Durham Geo-Enterprises,Inc.

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Durham-Geo Enterprises Inc.

S-500
TRIAXIAL/PERMEABILITY
PANEL

Owners Manual. Triaxial Panel

Durham Geo-Enterprises,Inc.

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FIRST RECORD THIS INFORMATION

Locate your machine's Model and Serial Number. Should you ever need to call for service, you will need these numbers. You'll find them on a plate on the front or bottom of your equipment.

Model # _____

Serial # _____

•Give both of these numbers if you ever need to call for service.

You will also find it convenient to have the following information.

Sold by: _____

Date Purchased: _____

THE OPERATOR SHOULD READ THIS ENTIRE MANUAL CAREFULLY BEFORE ATTEMPTING TO OPERATE THIS EQUIPMENT.

DANGER	Indicates serious injury or death MAY result if instructions are not followed.
WARNING	Indicates a strong possibility that serious personal injury or death may result if instructions are not followed.
CAUTION	Indicates a possibility that minor injury could result if instructions are not followed.
NOTICE	Indicates that equipment or property damage could result if instructions are not followed.
NOTE	Gives helpful information.

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TABLE OF CONTENTS

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INSTRUCTIONS FOR THE CONTROL PANEL WITH OPTIONAL WATER TANK

The Durham-Geo Pressure Control Panel can be easily set up in 15-20 minutes. The tools include open-wrenches (7/16", 1/2" and 9/16"), a cuter for plastic tubing (a knife will do if a cutter is not available), and whatever is required to tap into a nearby water line so that a water source can be supplied over to the panel.

Read the instructions carefully and follow the steps outlined below.

UNPACKING

Upon delivery of the panel, inspect the shipping box and make note of any signs of rough handling during shipment. Disassemble the box and inspect the panel. If any damage is found, report it immediately to the shipper.

After unpacking the panel, place it on a sturdy bench. The panel is slightly top heavy, so use care when moving it. Check for any parts on the panel that may have loosened during shipment and re-tighten them if necessary.

In selecting a location for the panel, choose a workbench that has plenty of space on either side of the panel for assembling and disassembling the cells. There must also be a pressure source, a vacuum source, drainage provision, and a water source to connect to the panel as well as an appropriate electrical outlet for operating the panel meter. Be sure the electrical outlet corresponds to the voltage requirements of the panel readout meter.

CONNECTING THE OPTIONAL DE-AIRED WATER TANK

Locate a space beneath the workbench and below the panel for the de-aired water tank. Uncoil the plastic tube that came with the tank. Remove the plastic bag that is taped to the tubing that contains the nut and the two part ferrule. Unscrew the two 1/4" caps (plugs) on the panel located directly behind the de-airing water tank controls (See Fig. 3a). Attach 1/4" tubing with the ferrules and nuts provided to the top valve (D) and pass the tubing down behind the panel between the workbench and the wall so that the tubing can be connected to the top of the water tank. Locate the fittings that is off center on top of the water tank, this is the pressure line and will supply air pressure and vacuum to the tank. The tubing from center fitting on the water tank will be connected to the lower valve (E) located on the back of the panel (De-airing controls area). This is the water supply line and will carry the water from the tank to the panel and vise versa.

To install tubing using the nut and ferrules supplied see FIG. 3b. Insert the ferrules as shown on FIG. 3b and thread nut onto the fitting (do not tighten). Insert the ¼ inch tubing into the nut until it seats into the fitting. Unscrew the nut and make sure the tubing goes through both ferrules. Thread the nut back onto the fitting and use a wrench to hold the fitting in place, while using a 9/16" wrench to tighten the nut on the fitting. The nut should be turned 1-1/8 turns beyond finger tight. . The water tank is now ready for to be filled and de-aired

NOTICE: Over tightening the nut will compress the tubing and could result in tube failure or restriction to flow.

NOTICE: Make sure that the water tank is placed away from electrical outlets and in a location where it will not be damaged or scratched. This tank is subjected to pressure and vacuum, scratches or damage to the stain rods could cause premature failure of the acrylic chamber.

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CONNECTING THE WATER DRAIN, VACUUM, AND PRESSURE LINES

Locate the four fittings on the back of the panel. A label should be associated with each fitting. Starting with the left (facing the back of the panel), the first fitting is the fill , then drain, vacuum, and pressure, respectively (see FIG. 3a). All fitting are 1/4" connections. Before inserting the tube into the fitting, loosen the top nut slightly and then push the tubing in as far as it will go. Make sure the tubing is pressed firmly down into the fitting and has passed through the ferrules. Finger tighten the nut and then turn it 1 1/8 turns past finger tight to ensure a secure connection. If the fitting is disconnected, turn until finger snug, plus ¼ turn with wrench, when reconnecting.

The fill or water line will need to reconnected to a nearby water source. A convenient method is to locate the closest copper water line and use a saddle-type connector which punches into the line and also accepts a 1/4" plastic tube (Saddle valves are used on refrigerator ice makers and are common). Make this connection and run this line over to the fill fitting on the back of the panel and connect it. Use caution when opening the saddle valve which will supply water to the panel, some local water pressures can be as high as 90 psi. To assure that no water is pushed from the panel back into the water supply, a check valve should be placed somewhere between the panel and the connection on the water line.

The drain line can be either run into a sink, into an exposed drain line, or into a floor drain (If unsure where to run the drain contact a local plumber). If no drain is available, the drain line can be placed into a bucket or other suitable receptacle. These will of course have to be emptied periodically. Wherever the drain line is installed, in all cases, be sure that the end of the drain line is securely fastened to prevent the tube end from whipping whenever the panel or cell is drained under pressure.

The vacuum will need to be plumbed to a vacuum source or vacuum pump. Be sure to install a vacuum trap (G-39620) between the vacuum pump and panel, this will prevent most water from entering the pump.

