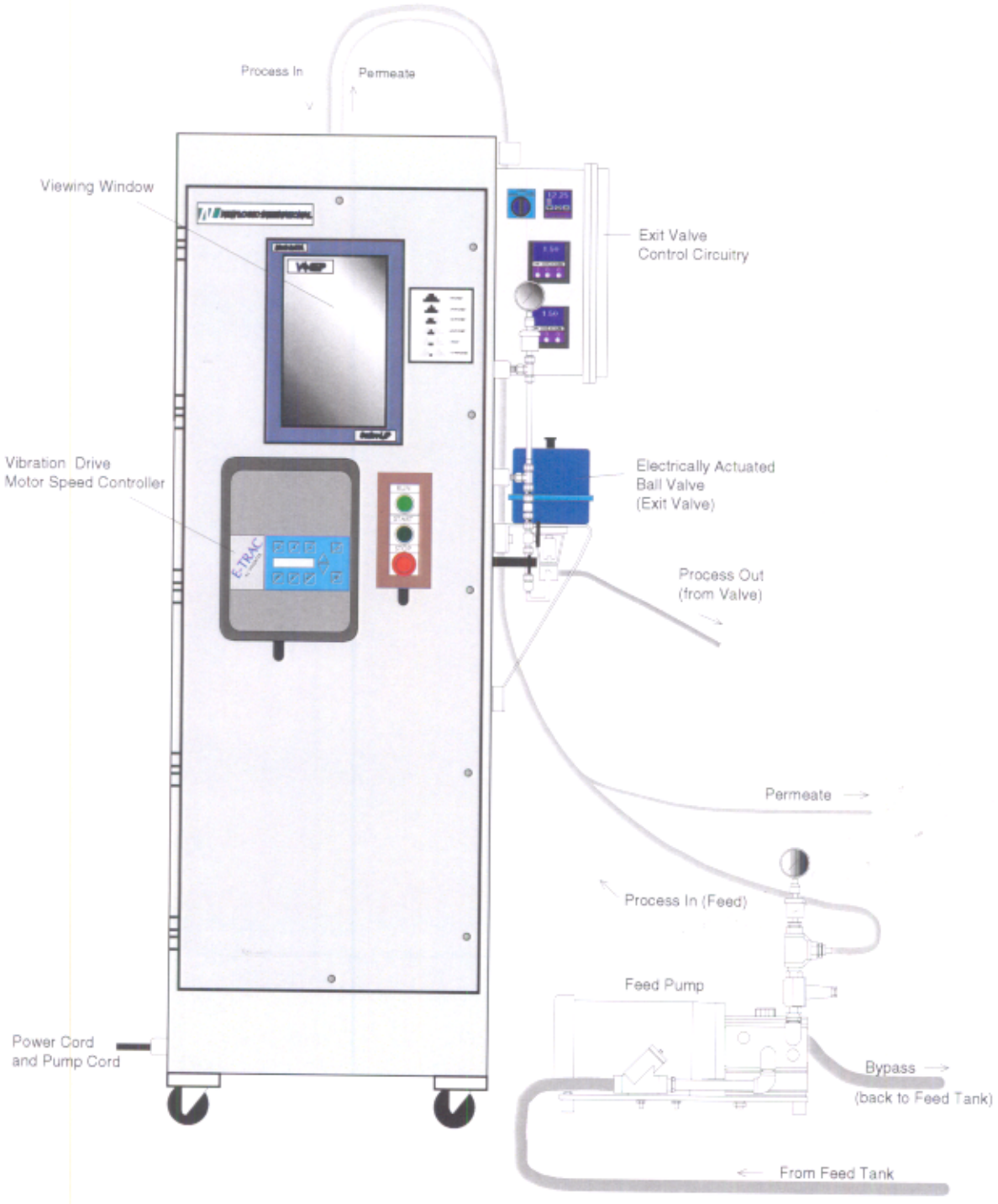
The "Process In" and "Permeate" hoses are connected through the top of the cabinet. The Ball Valve is in use in "P mode".



Series LP Machine in "L Mode"

FIGURE 1A

NEW LOGIC INTERNATIONAL 1295 67th Street, Emeryville, CA 94608 (510) 655-7305			
Series L/P	L/P V3.0 FIG 1A	7/11/94	6/18/98
SYSTEM FRONT VIEW, "L MODE" CONFIGURATION			



Series LP Machine in "P Mode"

FIGURE 1B

NEW LOGIC INTERNATIONAL 1295 67th Street, Emeryville, CA 94608 (510) 655-7305			
Series L/P	L/P V3.0 FIG 1B	7/11/94	6/18/98
SYSTEM FRONT VIEW, "P MODE" CONFIGURATION			

C. V✧SEP UNIT

5.2 Cabinet Interior View

Figures 2A and 2B are front interior views of the Series L/P cabinet. (The cabinet front is removed.)

2A shows the unit configured for "L mode operation.
2B shows the unit configured for "P mode" operation.

Starting at the bottom and moving up the visible main components are:

— The Seismic Mass is a heavy steel plate resting on an Isolation Mount. A motor driven Eccentric Weight is coupled with the Seismic so that the Seismic vibrates with an amplitude determined by the motor speed. The Seismic Mass vibrates 180 degrees out of phase with the Filter Pack Assembly, providing equal but opposite momentum.

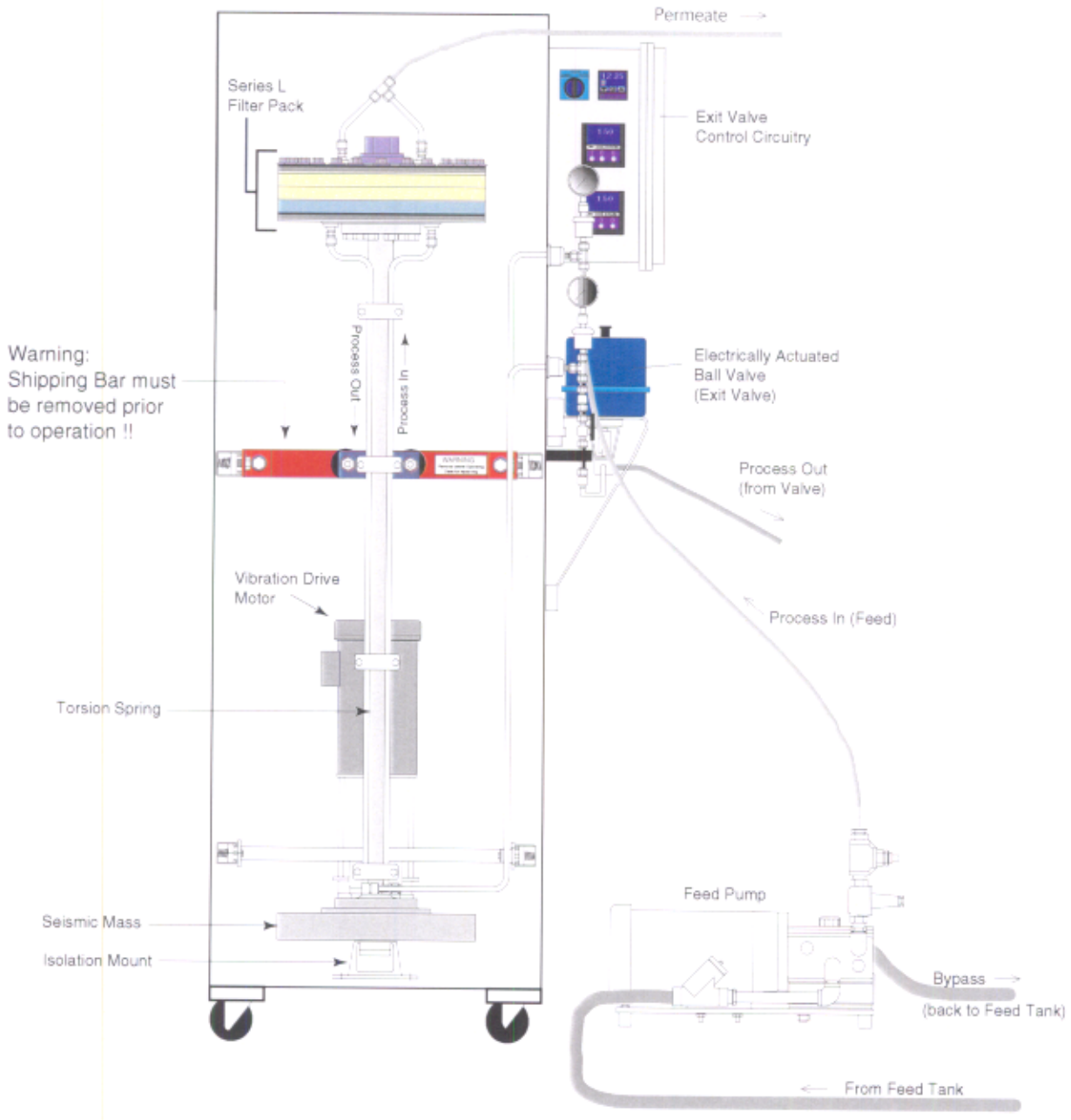
— Bolted to the center of the Seismic Mass is the Torsion Spring, the key component of the system. The Spring transmits the energy from the Seismic Mass to the Filter Pack assembly.

— Process Piping is clamped to the Torsion Spring at the vibration node.

In "L mode" the pipe on the left side is the *Process Out* pipe (concentrate out). The pipe on the right is the *Process In* pipe (feed) .

In "P mode" both of these pipes are *Process Out* pipes.

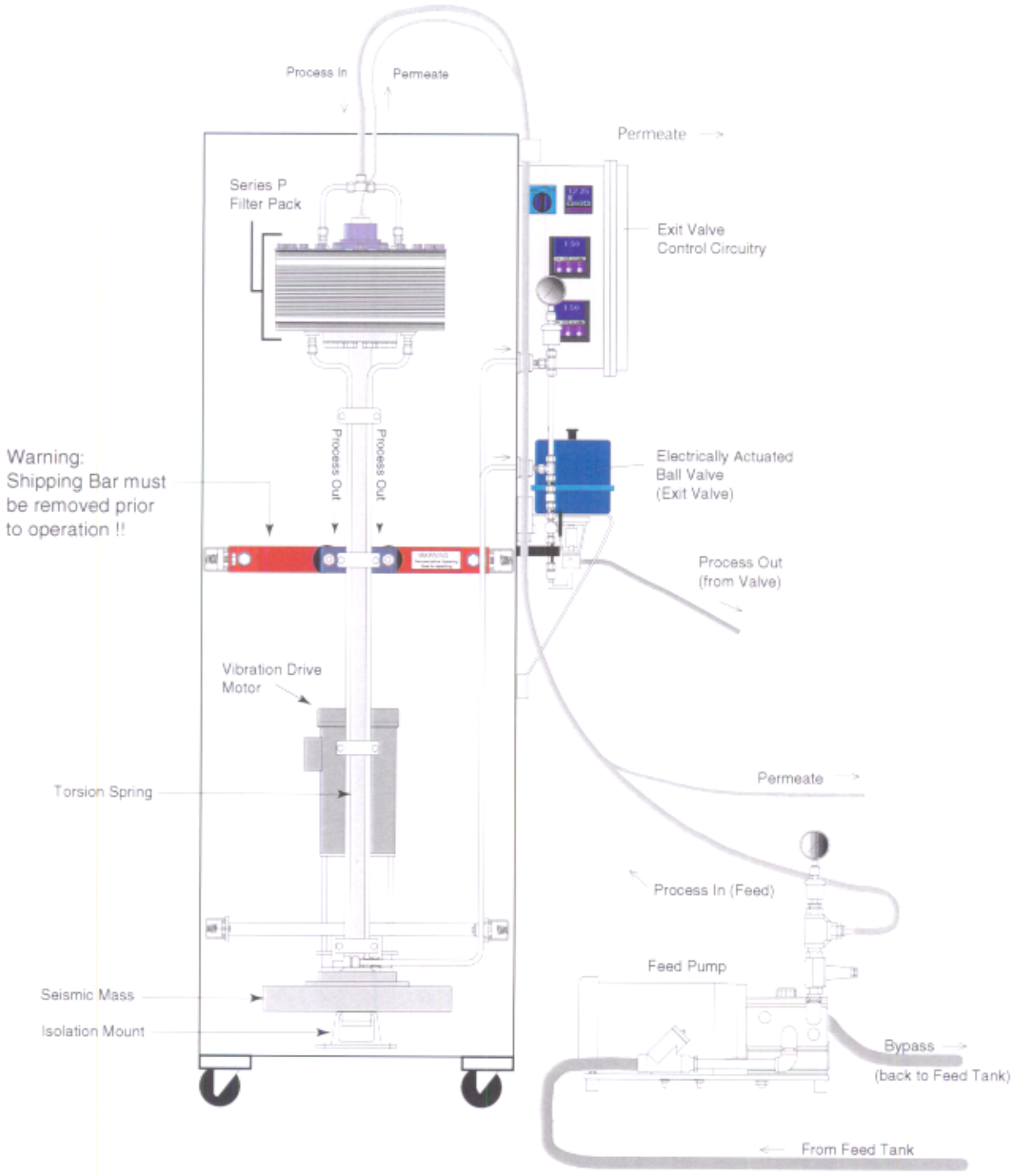
— At the top of the spring is the Filter Pack Assembly which consists of the Pressure Plates, the Clamshells and the membrane leaf elements.



Series LP Machine in "L Mode"

FIGURE 2A

NEW LOGIC INTERNATIONAL 1295 67th Street, Emeryville, CA 94608 (510) 655-7305			
Series L/P	L/P V3.0 FIG 2A	7/11/94	6/18/98
SYSTEM INSIDE VIEW, "L MODE" CONFIGURATION			



Series LP Machine in "P Mode"

FIGURE 2B

NEW LOGIC INTERNATIONAL 1295 67th Street, Emeryville, CA 94608 (510) 655-7305			
Series L/P	L/P V3.0 FIG 2B	7/11/94	6/18/98
SYSTEM INSIDE VIEW, "P MODE" CONFIGURATION			

C. V✧SEP UNIT

5.3 Filter Pack Assembly

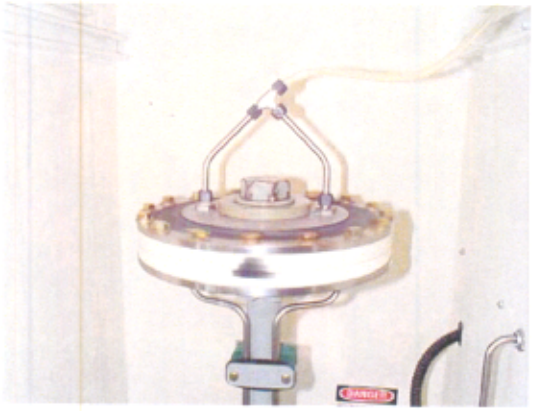
The Filter Pack assemblies are shown in **Figures 3A and 3B.**
3A shows the "L mode" Filter Pack Assembly.
3B shows the "P mode" Filter Pack Assembly.

— The "L mode" assembly consists of a membrane, screen and drain cloth held together inside the Upper and Lower "L mode" Clamshells. The clamshells are tightly held together to form the pressure vessel. O-rings are used to seal all component connections.

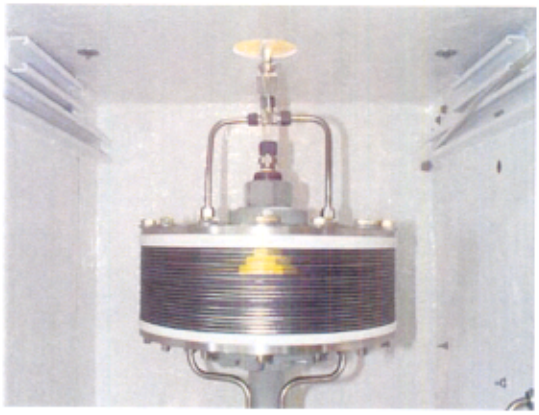
The Clamshells are held in place by the Upper and Lower Pressure Plates which are bolted together. The Filter Pack Assembly is attached to the top of the Torsion Spring by bolts through the Lower Pressure Plate.

— The "P mode" assembly consists of a stack of manufactured filter elements squeezed together between the Upper and Lower "P mode" Pack Plates. Unlike the "L mode" Clamshells , they do not form the pressure vessel. They provide the upper and lower ends of the pressure vessel which consists of the area between the filter elements. The filter elements are separated by Outer Gasket Seals.

The "P mode" assembly uses the same Upper and Lower Pressure Plates as the "L mode" assembly. Long bolts are used to squeeze the Filter Pack Elements together between the Pressure Plates.



L Mode Filter Pack



P Mode Filter Pack

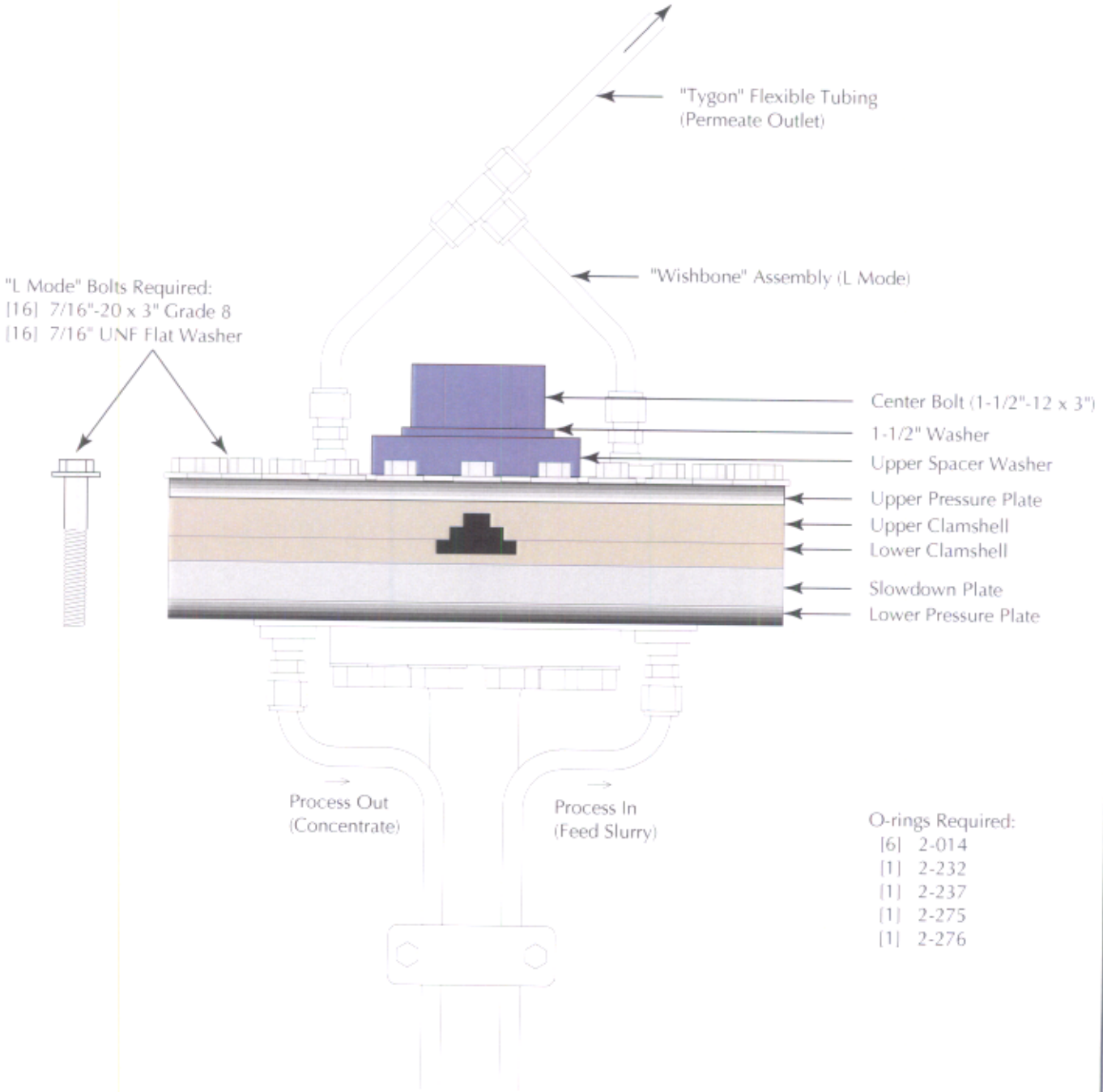


FIGURE 3A: "L Mode" Filter Pack assembly

24 px = 1"

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 3A	6/16/94	6/18/98
"L Mode" Filter Pack			