The pressure connection, which entails running a 1/4" tube from the nearest compressed air source to the panel. Some type of filter and water separator should be placed between the panel and the air compressor to remove as much moisture as possible. Never use a lubricator in this line, the oil will coat the burette and pipette and will create problems viewing the meniscus. There are several ways to eliminate moisture problems in the air line. Installing a filter regulator combination a few feet before the panel will usually do the job.

A drop line, which consists of a tee fitting place in a horizontal section of the air line to a straight pipe about 1-2 feet long facing down. Place a pet cock valve or similar device on the bottom of the drop, this will collect any water that has condensed in the line and can be periodically drained.

After checking that all connections have been made properly, connect the power cord to a nearby electrical outlet, and turn on the pressure and vacuum source. The maximum pressure source coming into the panel should not exceed 250psi. The panel is now ready for operation.

HOSES

The extra 1/4" and 1/8" plastic tubing have been supplied to make connections between the panel board and the permeability cell or triaxial cell.

Three hoses will need to be made up for each Cell (one with 1/4" plastic tubing and two with 1/8" plastic tubing). The length of the hoses depend on the distance between the cell and the panel. The 1/4" tubing should be made up with a quick connect at each end. Select the length of tubing desired, cut the tubing, connect one end into one of the quick connects by loosening the nut on the quick connect, pushing the tubing through the nut and onto the metal stud on the quick connect. Tighten the nut one turn past finger tight.

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The 1/8" tubing will have a quick connect at one end. This quick connect will be fitted with a Swagelok™ type fitting. The other end will be attached to valves 10 and 12 on the triaxial or permeability cell. The nuts on the Swagelok™ fittings should be tightened 1-1/8 turns past finger tight. The 1/4" vacuum (Tygon) tubing is connected to the Swagelok™ fitting located at lower left-hand side of the panel board connection H. The other end can be connected to a membrane expander.

1.0 Operating Instructions for the Triaxial/Permeability Control Panel

General procedures for operating the Triaxial/Permeability Control Panel are outlined below. Procedures other than those described that also work will become obvious as familiarity is gained with the controls and should be adopted if they seem more convenient.

The layout and valve positions of the Triaxial/Permeability Control Panel is shown in **Figure 1.** The panel has been divided up into six sections, and all of the major controls have been assigned a letter. The reader should refer to this Figure as the instructions for operating the panel are being discussed.

2.0 Activating the Panel

The panel is activated by regulator **A**, which is located in the panel control section. Regulator **A** is connected directly to the supply pressure, and controls the pressure made available to the other regulators in the panel. Turn regulator **A** in a clockwise direction to increase the pressure to the panel and view this pressure on gauge **B**. Generally, this pressure is set 5 to 10 psi below the minimum supply pressure. If no increase in pressure is indicated on gauge **B** when turning regulator **A**, check that the supply pressure has been properly hooked up to the back of the panel.

Gauge C in the panel control section indicates the vacuum that is available to all of the vacuum positions on the panel. No provisions for regulating this vacuum has been incorporated into the panel. If there is a need to regulated the vacuum, its suggested that a regulator be attached in line between the vacuum pump and the control panel. A vacuum in the range of 15" to 20" of mercury is sufficient for operating the panel.

3.0 Water Tank Operations (optional)

An optional water tank can be provided. For filling the burettes with de-aired water, rotate valve **D** to the **pressure** position and valve **O** to **water**, forcing water to flow out of the tank and into the burettes. When not in use, a vacuum is kept on the tank to de-air the water that it contains. To accomplish this turn valve "**O**" to the **off** position and valve **D** to **vacuum.**

NOTICE: Valve **D** should always be turned to **vent** when changing from pressure to vacuum or vise versa. Damage to the pressure supply regulator could occur if it encounters a vacuum.

If the tank should become empty, it can be refilled by rotating valve E to the fill position. When filling the tank, watch the water level closely so that the tank does not overfill. Since the water used to fill the tank is tap water and contains air, the tank should be left under a vacuum for a period before the water is used to fill the burettes. While the tank is under a vacuum, it is helpful if the tank is shaken to remove some of the air bubbles and to circulate the water in the tank. This will help de-air the water in a shorter period of time. The tank can be emptied by rotating valve D to pressure and valve E to drain.

4.0 Filling and Draining Triaxial or Permeability Cells

Triaxial and permeability cells are filled by first connecting a hose between quick connect G and the cell and then rotating valve F to fill the chamber. The flow of water into the cell can be metered by partially closing valve F. As the water level approaches the top of the cell, valve F

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should be used to meter the water so that it does not squirt out of the top of the cell. When the cell is filled, close valve F. Be sure the vent on the top of the cell is open during the filling process.

The cell is vented by using quick connect with a length of hose attached and drained into a suitable container.

Draining the triaxial cells can be facilitated by connecting a hose between quick connect G and the quick connect on the top of the cell (valve 16). Connect a tube from the bottom (Connector 15) of the cell to quick connect Q, turn valve N to off turn O to drain and Valve P to on. Rotate valve F to "force drain", and it will blow the water out of the cell through quick connection 15 on cell base.

5.0 Vacuum Hose

A vacuum hose has been provided with the panel that can be used to clean up water spills and to facilitate the saturation of drainage lines in Triaxial and permeability cells. Vacuum connection H is operated by opening valve I. The user should make sure that some sort of trap system is located between the vacuum hose and the vacuum pump so that water drawn into the vacuum hose does not get into the pump.

6.0 Pressure Readout

The digital indicator in the readout section can be used to display the pressure at any of the three pressure positions in the panel. The readout is turned on by switch J. The pressure to be displayed can be selected with valve K. When valve K is in the bleed position, the display should be zero. If the display is something other than zero, press the down key. This will re-zero the meter. Periodically the digital readout should be checked against a calibration pressure. If the

display reads something other than the calibrated pressure, recalibrate the readout following the instruction manual included with the readout.

NOTE: For electronic details, see the instruction manual on the E-400 readout.