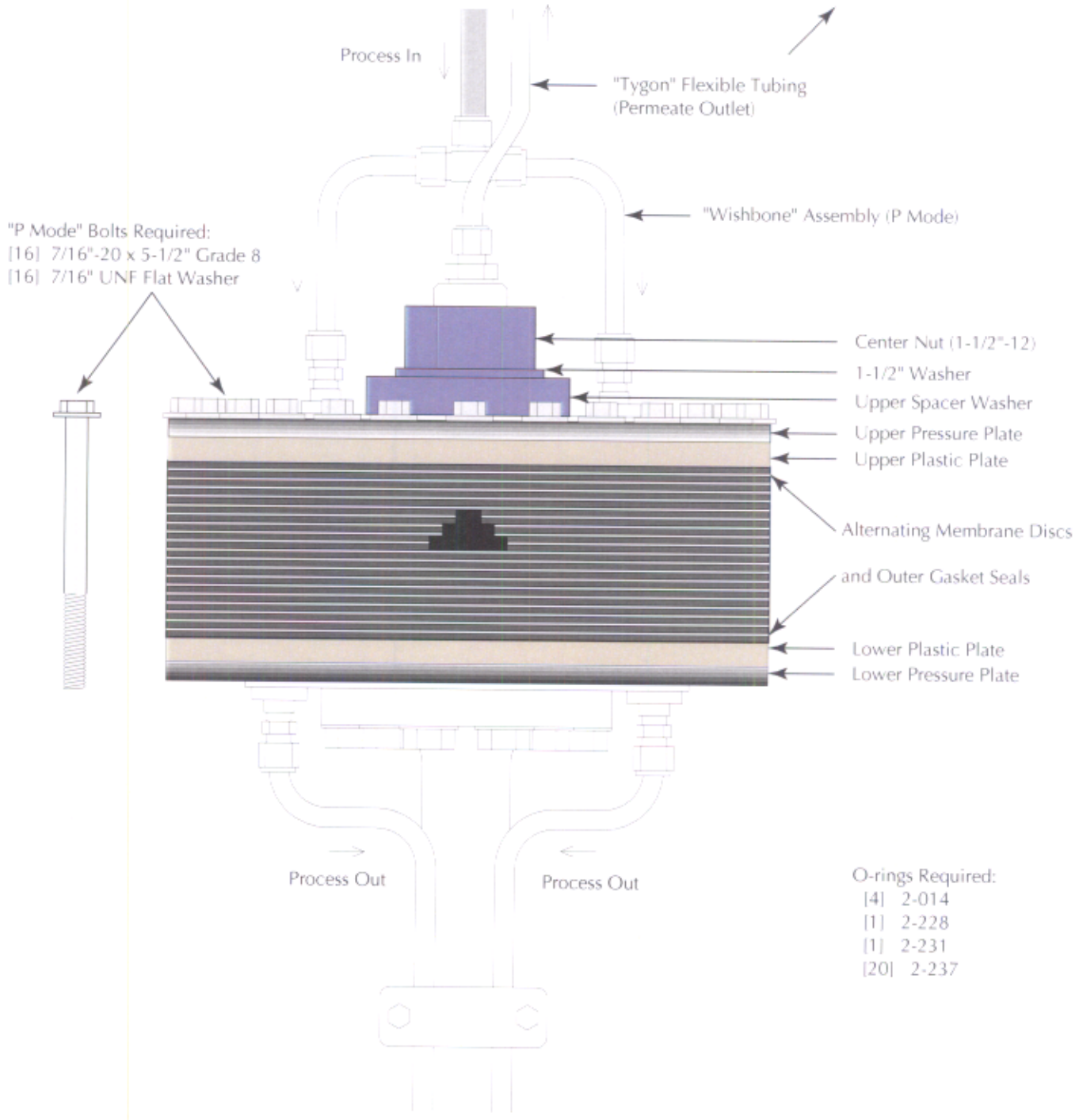


FIGURE 3B: "P Mode" Filter Pack assembly

24 px = 1"

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

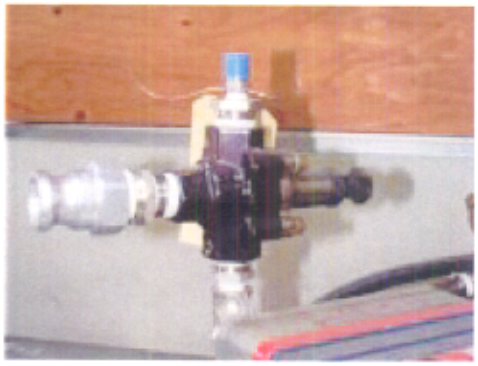
Series L/P	L/P V3.0 FIG 3B	7/11/94	6/18/98
"P Mode" Filter Pack			

C. V✧SEP UNIT

5.4 Fluid Controls

There are fluid flow control components on the *Process In* (Feed) and *Process Out* (Concentrate Out) pipe lines.

The Pump Bypass Valve is located at the high pressure outlet of the Feed Pump. This is a manually adjustable bypass valve. By turning the bolt on this valve, the amount of liquid that is sent back to the Feed Tank (bypassing the **V✧SEP** unit) is adjusted. This is the primary control for adjusting the operating pressure of the **V✧SEP** unit. Note: Turning In (tightening) this bolt increases flow to the **V✧SEP** unit.



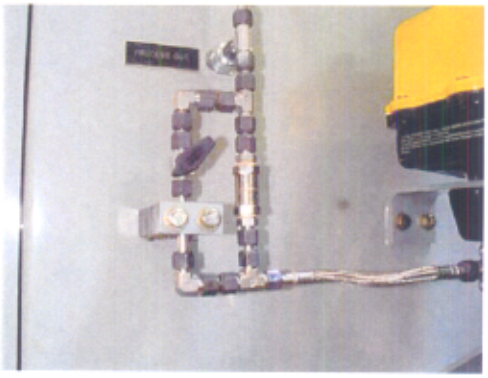
Pump Bypass Valve

Feed & Concentrate Gauges

The *Process In* fluid pressure is displayed by a liquid filled Pressure Gauge. During "L mode" operation this gauge is located a the *Process In* port at the **V✧SEP** cabinet. During "P mode" operation this gauge is located at the Pump Bypass Valve.

The *Process Out* fluid pressure is displayed by a liquid filled Pressure Gauge. This gauge is located at the Process Out port at the **V✧SEP** cabinet.

A Flow Regulator is mounted on the *Process Out* line to limit membrane crossflow to .25 gpm (when the Control Valve is closed.) The Control Valve is connected in parallel with the Flow Regulator. It serves as a Flow Regulator bypass valve. This allows the cross flow to be increased by allowing output fluid to bypass the Flow Regulator.



Flow Regulator

Actuated Concentrate Valve

The Electrically Actuated Ball Valve is located, on the Process Out line, after the Flow Regulator and Control Valve.

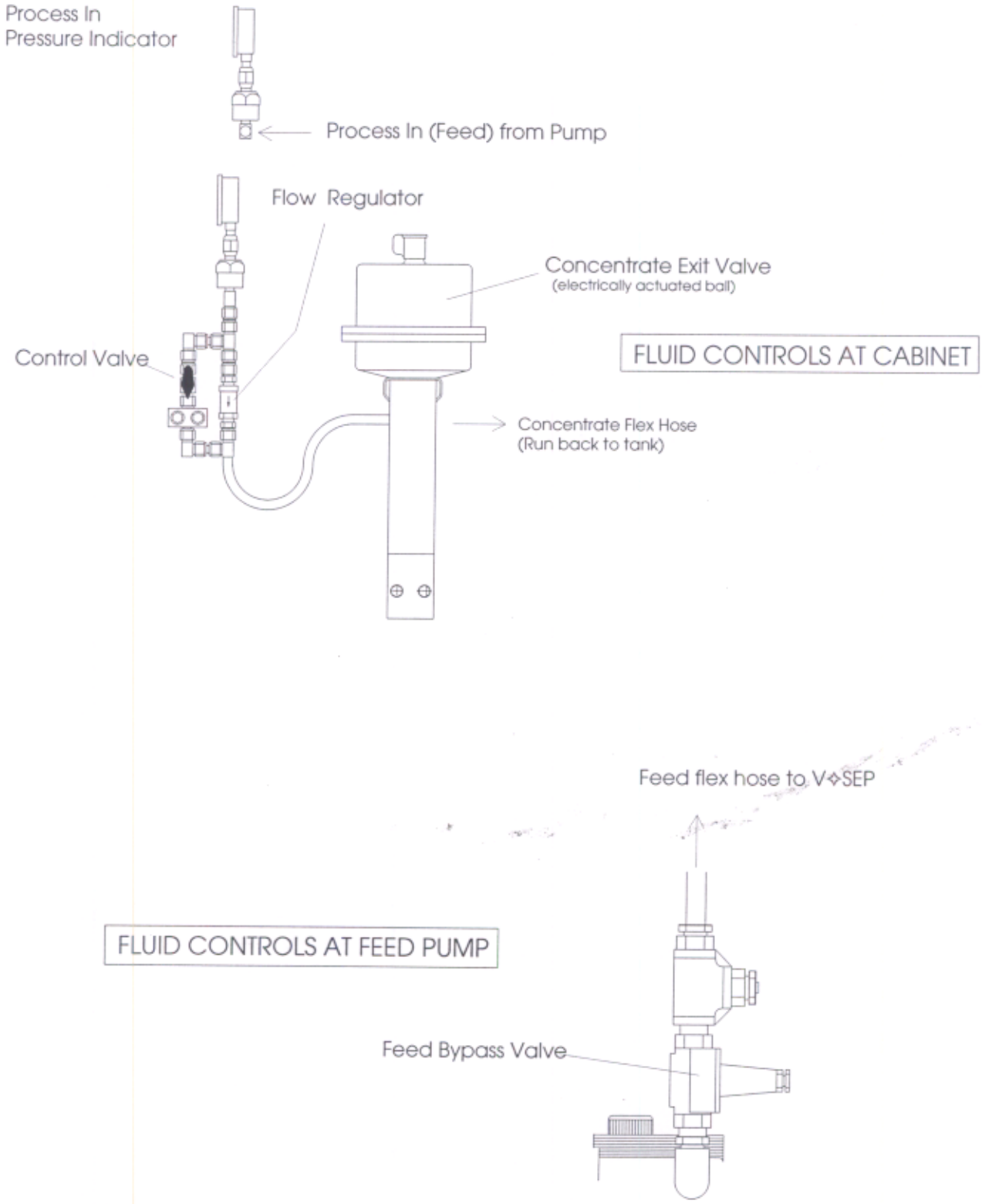


FIGURE 4a

" L mode " Fluid Controls

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 4a	7/11/94	6/18/98
L mode Fluid Controls			