7.0 Pressure Position Operations

The operating procedures for the three pressure positions are basically the same. The pressure available in each position can be adjusted and set by regulator L. The pressure to the top of the burette is controlled by valve M. This pressure acting on the burette can either be a vacuum, atmospheric, or the pressure set by regulator L. Valve N controls the flow out of the burette accumulator. The flow out of the burette accumulator can be restricted solely to the annulus, solely to the pipette, or drainage can be out of both. Valve O is used to fill and drain the burettes while valve P is a shutoff valve which you can use to isolate the triaxial cell from the pressure control panel. The cell or drainage line is connected to the pressure position through quick connect Q. A more detailed description of the various operations that can be performed with the pressure position is as follows.

7.1 Filling the Burette Accumulators (from the de-aired water tank)

1. Switch valve D to the pressure position. This puts an approximate pressure of 7 psi on the top of the water tank.

2. Switch valve P to the "off" position if there is a cell connected to quick connect Q. This will lock on the pressure that is in the cell or the pressure being applied in the drainage lines leading to the sample.

3. Switch valve M to the vent position. Be sure that valve M is not left in the pressure position. If valve M is accidentally left in the pressure position and the pressure being applied to the

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top of the burette is greater than the 10 psi being applied to the top of the water tank, water will flow out of the burette accumulator and back into the tank. In addition, the tank is only designed for a pressure of 20 psi, so that if valve M is accidentally left in the pressure position at a pressure higher than 20 psi, there is a danger that the water tank will be over pressurized.

4. Use valve N to select either the annulus, the pipette, or both, depending on what needs to be filled.

5. Switch valve O to the water position. Water should now enter the burette accumulator. The burette or pipette will fill more quickly than the annulus; so if valve N is in the "both" position, carefully monitor the rise in the water level in the burette and make sure that the burette is not overfilled. Overfilling the annulus or the pipette will cause water to leak out of valve M behind the panel board. Also, if valve M had been accidentally left in the pressure position at a pressure lower than 10 psi, the water level can rise up into and enter regulator L. **This situation MUST be avoided.**

6. Switch valve O to the "off" position when the pipette or annulus is filled to the desired level. Switch valve M back to the pressure position. Switch valve P to the "on" position.

7.2 The burette accumulator can be drained simply by switching valve O to the drain position. This can be done even if valve M is in the pressure position; however, if valve M is in the pressure position and a high pressure has been selected using regulator L, switch valve O slowly so that the water level does not drop too quickly out of the pipette or annulus. When the water level in the annulus or the pipette is lowered to the desired level, switch valve O back to the "off" position.

7.3 Applying a Confining or Chamber Pressure:

1. Switch valve P to the "off" position.

2. Locate a hose with a quick connect on each end and connect one end to the panel board at quick connect Q and the other end to the quick connect on the base of the triaxial or permeability cell (Connector 15).

Note: The Triaxial or permeability cell should have been previously filled with water.

3. Fill the burette accumulator with water to the desired level as described previously (See 7.1). If volume change is not to be measured, it is not necessary to set the meniscus in the burette or annulus at any particular level. However, it is best to fill the burette accumulator near the top so that, when a pressure is applied to the cell, the burette accumulator does not drain due to the expansion of the cell. If volume change is not to be measured, then valve N should be switch either to the "both" or "annulus" position where the volume of water is greater and can make up for expansion of the cell when the confirming pressure is applied.

4. Switch valve K to the corresponding regulator position that is being used to apply confining pressure.

5. Adjust regulator L to the desired pressure.

6. Switch valve M to the pressure position.

7. Switch valve N to either the "both" or "annulus" position.

8. Switch valve P to the "on" position. Pressure is not being applied to the chamber. If

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the water level in the burette accumulator seems to drop excessively and continues to drop, there is most likely a leak somewhere in the cell. The confining pressure is easily removed from the chamber by switching valve M to vent.

7.4 Applying a Back, Head, or Tall Pressure

1. Using a 1/8" hose with a quick connect on one end. Connect the hose to quick connect Q at position #2 or #3 on the panel and the other end to one of the valves (valve 10 or 12) on the Triaxial or permeability cell. Be sure that the drainage valves on the Triaxial or permeability cell are closed at this time.

2. Saturate the connecting hose and drainage lines as follows:

   a. Fill the burette accumulator with water as described previously, (See 7.1).
   b. Switch valve M to the "vent" position.
   c. Switch valve N to the "annulus" position.
   d. Ensure Valve O is in the off position
   e. Switch valve P to the "on" position.
   f. Open the drainage valve on the Triaxial cell to allow water to flow from the accumulator into the drainage lines.
   g. Allow water to flow out of the accumulator through the drainage lines. Switch valve P off and on occasionally to try to dislodge any bubbles that are trapped in the drainage lines. Continue this process until either: 1) the burette accumulator needs to be refilled or 2) the bubbles cease to emerge from the drainage lines. Once the drainage lines and the hose connecting the cell to the panel are filled and de-aired, close valve P on the panel board as well as the associated valve on the cell.

3. Switch valve K to the regulator position that is going to be used to apply a back, head, or tail pressure.

4. Adjust regulator L until the desired pressure is achieved.

5. With the Valve M in the off position, fill the burette accumulator to the desired level.

6. Switch valve M to the pressure position.

7. Switch valve N to restrict the drainage out of the burette accumulator as desired. Normally when a back, head, or tail pressure is used, volume change is measured so valve N is generally switched to the pipette position. If large volume changes are expected, switch the valve to both.

8. Switch valve P to the "on" position. Pressure is now being applied directly to the drainage valve on the Triaxial or permeability cell.

9. Opening the drainage valve on the Triaxial cell to which the hose is attached will now apply the back, head, or tail pressure to the sample.

7.5 Measuring Volume Changes:

Flow in or out of any of the pressure positions due to volume change of the chamber, consolidation or swelling of the sample, or flow through a sample can be measured using the burette accumulators. Flow up to 25 cc's with the pipette or 125 cc's with the annulus can be measured before the burette accumulator needs to be refilled.

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Volume changes can be read directly from the pipette by noting the change in elevation of the meniscus. The pipette is marked in cc's. Flow in the annulus can also be determined using the marks on the pipette; however, a calibration factor is needed to convert the reading to cc's.

The calibration factor can be determined as follows:

1. Close valve P.

2. Set the meniscus in the annulus to the zero mark on the pipette.

3. Set the meniscus in the pipette to the 20 mark (switch valve N through the "both" position quickly so that the meniscus and the annulus doesn't change).

4. Switch valve N to the "both" position. Allow the meniscus in the annulus to drop to the 1 mark on the pipette and switch valve N back to the pipette position to stop flow.

5. Determine the volume change in the pipette (should be between 3 and 4 cc's). This is the calibration factor (cf) to use to determine flow in the annulus.

Example: If cf = 3.8 and the change in elevation in the annulus is 7.2 divisions, the flow then is 3.8 x 7.2 = 27.4 cc's.

Note: This calibration factor needs to be determined with the burette accumulator subjected to the pressure that is to be used.

7.6 Autoload Feature:

The autoload feature makes it convenient to maintain a set pressure difference between regulators #1 and #2. This feature is mainly used to maintain a pressure differential between the the confining pressure (#1 regulator) and the sample pressure (#2). A typical way in which this feature is used is to first use position #1 to apply the chamber pressure to the cell. Position #2 then is used to apply a back pressure to a sample. Initially, regulator #2 is backed off so that there is no pressure in position #2. Once the confining pressure has been set (Example: 5 PSI) valve R can be switched to the "on" position and back pressure can be applied to the sample by dialing in the back pressure using regulator L in position #2. With the autoload feature on, the cell or confining pressure will automatically increase by the amount increased on regulator #2. This feature eliminates the need to adjust the confining pressure and then the back pressure separately.

7.7 Bridge Valve Options:

The bridge valve S is located between pressure positions #2 and #3. The bridge valve allows the operator to apply the same pressure to both burette #2 and #3 simultaneously. This is accomplished by rotating valve M in position #3 to the "off" position , and switching valve S to the "on" position, then dial in the desired pressure using regulator L in position #2. This feature is convenient when saturating a sample from both ends, such as in a permeability test where it is desired to have an equal pressure at both the top and bottom of the sample. The bridge valve allows the controlled pressure on regulator #2 to be applied not only to the burette accumulator in position #2 but also to the burette accumulator in position #3. The only difference in pressure felt by the sample is due to the different water heights in the accumulators.

Step by Step Operation of Panel Board and Cell

7.8 Preparation of Equipment (Reference Fig 1 & 2)

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1. Position all valves on the panel and chamber to either closed, off, or vent.

2. Adjust regulators 1, 2, and 3 to zero.

3. Connect line from port Q position #1 to quick connector 15 on cell.

4. Connect line from port Q position #2 to valve 10 on cell.

5. Connect line from port Q position #3 to valve 12 on cell.

6. Connect Swagelok connector 14 on cell to pressure transducer.

If the optional de-aired water tank IS NOT used, Place valve D in the vent position and valve E in fill position, then continue to step 11.
If the de-aired water tank IS used, turn valve D to the vent position. Turn valve E to the fill position. Fill de-aired water tank to about 2/3 of its capacity. Move valve E to off.

7. Insure Valve E is in the off position.

8. Turn valve D to vacuum (assumes vacuum pump is operating).

9. Turn valve D to vent after completion of de-airing.

Note: Move Valve D To Vent slowly. Switching quickly from Vacuum to pressure with valve D will cause damage to the supply regulator. Always allow vacuum to vent before applying pressure to the de-airing tank.

10. Turn valve D to pressure position.

11. Turn valve N (3rd position) to annulus, pipette, or both positions. (you choose).

12. Turn valve M (3rd position) to vent position.

13. Fill third burette to mid burette by turning valve O (3rd position) to water position. (Caution: Do not fill burette more than half, when de-airing the level will rise).

14. Turn valve O (3rd position) to off position.

15. Turn valve M (3rd position) to off position.

16. Turn valve S to bridge.

17. Repeat steps 11 to 14 for position 1 and 2.

18. De-air water in burettes 2 and 3 by slowly turning valve M (2nd position) to vacuum. (assumes vacuum pump is operational).

19. Turn valve M (2nd position) to vent once de-airing is complete. Fill burettes 2 and 3 to operating level and repeat de-airing process.

Note: If using De-airing tank, once burettes are filled to operating level turn valve D to vent.

20. Insure valve M (2nd position) is in the Vent Position.

21 Turn valve N (3rd position) to the "both" position.

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Fax: 770-465-7447
Web site: www.durhamgeo.com

22. Turn valve O (3rd position) to the "off" position.

23. Turn valve P (3rd position) to the on position.

24. Slowly open valve 12 on cell to flush air from the line, valve 12, and the tube to the Top Cap.

25. Close valve 12.

26. Turn valve P (3rd position) to off.

27. Insure valve M (2nd position) is in the Vent Position.

28 Turn valve N (2rd position) to the "both" position.

29. Turn valve O (2rd position) to the "off" position.

30. Turn valve P (2nd position) to the on position.

31. Slowly open valve 10 on cell to flush air from line, valve 10, and the bottom pedestal.

32. Turn valve 10. to off.

33. Turn Valve P (2nd Position) to Off.

34. Insure valve M (1st position) is in the Vent Position.

35 Turn valve N (1st position) to the "both" position.

36. Turn valve O (1st position) to the "off" position.

37. Slowly open valve P (1st position) until water appears on the connecting line halfway.

38. Turn Valve P (1st Position) to Off.

39. Turn valves P, and O off , and N to both (all positions). All valves on the panel and chamber should be either closed or off and the system is flushed except for valves 11, 13, connector 14, and the pore pressure transducer.

7.9 Preparation of Equipment and Specimen

1. Place saturated porous stones on lower pedestal and cover with saturated filter paper disc (same diameter as specimen).