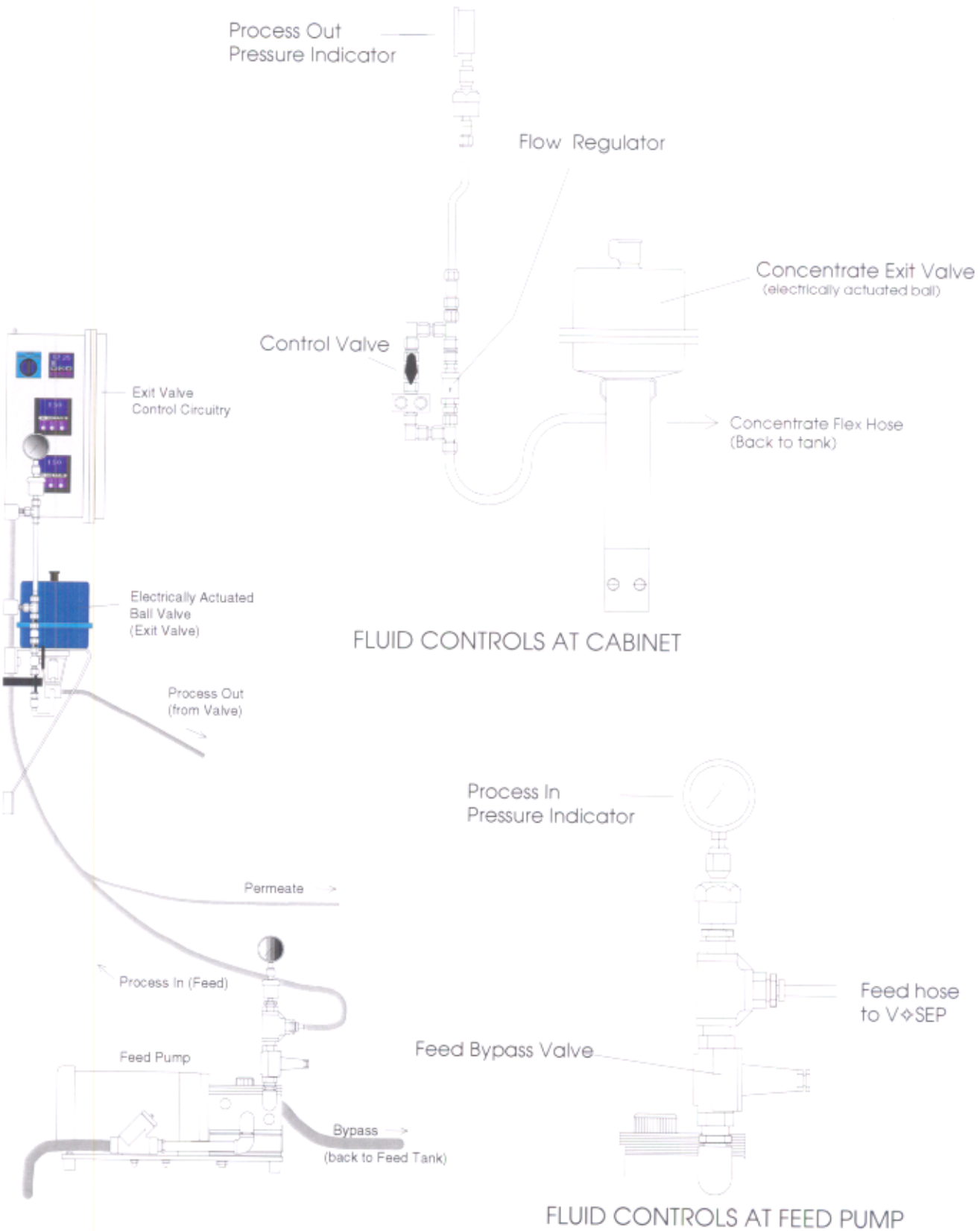


FIGURE 4b

" P mode " Fluid Controls

NEW LOGIC INTERNATIONAL			
1295 67th Street, Emeryville, CA 94608 (510) 655-7305			
Series L/P	L/P V3.0 FIG 4b	7/11/94	6/18/98
"P mode" Fluid Controls			

5. SYSTEM COMPONENTS

C. V✧SEP UNIT

5.5 Operator Control Panels

Figure 5 shows the START-STOP controls and the EXIT VALVE controls.

START-STOP

— The START-STOP buttons start and stop the motors.
The RUN light is on when there are no faults at the motor controls.

EXIT VALVE CONTROLS

— VALVE CONTROL selector switch:

OPEN: Valve is held open. CLOSE: Valve is held closed
AUTO: Valve is cycled by the timers and load controller. (when pump is on).

— % LOAD CONTROLLER

This is an Alarm Limit Controller. When the % Motor Load (as measured by the Inverter) exceeds the programmed AL1 setpoint, the valve is opened.

— CLOSE PERIOD timer.

This count up timer is used to control the closed period when the valve is being cycled. The units of measurement and decimal point location are configurable.

— OPEN PERIOD timer.

This count up timer is used to control the open period when the valve is being cycled. The units of measurement and decimal point location are configurable.

Start Stop Controls

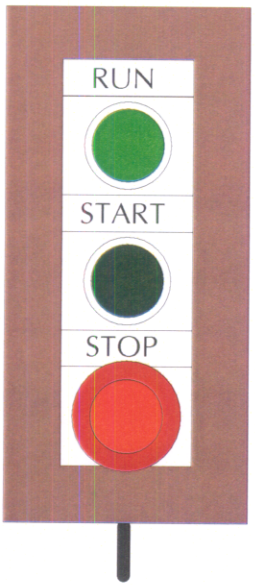
Exit Valve Controls

% LOAD CONTROLLER
Alarm Limit Controller. When AL1 setpoint is exceeded, valve is opened.

VALVE CONTROL SWITCH

OPEN: Valve always open
CLOSE: Valve always closed
AUTO: Valve cycled by Timers and % LOAD Controller,

VALVE CYCLE TIMERS
Individually selectable open and close periods for the Exit Valve. (units of time are selectable: hours, minutes, seconds)



RUN Indicator light:
On when machine is on with no faults detected by the motor controllers.

START Button
Starts motors.

STOP Button
Stops motors.

FIGURE 5

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 5	7/12/94	6/18/98

START-STOP and EXIT VALVE controls.