2. (Optional) Saturated strips of filter paper may be used to aid in drainage and saturation. See Corps of Engineers laboratory manual, page X-33, for details. (triaxial shear test)

3. Place specimen on lower pedestal.

4. Place saturated filter paper disc (same diameter as specimen) on top of specimen.

5. Place saturated porous stone on specimen.

6. Place cap on top of specimen. (Vacuum grease can be applied to cap and base pedestal)

7. Place a membrane in the stretcher and apply a vacuum, carefully lower over the specimen,

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Fax: 770-465-7447
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release the vacuum, and remove the stretcher. (Refer to Corps of Engineers laboratory manual, page X-18, figure 9).

8. Seal the membrane to base and cap with either o-rings or rubber bands.

9. Connect tubes to cap.

10. Align sample, stones, and cap to pedestal.

11. Connect male quick connector with length of ¼ tube to female quick connector **16** on cell (vents chamber).

12. Ensure that piston is raised to highest position in chamber and lock in place.
(Triaxial Cell ONLY)

13. Install the top of Triaxial \ perm chamber in place.

CAUTION: FACE THE BAND LATCHES ON THE STAINLESS BANDS AWAY FROM THE OPERATOR.

14. Tighten the three tie rods by hand, applying equal pressure.

15. Unlock and gently insert loading piston into top cap.
(Triaxial Cell ONLY)

16. Lock loading piston with lateral lock screw.
(Triaxial Cell ONLY)

17. Attach dial indicator and set to zero.
(Triaxial Cell ONLY)

18. Disconnect line from connector Q (1st position).

19. Connect to position G.

20. Turn valve F to fill position. Allow chamber to fill until water flows out of valve 16 (on Cell).

21. Turn valve F to off.

22. Disconnect line from G and place it into connector Q (1st Position).

23. Remove male quick connector from 16 (on Cell).

24. Check to ensure that all burettes have water in operating level. If not, See 7.8 10-14

8.0 Procedure for Saturation

1. Insure all regulators are adjusted to “O” Pressure.

2. Insure all valves are off

3. Turn valve S to OFF

3. Turn valve K to Regulator 1.

4. Adjust chamber pressure to 3 psi by turning regulator L (1st Position).

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5. Turn valve M (1st Position) to pressure.

6. Turn valve N (1st Position) to both, annulus or pipette (your decision).

7. Turn Valve O (1st Position) to off.

8. Turn valve P (1st Position) to on.

9. Turn valve K to Regulator 2 (reading should be 0 psi).

10. Turn valve M (2nd Position) to vent.

11. Turn valve N (2nd Position) to both.

12. Turn valve O (2nd Position) to off.

13. Turn valve P (2nd Position) to on.

14. Open valve 10 and 11 (On Cell).

15. Close valve 11 (On Cell) when water starts flowing through connector 14.

16. Turn valve P (2nd Position) to off.

17. Turn valve K to Regulator 3 (reading should be 0psi).

18. Repeat steps 8 to 11 with valves in position 3.

19. Open valves 12 and 13 (On Cell).

20. Close valve 13 when water starts flowing through connector 14.

21. Attach pressure transducer. Open de-airing valve (threaded cap on transducer).

22. Repeat steps 17 and 18.

23. Close De-Airing valve on transducer when all air has been purged.

24. Attach dial indicator and set to zero.
(Triaxial Cell ONLY)

25. Disconnect line from connector (first position).

26. Valves 12 and 10 should be open.

27. Turn auto load valve R to on.

28. Turn Valve M (3rd Position) to Off (DOWN).

29. Turn valve M (2nd Position) to pressure.

30. Turn valve S to on.

31. Turn valve N (2nd and 3rd Positions) to both, annulus, or pipette (your choice).

32. Insure Valve O (2nd and 3rd Positions) are in the off position.

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33 Turn valve P (2nd and 3rd Positions) to on.

34. Adjust back pressure regulator L (2nd Position) to first increment, approximately 5 psi. (Chamber pressure will automatically increase by same increment.)

Note: Observe fluid movement in burette on second position and third position for evidence of leaks. If the pore pressure readout reads same as chamber pressure or if water is rising in back pressure burettes, there is a leak.
When the measured pore pressure becomes essentially the same as back pressure and the burette reading is constant, record the reading and continue to add increments of back pressure until either a predetermined pressure is reached or until the b coefficient equals 0.95. When the sample is completely saturated, a change in chamber pressure should result in an immediate and equal change in pore pressure. To check, close valves 12 and 10, open 11 and 13, adjust chamber regulator upward 5 psi, and check pore pressure readout for equal increase. If the b coefficient is less than 0.95, reduce chamber pressure regulator by 5 psi, open valves 12 and 10, and continue saturation. If b coefficient equals 0.95, reduce chamber pressure regulator by 5. Open valves 12 and 10 and proceed to desired test.

NOTE: If water level becomes low in any burette, close valve P (2nd and 3rd Positions), turn valve M (2nd Position) SLOWLY to vent, turn N to your choice, turn E to fill, and slowly turn valve O to water position. (CAUTION: DO NOT OVERFILL BURETTE.) After these, reverse steps until you go back where you were.

8.1 Procedure for Consolidation

1. Open valves 10 and 12. BOTH VALVES OPEN WILL ALLOW FOR DRAINAGE AT BOTH BOUNDARIES. YOU MAY CHOOSE TOP ONLY OR BOTTOM ONLY DRAINAGE.

2. Valve P is open.

3. Record water level in the sample and chamber burettes.
CAUTION: WATER LEVELS SHOULD BE LOW ENOUGH TO ALLOW FOR CONSOLIDATION AND VOLUME CHANGE.

4. Close valves 10 and 12.

5. Auto load valve is on.

6. Adjust chamber pressure regulator until the difference between the chamber pressure and back pressure equals the desired consolidation pressure.

7. Open valves 10 and 12 (see step 1) and allow specimen to consolidate. DO NOT OVERFILL THE BURETTE.

8. Reading of burette level at time intervals may be made and recorded to determine completion of primary consolidation. If left overnight, the desired consolidation will normally take place in most soils.

9. Close valve P (S.P. and T.P.), 10 and 12. Observe pore pressure readout for stability.

10. Place chamber in the compression testing machine.

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11. For S test, open valves, 10, 12 and P.

12. Bring load cell or proving ring to soft contact with the loading piston.

13. Release piston locks.

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WARRANTY STATEMENT

Durham-Geo Enterprises Inc. warrants that equipment shall be free from defects in material and workmanship for a period of **90 days** from the time the equipment is put into service. In any event, the warranty period will not exceed **6 months** from the date of shipment.

Durham-Geo Enterprises Inc.liability shall be limited to replacement of components or equipment (at the manufacturer's discretion) that has been determined by the manufacturer to be faulty. No claims in excess of component replacement value will be recognized. Durham-Geo will not be held liable for damages or lost business relating to a warranty claim.

Specifically excluded from this warranty are claims deemed by the manufacturer to have resulted fron normal wear and tear, improper use, or abuse of the equipment.

For complete warranty disclosure, please call 1-800-837-0864(outside GA) or 770-465-7557 (inside GA) or refer to the printed statement on the back of any Durham-Geo original invoice.

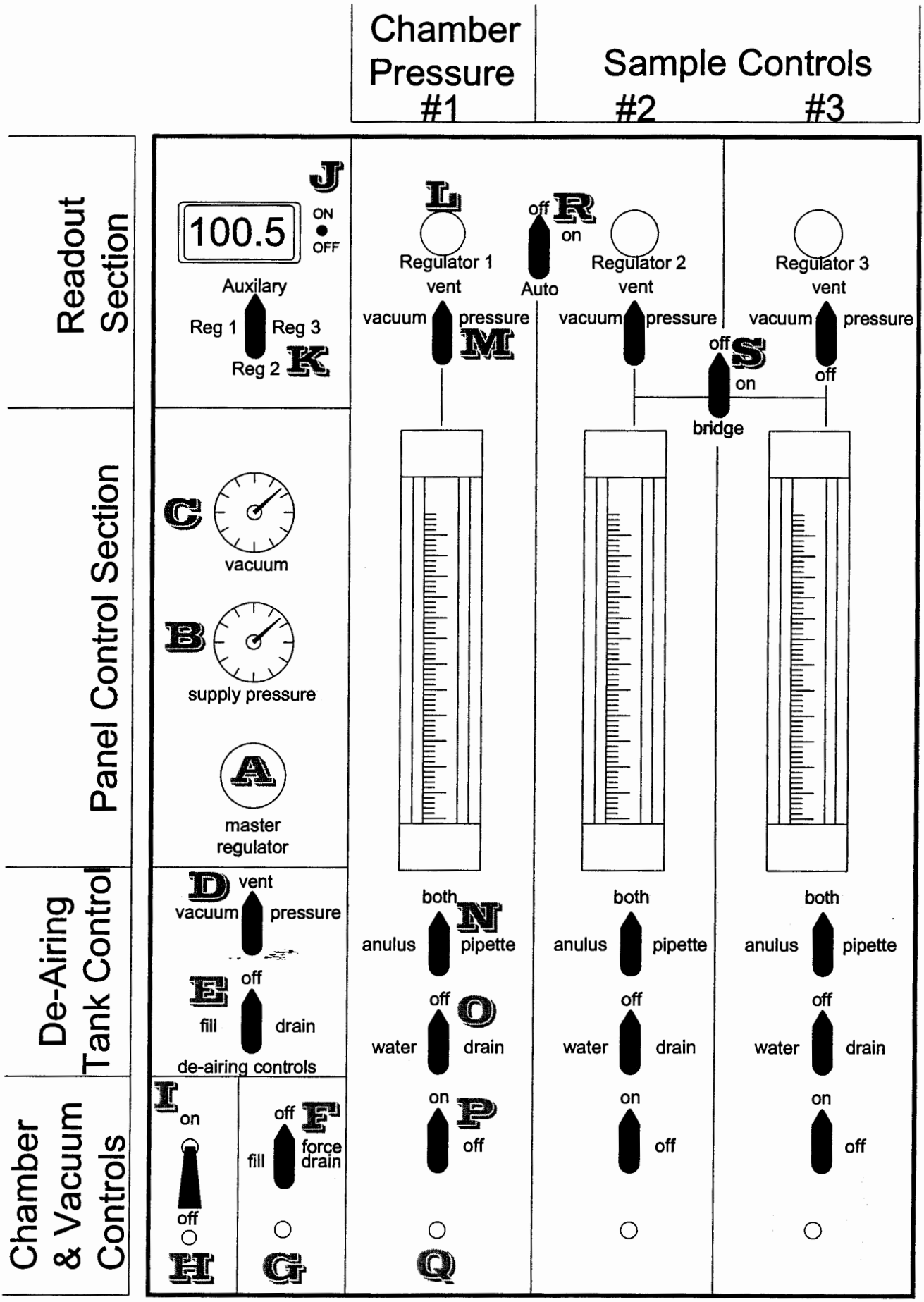
Chamber Pressure #1
Sample Controls #2 #3
Readout Section
Panel Control Section
De-Airing Tank Control
Chamber & Vacuum Controls
J
100.5
ON
OFF
Auxilary
Reg 1
Reg 3
Reg 2
K
L
Regulator 1
vent
vacuum
pressure
M
off
R
on
Auto
Regulator 2
vent
vacuum
pressure
Regulator 3
vent
vacuum
pressure
off
S
on
bridge
off
C
vacuum
B
supply pressure
A
master regulator
D
vent
vacuum
pressure
E
off
fill
drain
de-airing controls
both
N
anulus
pipette
off
O
water
drain
on
P
off
I
on
off
H
off
F
fill
force drain
G
Q