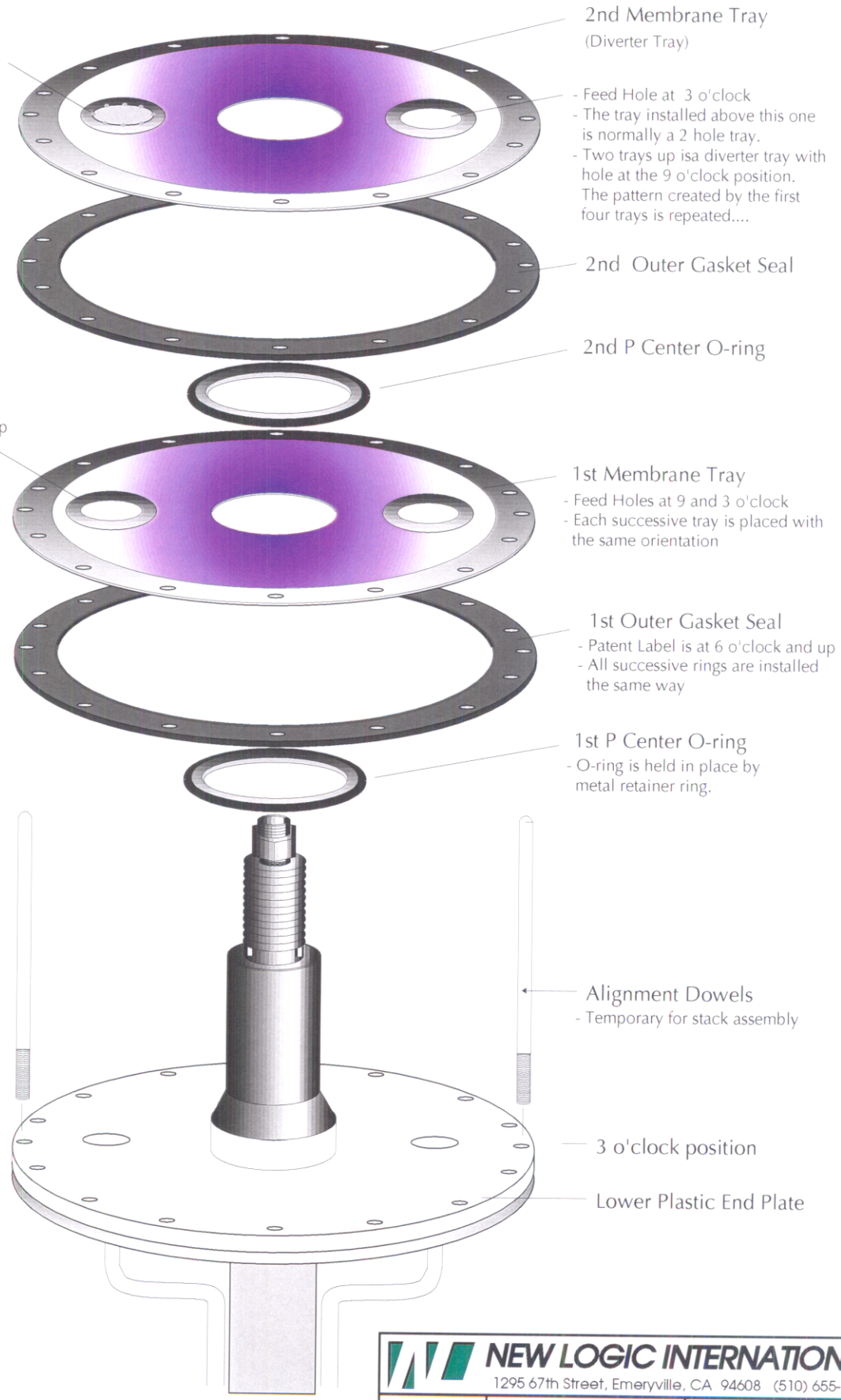


Figure 19

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 19	7/11/94	6/18/98

P MODE: Installation of first two Membrane Trays

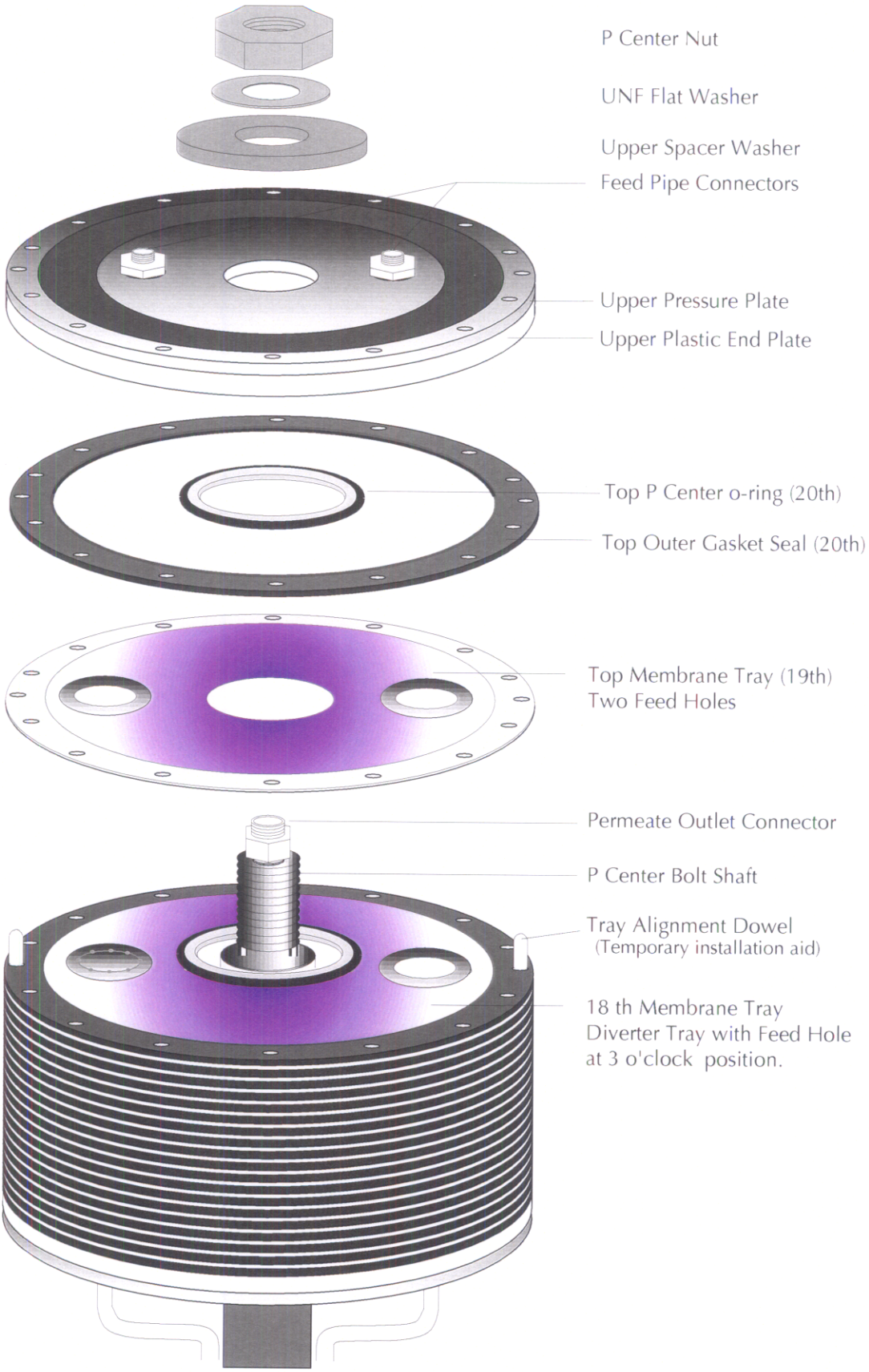


Figure 20

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 20	7/11/94	6/18/98

P MODE: Last Membrane Tray Installation

12. P MODE: OPERATION OVERVIEW

There are two independent control parameters: shear and pressure.

Shear is created by vibrating the Filter Pack. The amount of shear is controlled by controlling the amplitude of vibration. The operator may adjust this parameter by turning the amplitude control knob at the operator panel.

Pressure is created by the Feed Pump. Pressure is controlled through the use of valves and a flow regulator. With "P Mode" configuration there are two adjustable valves, a flow regulator and a time cycled valve.

- The "Feed Bypass" valve is located at the output of the Feed Pump. This valve serves as the main flow/pressure controller for the **V✧SEP** unit.
- The "Control Valve" is located at the Concentrate Output from the **V✧SEP** unit. This valve serves as the "trimming" control for flow/pressure. This valve is used to increase the flow rate (bypassing the flow regulator).
- The Flow Control Fitting is in parallel with the Control Valve. This regulator insures safe flow at the Concentrate Output.
- The "Concentrate Exit Valve" controls the concentrate flow from the Filter Pack.

Although shear and pressure are independently adjustable parameters they must exist together for **V✧SEP** to function. The most important relationship to remember for trouble free operation is that **"Vibration needs pressure"** and **"Pressure needs vibration".** To elaborate, during vibration the membrane needs a minimum pressure to hold it in place; without pressure the membrane will fail. Conversely, **V✧SEP** can only operate as a pressure filter for a very short time without vibration because cake formation on the membrane is so rapid that the device will plug solid.

The general operating procedure is as follows:

1. Start the Feed System with just enough flow/pressure to hold the membranes in place. (30 psi)
2. Start Vibration with just enough amplitude to protect against cake formation on the membrane. (1/4")
3. Increase system flow/pressure to the desired operating point.
4. Increase the vibration amplitude to the desired setpoint.
5. Begin cycling the Concentrate Exit Valve. Slowly increase the closed period to increase the concentrate density.
5. Process the material and log data.

12. P MODE: OPERATION OVERVIEW

If the operator should fail to properly execute the operating procedure the result will be damaged or fouled membranes.

IMPORTANT:

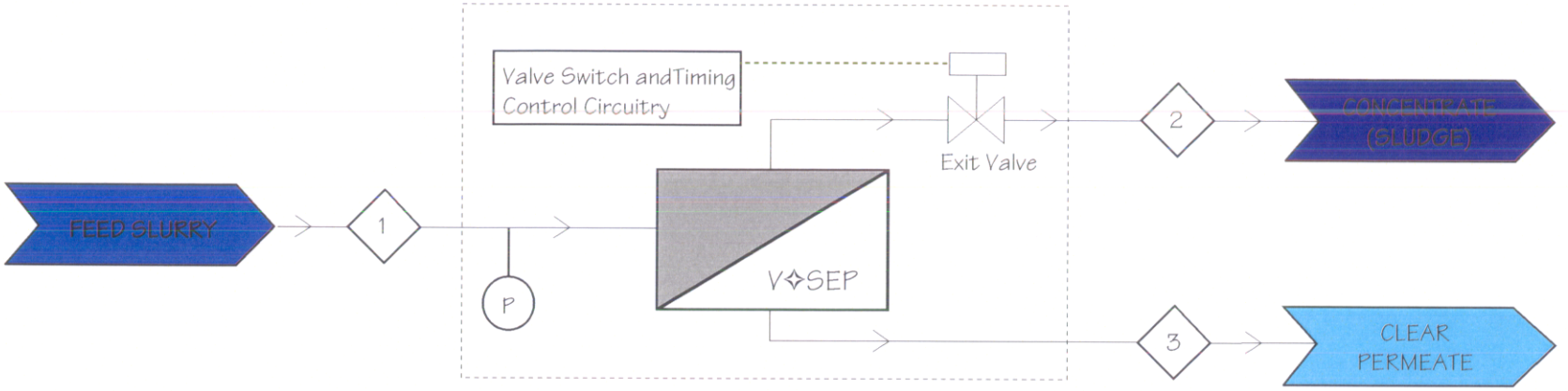
There is one main operating mistake that can seriously damage the system:

If the vibration amplitude is allowed to be too high the Torsion Spring may break.

The vibration amplitude must be kept at or below the maximum allowable operating amplitude. (1 1/4").

To protect the system, the Motor Speed Controller must be configured so that the motor speed setpoint can only be varied over a limited control frequency range. The upper limit is set for a "warmed-up" system. When the system is cold it may be difficult to reach maximum amplitude. As the system warms up the Motor Slip will decrease and amplitude may drift up. Slight drift up may continue for hours.

The most important responsibility of the system operator is to regularly monitor the amplitude until there is no more amplitude increase.



"P Mode" System Operation

At start-up the V✧SEP system is fed with slurry (stream 1) and the Exit Valve is closed. Permeate (stream 3) is instantaneously produced and suspended solids in the feed are collected inside the V✧SEP filter pack. After a programmed time interval valve 1 is opened dumping the solids contained in the filter pack (stream 2) at a pre-set concentration of suspended solids. This cycle repeats indefinitely.

In some cases the parameter used to actuate valve 1 is motor load. As the solids level increases so does the motor work. The Control Circuitry, when properly set, completely automates the separation process.

.

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

Series L/P	L/P V3.0 FIG 21	7/11/94	6/18/98

"P MODE" P. I. D.

13. P MODE: OPERATION PROCEDURE

This section applies only for systems that have been configured for "P mode" operation with the P Mode Filter Pack installed.

Provided that all installation procedures are completed, the **V✧SEP** unit is ready to be placed in operation.

Remember:
Do not operate Vibration without minimum pressure (30 psi)
Do not operate with pressure for more than about 20 seconds without minimum vibration. (1/4 inch)

IF POSSIBLE: OPERATE THE SYSTEM THE FIRST TIME USING CLEAN WATER AS FEED.

A. PREPARATION

1. Check the tightness of the perimeter bolts on the Filter Pack. Torque to 45 ft-lbs. It is possible for the bolts loosen due to thermal cycling of the Filter Pack.

2. Fill the Feed Tank and open any valves upstream of the Feed Pump suction. (Use water to initially test the system)

3. Confirm that all fluid connections are secure.

4. Confirm that the "Concentrate Exit Valve" and the black knobed plug valve are open.
   - open the actuated valve by using the Valve Control switch @ the operator panel.

   Failure to open the Concentrate Exit Valves may cause the system to rapidly become plugged.

5. Close and secure the **V✧SEP** cabinet door.

6. Refer to **Figure 15** before starting vibration. Verify that there are amplitude indicator marks on the front of the P Mode Filter Pack. These marks allow the operator to accurately set the vibration amplitude. As the amplitude increases, various parts of the step pattern will show areas of overlap, blur and clear non-overlap. By matching the observed pattern to those in **Figure 15**, the operator should be able to accurately adjust the amplitude to within 1/8 inch.