Fig. 1

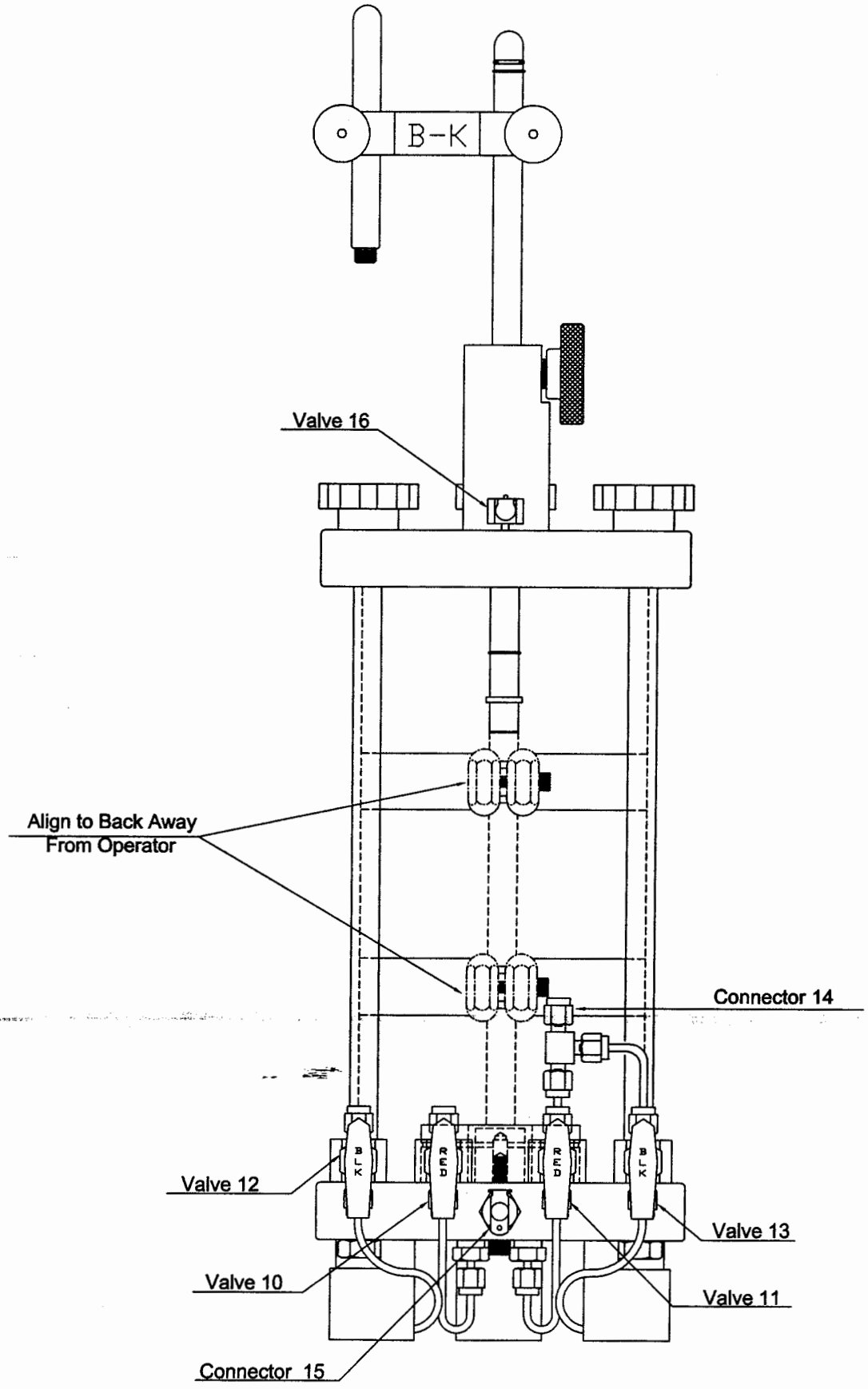
B-K
Valve 16
Align to Back Away
From Operator
Connector 14
Valve 12
Valve 13
Valve 10
Valve 11
Connector 15

Fig. 2

Supply Connections for S-500 Panel

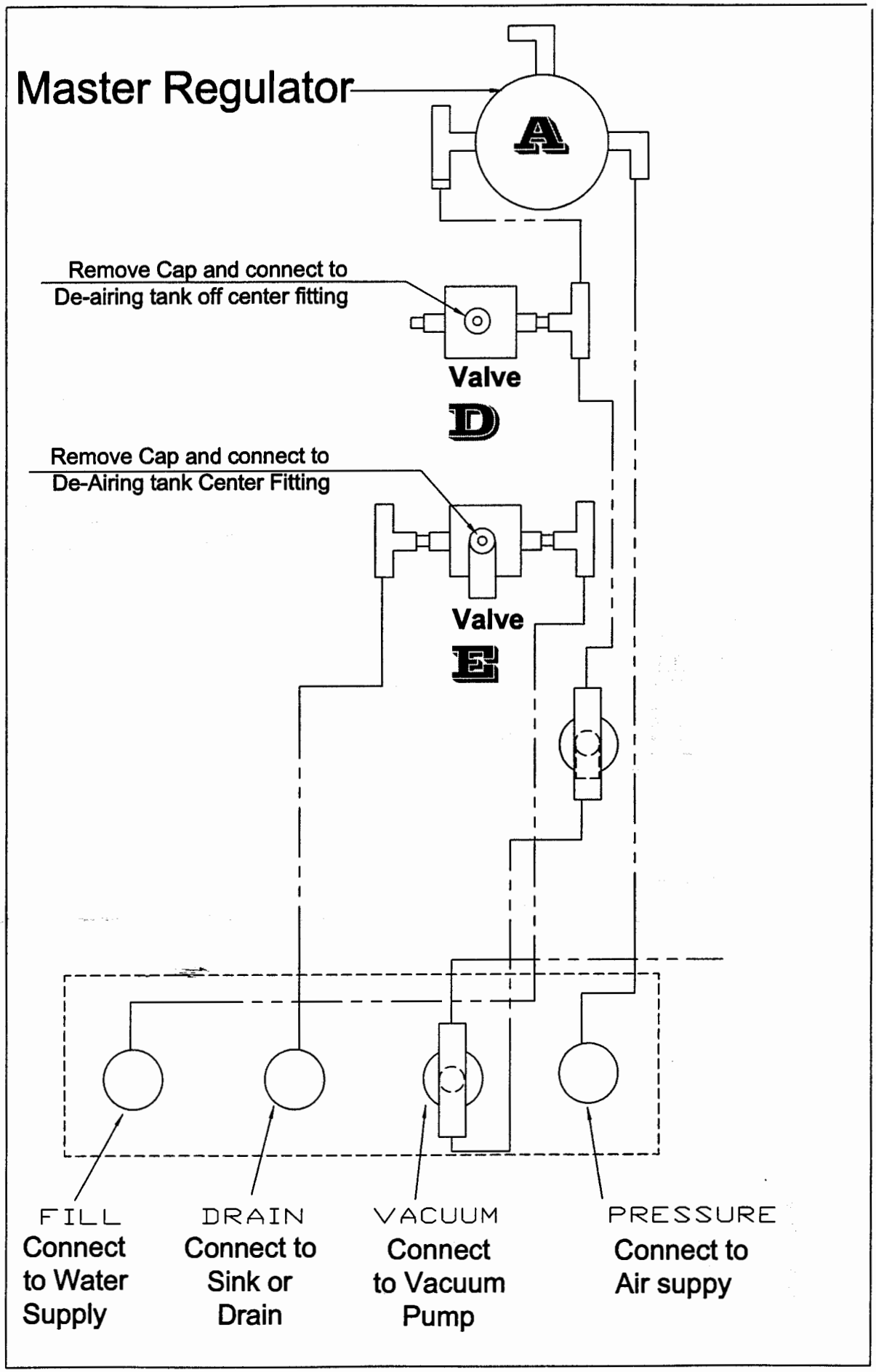

Fig. 3a

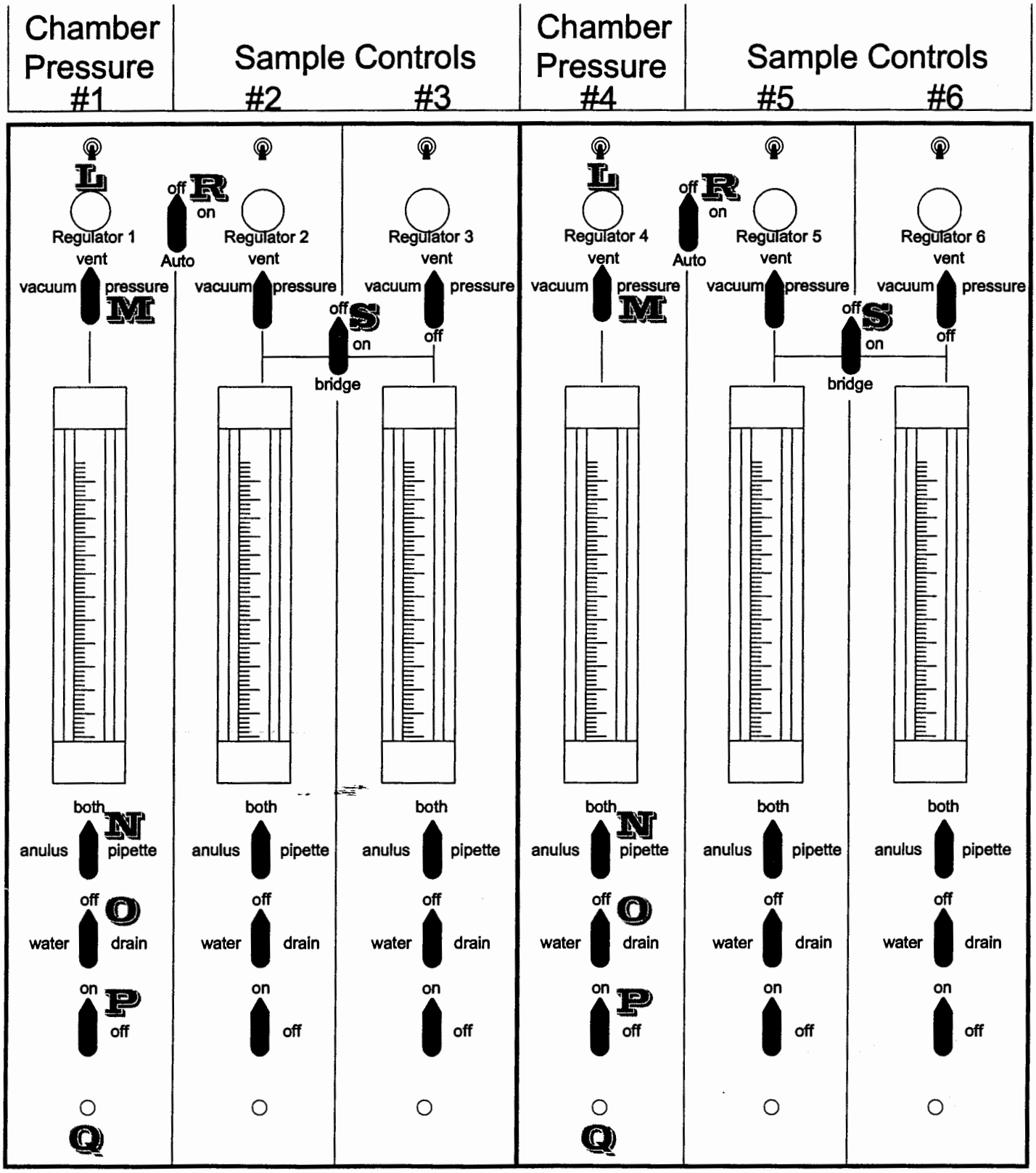
Chamber Pressure #1
Sample Controls #2 #3
Chamber Pressure #4
Sample Controls #5 #6
L
R
off
on
Auto
Regulator 1
Regulator 2
Regulator 3
Regulator 4
Regulator 5
Regulator 6
vent
vacuum
pressure
M
S
bridge
both
N
anulus
pipette
O
water
drain
P
Q

Fig. 4