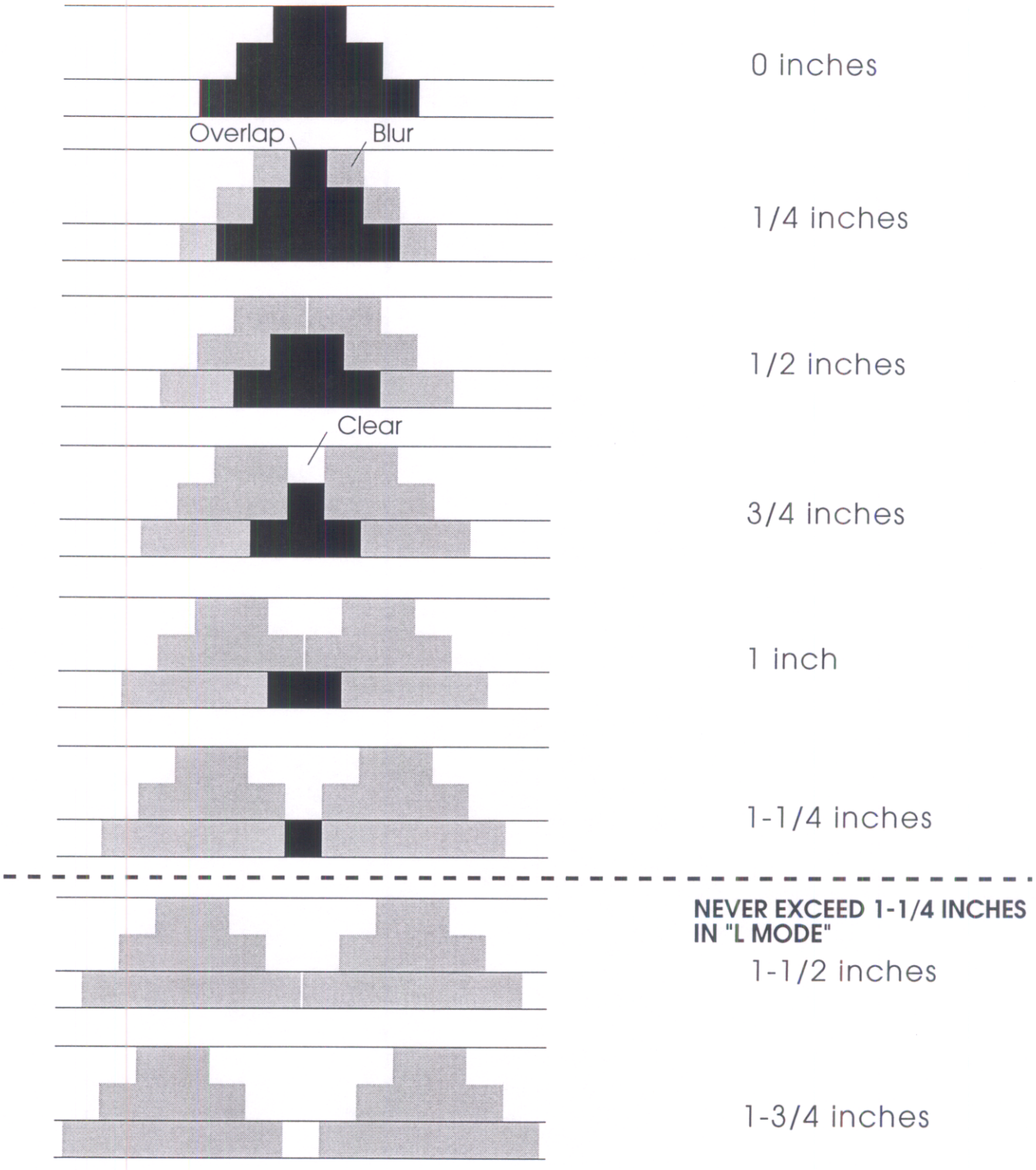


Figure 15 **Setting Amplitude**

NEW LOGIC INTERNATIONAL
1295 67th Street, Emeryville, CA 94608 (510) 655-7305

SERIES L/P	L/P V3.0 FIG 15	7/11/94	6/18/98

Setting Amplitude -- Reading the Scale on the Filter Pack

13. P MODE: OPERATION PROCEDURE

B. MANUAL START UP PROCEDURE (for Standard "P MODE" operation)

1. Open the Control Valve (turn black handle pointing down). **Make sure the Concentrate Exit Valve is open** (Panel switch in **OPEN** position).

2. Adjust the Feed Bypass Valve (at the Feed Pump outlet) to the Full Bypass position. Ideally only about 20% of full flow should be allowed to the **V✧SEP** unit.

   *Loosening the Bolt out from the Valve decreases (bypasses) flow to **V✧SEP**.
   *Tightening the Bolt into the Valve increases flow to **V✧SEP**.

3. Check that the Vibration Controller frequency output is set near minimum setpoint value. The setpoint should be about 48 Hz. If necessary decrease the setpoint by repeatedly pressing the Down Key until the displayed frequency is 48 Hz. Pressing ENTER will lock this setpoint in.

4. Push the START button.

   - The RUN pilot lamp should energize and the Feed Pump should start.
   - The Vibration Motor should start but the Filter Pack should be motionless.

   Adjust the Control Valve so that the Outlet Pressure at the **V✧SEP** is at least 30 PSI. If this cannot be done quickly, stop the system and adjust the Bypass Valve.

   There must be at least 50 ml/min flow through the system when the Flow Control Valve is closed. If not, stop the system. The Flow Regulator may be plugged.

5. If the outlet pressure is safe (at least 30 psi) and the flow is adequate (at least 25ml/min) start vibration of the Filter Pack. By successively pressing the UP KEY on the Vibration Drive Controller, Increase the vibration amplitude to 1/2 inch. Proceed cautiously. The amplitude may increase very rapidly when the frequency is near the resonant frequency of the system.

6. Adjust the Bypass Valve to increase the outlet pressure to approximately 120 PSI . Use the Control Valve to trim the outlet pressure to 150 PSI (or higher if desired) .

7. After setting pressure always confirm that the return feed flow (from the Concentrate Exit Valve back to the feed tank) is adequate. **A flow rate of no less than 1 liter/min is required.** Use the Pump Bypass Valve to adjust the flow rate. **Adjust the Control Valve so that the Concentrate Out flow is 10 to 20 times the Permeate Out flow.**

13. P MODE: OPERATION PROCEDURE

B. MANUAL START UP PROCEDURE (for Standard "P MODE" operation)

8. Use the UP / DOWN keys at the Vibration Controller to adjust the vibration amplitude to the desired level. Do this very slowly. Never run at a setpoint above 1-1/4 inches (peak to peak).

IMPORTANT NOTE: ——AMPLITUDE DRIFT——
When the V✧SEP is started cold, the amplitude may drift upwards in the first 2-24 hours of running. (most of the drift will be in the first few hours).
Check the amplitude 2,6,12 and 24 hours after start up. This is especially important when operating near the maximum amplitude.

The decreasing load on the motor due to bearing warm up can be seen on the % load Display.

9. Set the Concentrate Exit Valve cycling rate.

TIME CYCLING:

When the Valve Control Switch (OPEN-CLOSE-AUTO) is set to the AUTO position, the Exit Valve is time cycled. Timing adjustments are made using the OPEN PERIOD and CLOSED PERIOD potentiometers.

Determining the proper timer settings requires careful experimentation. **The operator must be careful not to allow the valve to be closed so long as to plug the Filter Pack. Adjust the time settings slowly.**

A good starting point :

—Set the OPEN period equal to the time required for 3 liters concentrated slurry to exit the system. The volume of the Filter Pack is approximately 3 liters.

—**Very slowly** increase the CLOSE period. Be careful not to go to far.

% MOTOR LOAD

For some applications it may be possible to control the cycling of the Exit Valve based on the loading of the Vibration Drive Motor.

As the feed slurry is concentrated in the Filter Pack the weight of the Pack and the loading on the Drive Motor will increase. The % LOAD controller will trigger the valve to open when the motor load exceeds the setpoint (AL1) in the controller. By starting with a very low AL1 setpoint and slowly increasing it, the density of the concentrate may be increased.

13. P MODE: OPERATION PROCEDURE

C. Stopping and Auto Restarting

1. The system may be stopped at any time by pressing the STOP button.
2. To restart under the same conditions , press START.

Flush the system with clean water if it is to be shut down for an extended period.

D. Error or Overload Recovery

The machinery will shut down if there is a fault detected by the Vibration Controller or if the Feed Pump Motor should become overloaded.

1. If the Vibration Controller detects a fault it will shut down the system and display a message at the LCD. Refer to the Controller Manual for message explanations. After correcting the problem, press STOP at the keypad to clear the message.
2. If the pump motor should become overloaded it will be shut off by the motor starter located in the box on the inside of the cabinet door. Press the RESET button on this box to reset the Motor Starter.

E. Data Collection

1. Important parameters that will affect results and should be monitored are: Inlet and Outlet Pressures, Vibration Amplitude, Feed Temperature, Permeate Rate, Feed Flow Rate, Return Flow Rate and Feed Properties (such as Concentration, Viscosity, Conductivity and Density).
2. Permeate Rates are easily measured either volumetrically or gravimetrically from the permeate outlet tube. The Membrane Flux Rate is calculated by converting the volumetric rate to gallons/day and dividing by the membrane area of 16.7 sq. ft. to give GFD (gallons/sq.ft-day). Average flux rates are calculated by collecting a large volume of permeate over an entire concentration range.

   Important derived equation:

   GFD = (L/min of Permeate Flow)(22.78)

3. Concentration measurements can be made directly at the feed tank since the system is in an open loop configuration. Feed flow rates can also be measured by taking a volumetric rate at the feed return line at the feed tank.

F. Clean-up

1. FLUSHING THE SYSTEM: When flushing with water the amplitude is generally set very low.
2. Components inside the **V✧SEP** cabinet may be rinsed with water.

V✧SEP Series L/P "P Mode" Test Data

Client: ______________________ Date ____________

Material ______________________________

Time	Pressure IN (PSI)	Pressure OUT (PSI)	Permeate rate (Gal/min.)	Solids Level Starting-Ending	Temp (C)	Vibration amplitude (inches)	Motor Load (%)	Exit Valve Open Period ( )	Exit Valve Close Period ( )

Vibrational Shear Enhanced Processing (VSEP)

Operating Manual

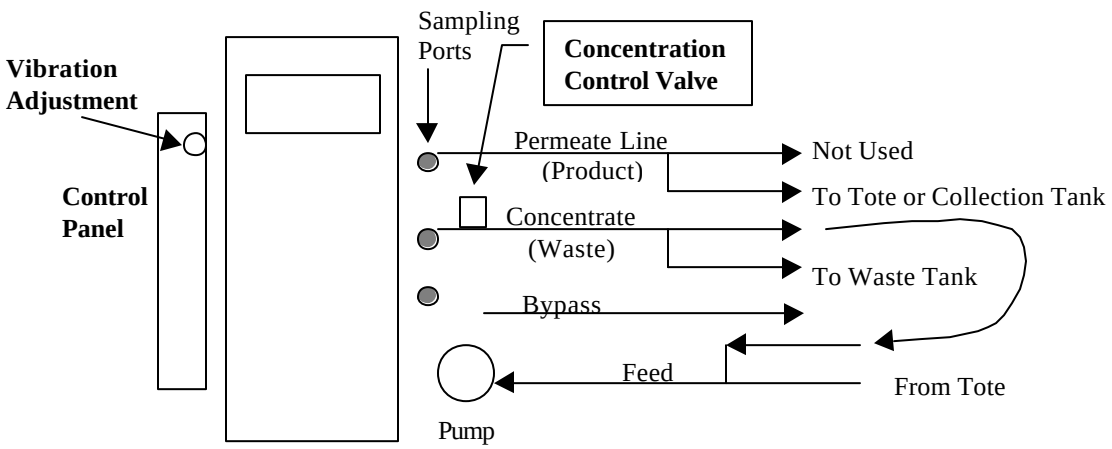


Figure 1: Simple Sketch

Introduction:
The Vibrational Shear Enhanced Processing (VSEP) system is a membrane based separations process whereby the fluid being processed can be recycled for reuse while concentrating and collecting undesirable wastes.

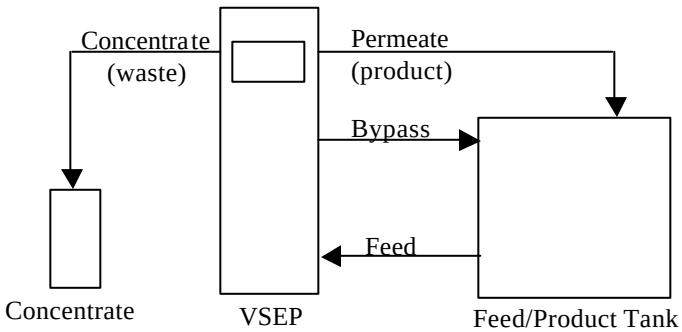
The VSEP system is fully automated and should require only periodic adjustments to ensure safe and continuous operation. All electric valves are controlled by the Panel View-550 Control Panel. All manual valves are in marked as normally open (green tape on handle) or normally closed (red tape on handle). There is no need to change manual valve positions to change operations.

The system is designed to automatically set all valve positions and direct flows for all of the necessary procedures. The computer adjusts all settings for filtering, solvent addition, and for flushing. All that is required of the operator is that the hoses are directed to the correct tank and that the correct set points are entered into the Configuration screens.

For normal filtration, the feed tank serves to supply process fluid to the VSEP and for collection of the product stream. When operated in this fashion the process fluid is passed through the VSEP system several times in such a manner as to render the product stream cleaner with each pass. For optimal performance the total volume of the feed tank should be processed 3 to 5-times. For example: If the feed tank has a volume of 250-gallons, then each 250-gallons processed is one volume turnover (VTO). For optimal

performance the VSEP should process 750-gallons (3-VTO's) to 1,250-gallons (5-VTO's).

By directing the product stream to a separate collection vessel the cleaning operation can be performed much faster; however, the product stream will not be as clean as what would be accomplished by performing several volume turnovers.



Preferred Setup

Modes of Operation:

Filter mode:
This is the standard mode of operation for the VSEP system.

The VSEP system directs flow from the Feed Tank through the membrane pack. The filter pack is a stack of membranes that have been configured in such a manner as to allow for the passage of a desirable product through the membranes while prohibiting passage of undesirables and particulates. The filter pack separates the feed stream into two streams: the product (permeate) stream and the undesirable waste (concentrate) stream. The product stream is a clean solution that is directed back to the feed tank or to a separate collection vessel for eventual placement in the parent process. The concentrate is collected in a separate collection vessel for eventual disposal.

For the first 10-minutes of operation any flow out of the concentrate line is directed back to the feed line. This is accomplished by directing flow through the upper concentrate line for the first 10-minutes and through the lower concentrate line thereafter. This is to allow the system to stabilize before normal operations begin.

Solvent Addition Mode:
Sometimes it is desirable to add clean solution or an additive to the feed solution after processing. The solvent addition mode and solvent addition tank are designed to simplify that process.

The white 15-gallon tank (solvent addition tank) on the VSEP platform can be used to add fresh solution to the feed tank, or for directing flush water to either the waste tank or to the feed tank for eventual processing. This tank can also be drained manually by opening the valve at the base of the tank and the drain line valve(s) at the back of the system.

Solvent addition fluid is routed automatically by the control panel to the bypass line and to the tank that the bypass line is connected to.

Flush Mode:

Flushing cleans the filter pack of unwanted residues and helps refresh the membrane material. Regular flushing will improve separations performance and dramatically increase membrane life.

Periodically the filter pack must be flushed with clean, process-compatible fluid. Either water or dilute (10%) sodium hydroxide can be used to flush the system while processing fluid from the chrome stripping process.

Flushing should be performed as the first step in the filtration process for every Feed Tank. By performing flushing operations at the start of a new Tote, all of the flushing fluid will be directed automatically to the feed vessel for processing.

The system must be flushed prior to allowing the system to remain unused for longer than a week. If the system is not flushed prior to long term idle periods, the membranes will become fouled. Once fouled, the membrane pack can only be cleaned by flushing several times with a 10% to 30% sodium hydroxide solution.

Flushing is accomplished by passing at least 10-gallons to 15-gallons of clean fluid through the filter pack.

Flushing is typically performed by running three 5-gallon loads through the VSEP system and routing each flush solution either back to the feed tank or to the waste container for ultimate disposal. That determination can be made by observing the quality of the fluid in the solvent addition tank at the end of the flush cycle.

Standard Operating Procedures

The VSEP system is fully automated. The Panel View-550 in the Control Panel controls all of the electric valves. The mode of operation is selectable by F1 at the **Main Screen.** Several options are available by simply touching the screen. For example, instead of selecting F1 to enter the **Operations Mode** screen, simply touch the screen at the **Operations Mode/Set Points** box.

Every screen has operator instructions. When in doubt, read the screen.

All of the manual valves that are normally closed are marked with **Red** tape on the handles.

All of the manual valves that are normally open during operation are marked with **Green** tape on the handles.

There is no need to change the position of any of the manual valves for normal operation of the system.

Note: The STOP Button must be depressed before a change in operation can be selected.

For Filtration Mode:

Ensure all hoses are directed to their proper destinations. The Feed and bypass lines are connected to the feed tank; the permeate line is connected to the product tank (typically the feed tank); the upper concentrate line is connected to the upper feed line; and the lower concentrate line is connected to the waste collection vessel.

Ensure all manual valves are in their proper position. Valves with green tape are normally open; valves with red tape are normally closed.

Enter the **Operations Mode/Set Points Screen** by selecting F1 from the **Main Screen** or by touching the **Operations Mode/Set Points** box on the **Main Screen.**

Select Filtration Mode.
Note: the Stop Button must be depressed to select a mode of operation.

Ensure all set points are at desired values:
Feed Pressure = 400-psi;
Permeate Flow (Open/Close) = 45%;
ML: Valve Min Open Time = 60-seconds;
F1 to enter the Next screen;
Filter Stabilization Time = 600-seconds

Exit to the **Main Screen** by pressing F5.

Enter the Status/Run Window from the Main Panel by pressing F5 or touching the **Status/Run** box on the **Main Screen.**

Pull the stop button to the ON position.

Press F7

Press the Green Start Button.

Pressing the Red Stop Button will shut the system down. To restart, simply pull the red stop button to the on position; press F7; and press the green start button.

For Flush Mode:

Add 3-gallons to 5-gallons of flush fluid to the **Solvent Addition Tank.** This will either be water or dilute (10%) sodium hydroxide. Higher concentrations of sodium hydroxide can be used for flushing if the sodium hydroxide cycle is followed by at least one water cycle.

Ensure all manual valves are in their proper position. Valves with green tape are normally open; valves with red tape are normally closed.

Press F3 at the **Main Screen** to set the Flush Cycle time in seconds. The default is 600-seconds.

Exit the **Flush Screen** by pressing F5.

Enter the **Operating Mode/Set Points Screen** by either pressing F1 or touching the box on the **Main Screen Window.**

Note: the Stop Button must be depressed to select a mode of operation.

Select Flush Mode.

Exit the **Operating Mode/Set Points Screen** by pressing F5.

Enter the **Status/Run Screen** by pressing F5 or by touching the **Status/Run Box** on the **Main Screen.**

Pull the Stop button to the ON position.

Press F7

Press the Green Start button. The flushing operation will stop automatically at the end of the set point value.

Flushing can be stopped at any time by pressing the Red Stop Button.

Then Solvent Addition Tank can now be drained manually, or the system put into **Solvent Addition Mode** to direct the flush fluid to a desired container.

Solvent Addition Mode:
Add desired solvent to the Solvent Addition Tank.

Ensure that the bypass line is connected to the appropriate collection vessel.

Ensure all manual valves are in their proper position. Valves with green tape are normally open; valves with red tape are normally closed.

Enter the **Operating Mode/Set Points** screen by touching the **Operating Mode/Set Points Box** on the **Main Screen** or by pressing F1.

Select Solvent Addition Mode.
Note: the Stop Button must be depressed to select a mode of operation.

Exit the **Operating Mode/Set Points** screen by pressing F5.

Enter the **Status/Run** Screen by pressing F5 or the touching the screen at the **Status/Run Box**.

Pull the Red Stop Button to the On Position.

Press F7

Press the Green Start Button.

Visually observe the level in the solvent addition tank. When the tank is empty, press the Red Stop Button at the Main Control Panel.
Note: Do not allow the tank to empty to the point where the fluid level is lower than the connecting tubing below the Solvent Addition Tank. Doing so will introduce air into the feed line and upset the system.

Membrane Pack Replacement

Membrane Packs can be ordered through New Logic International in Emeryville California. Request pre-assembled packs as specified by Battelle.

Phone Numbers:
New Logic International: (888) 289-8737
Larry Stowell (Sales Representative for this system) (770) 421-9205

The membrane for sodium chromate separations is an **N-30F**. Different separation processes required different membranes.

To confirm membrane selection: Max Phelps (509) 375-6678

The membrane pack will arrive fully assembled and ready for installation.

Flush System with water at least 3-times at 5-gallons each flush.

Install the Shipping Bar (reference VSEP Operators manual in the AMF Library).

Loosen, but do not remove the three hose connections at the top of the Filter Pack.

Open the permeate and concentrate sample ports to drain the filter pack of excess fluid.

Remove the three hose connections at the top of the filter pack.

Remove the large nut at the top of the filter pack with a 2-1/4" striker wrench.

Remove the center stud by first unscrewing it and then pulling it out of the membrane pack. The center stud should be relatively easy to remove; however, there is the drag from an O-ring located in the filter pack that needs to be overcome. The operation can be simplified by threading the large nut and washer onto the center stud and then prying the center stud out with a pry bar using the top of the membrane pack for leverage.

Note that there are 16 bolts in the membrane pack and that 8 of those bolts are part of the pre-assembled pack assembly. When viewed from the top the bolts at the 3:00, 6:00, 9:00 and 12:00 positions are permanent and part of the pre-assembled pack. Permanent bolts are alternated with installation bolts. This configuration is self-evident when viewing the new filter pack assembly.

Remove the 8-installation bolts.

The filter pack must be raised straight up by approximately 1-inch to clear the centering collar.

The filter pack can be lifted and removed from the system. This should be relatively easy; however, because of differences in machining, some filter packs are more difficult to remove than others.

For a difficult to remove pack; wedge a pry bar under the two bottom stainless steel plates on the complete assembly and pry the pack up. Sometimes it is necessary to use two pry bars, and in severe cases the bolts at the 3:00 and 9:00 positions may have to be loosened and a shim placed between the bottom of the bolt and the bottom stainless steel plate. The bolts are then re-tightened, which forces the filter pack up and off of the centering collar.

Clean the surface of the stainless steel plate thoroughly. Dry the hole that the center stud screws into.

Note that there are two small O-rings at the 3:00 and 9:00 positions on the stainless steel plate. If needed, replace these O-rings.

Apply a film of lubricant to the two O-rings on the stainless steel plate and to the O-ring located inside the filter pack. This lubricant can be anything from dishwashing liquid to high purity vacuum grease. The purpose is to lubricate the O-rings while preventing them from accidentally dislodging from their position while installing the new pack.

Lift the new pack onto the stainless steel plate and set in place by aligning the two hose connection ports to the 3:00 and 9:00 positions. It does not matter which hose connection is in which position.

Install the Center Stud and Tighten.
Install the 8-installation bolts and tighten.

Install the large nut and washer to the Center Stud and tighten.

Torque all 16-bolts to 40-ft/lbs.

Retighten Large Nut on top of filter pack.

Install hoses.

If not already present: remove the vibration amplitude indicator from the old filter pack. Strapping tape holds this on. Take care to not destroy the indicator. Install on the new filter pack.

Remove the shipping bar.

Close the door and start the system; check for leaks.

After operating for two-hours, re-torque the bolts. After two-days of operation re-tighten the large nut at the top of the filter pack and re-torque the bolts.

Vibrational Shear Enhanced Processing
(VSEP)

Operating Manual

(Supplemental)

This portion of the operator's manual is for reference purposes. The reader will be able to reference set points and identify various parts of the system as required for operating, troubleshooting, and performing normal maintenance.

A more complete set of manuals is available through the AMF Library.

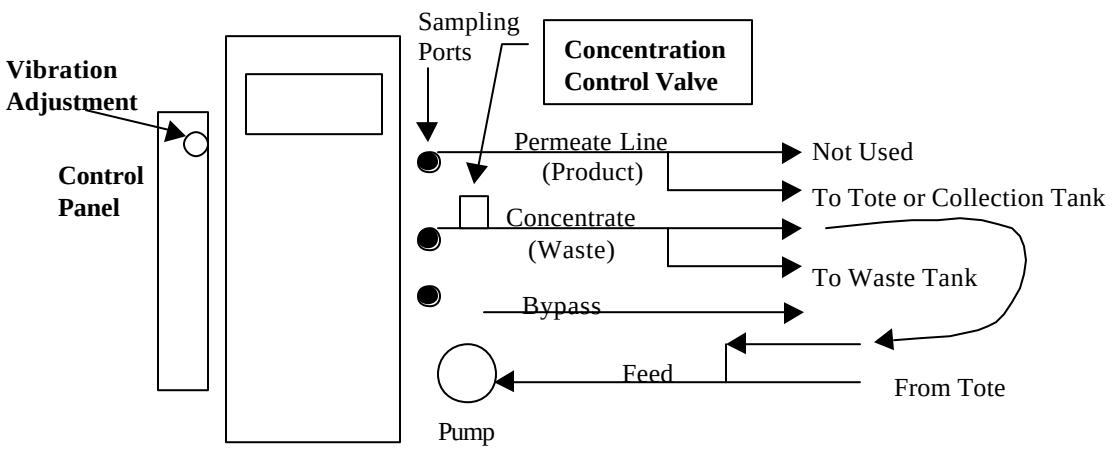
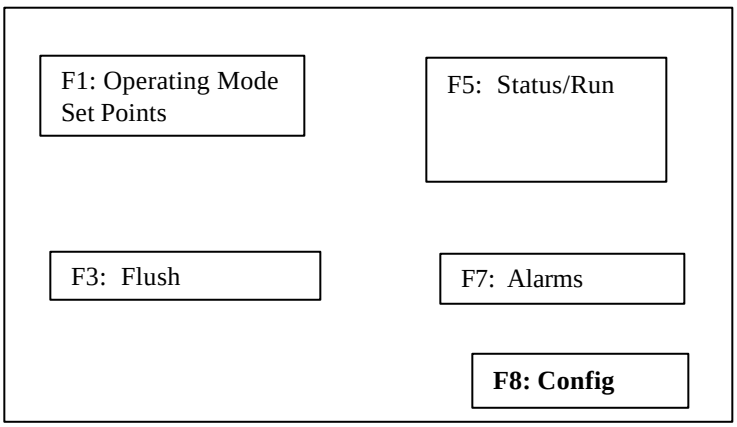


Figure 1: Simple Sketch

Do not remove power to the system for longer than 15-minutes without turning the UPS to the OFF position (back of system in UPS Cabinet).

Do not restore power to the system without turning the UPS to the ON position.



Main Screen
(Touch Screen)

All controls and set points can be accessed through the main screen.

Executing an **F5** from any screen in the system will eventually take you directly to the **Main Screen**.

This section of the manual will walk you through the various settings and lists the default set points.

Note: The Stop Button must be in the off (pressed in) position to make changes to set points and operating modes.

F8 Accesses the Configuration Menu.

Analog Input Scaling

PT1-1 (F)	Min 0	Max 1000
PT2-1 (C)	Min 0	Max 1000
PT3-1 (P)	Min 0	Max 1000
FT5-1 (P)	Min 0	Max 100
TT8 (CIP)	Min 0	Max 150

F1: Next Screen

ML4-1	Min 0	Max 0
pH	Min 0	Max 14

F3: Back

Feed Pump Control Limits

F1: Min Output	0%
F2: Max Output	50%

Constant Pump Speeds

F6: Offline Recirculation	35%
F7: Flush	25%
F8: Solvent Addition	30%

F3: Back

Filter Mode Conc. Valve Control Method

% Perm Flow – Open/Close * (Other modes do not apply)

F3: Back

Concentrate Valve Constants/Limits

F6: Minimum Opening (Pump On)	0%
F7: Minimum Opening (Vibr On)	10%
F8: Maximum Opening	36%
F9: Valve Position During Flush	32%

F3: Back

Start Control (F = Feed; C = Concentrate; TM = Trans Membrane)

F1: Min Pressure (F&C) for Vibration	3
F2: Min Pressure (TM) for Vibration	3
F4: Auto Start Vibration	YES
F7: Vibration Preset Speed Timer	3 seconds

F3: Back

PID Feed Pressure

Note: Screen Says F3 to go back; Actual Value is F5

F9: Local Mode =	Auto
F2: Gain	0.50
F3: Reset	0.07
F4: Rate	0.0
F10: Manual SP	0.0
F6: SMAX	1000
F7: SMIN	0
F8: DB	0

F5 Back

PID Motor Load **N/A for this process**

PID Concentrate Flow **N/A for this process**

Miscellaneous **N/A for this process**

Output Test **N/A (except for an instrument technician).**

F5: Back to Main Screen

F7: Alarms

F1: Alarm Set Points

F2: High Feed Pressure	650
F4: Low Feed Pressure	0
F6: High Concentrate Pressure	650
F8: High Diff (F – C) Pressure	500
F9: Low Trans Membrane (C – P) Pressure	0

F1: Next

F2: High Motor Load	0.88%	
F4: Low Permeate Flow	0.0	
F6: High Temperature	200	
F7: Low Concentrate Flow	0	(N/A)
F8: Low pH	0	(Disabled)
F9: High pH	14	(Disabled)

F5: Main

F1: Op Mode & Filtration Set Points

Note: Stop Button must be depressed to change modes of operation:

F2: Feed Pressure	400 psi
F3: % Permeate Flow	55%
F4: ML: Valve min open time	60 seconds

F1: Next

F2: % Motor Load	N/A
F10: Filter Stabilization Time	600 seconds
Concentrate Valve Time Cycling	N/A

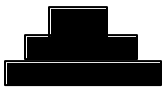
F5: Main

F3: Flush

F7: Timed Flush Length	600 seconds

F5: Main

There are no other settings available from the **Control Panel**
Vibrational Adjustment (Amplitude): ¾”
There is a diagram to the right of the viewing window for the filter pack. Slowly adjust vibration adjustment knob (Figure 1: Simple Sketch) to ¾” setting.



If there is no diagram on the filter pack; set the vibration adjustment to 6.

Do Not Under Any Circumstances Allow the Filter Pack to Vibrate at an Amplitude Higher than 1-1/4”

Troubleshooting

Machine Stops: Alarm Light is on:

Push Stop Button
Enter Alarm Screen
Read Alarm Condition
Check Condition
Reset Alarm (Touch Screen)
F5 to go to Main Screen
Touch Screen to go to Status Run (or use F5)
Pull Stop Button to the on position
F7 to put system in run mode
Push Green Start Button

VSEP Vibrates, but the pump has stopped:
This is usually due to a surge of air entering the pump housing; causing the pump to partially lose prime and not be able to maintain the pump pressure set point. Because the pump operates by constant pressure/variable speed, any cavitation in the pump will cause the pump drive to fault out, thus shutting off the pump.

First: Try pushing the stop button to the off position, then pulling it back out and restarting the system (F7 and Run). If this doesn't work, the system must be powered down and allowed to reset.

Power down the system by turning the 440/220-Volt Breaker on the back of the system (breaker closest to the control panel) to the off position and then back on. Restart the system.

Pump is Noisy:
The pump makes a relatively high pitched tinny sound when air enters the pump head. This is indicative of cavitation in the pump head. Turn off the system; allow setting for approximately one minute; restart system.

Membrane Pack and/or Inside of Membrane Cabinet Shows Signs of Leaking:
Periodically the bolts on the membrane pack need to be re-torqued to 40-foot pounds.

Re-torque all bolts.
Tighten large nut on the top of the membrane pack.
Restart system.

A substantial increase in permeate flow is noted <u>and</u> there is no difference between feed and permeate samples, and/or permeate and concentrate samples.
There are several causes for this behavior.

1. The membrane pack has failed. Replace the membrane pack.
2. An O-ring in the membrane pack has failed. Replace the membrane pack.

3. The bolts on the membrane pack have loosened. Re-torque all bolts to 40-ft/lbs.

4. The Center Stud is loose. Remove Center Stud and check O-Ring integrity. Reinstall O-ring and Center Stud and re-tighten. Use Vaseline or similar lubricant to lubricate O-Ring and Center Stud before reinstalling. The Vaseline serves to both lubricate the O-ring and keep the O-ring in place for installation.

5. The O-ring under the center stud has failed. Remove Center Stud. Replace O-ring. Reinstall Center Stud and tighten. Use Vaseline or similar lubricant to lubricate O-Ring and Center Stud before reinstalling. The Vaseline serves to both lubricate the O-ring and keep the O-ring in place for installation.