



Volume Change Apparatus

## Introduction

The Humboldt HM-2315 Volume Change Apparatus consists of a two chamber, reversible piston assembly mounted onto an enclosure, which contains the flow control valves and internal fluid lines. The HM-2315 uses two different methods for measuring the volume change. The standard 100 cc Volume Change Apparatus is designed to be used with a 25 mm LSCT and bracket, or can be purchased complete with a Digital Gauge. These units are usually supplied to connect to an existing laboratory set up where there are sufficient change over valves and panels within the pressure system to enable the reverse flow. Sometimes these units are used directly in the pressure line by connecting the upper chamber to the base of the Triaxial Cell and the lower chamber receives the de-aired water. In such case, it is necessary to apply a pressure to the top of the chamber after each test to reverse the flow. This pressure could be taken from the cell pressure line.

The Volume Change Apparatus comprises a change over valve system, which provides an unlimited capacity by reversing the flow.

## Installation

Using 1/8 inch O/D tubing, attach a fluid line from the pressure system into the left hand side (when viewed from the front) of the Volume Change Apparatus (see Figure 1 on Back Cover).

**Note:** *The tubing is to connect into the same side as the Volume Change/Bypass control valve.* Using the same sized tubing, run a line from the right hand side of the Volume Change Unit (i.e. from the Flow Up/Flow Down valve side) to the backpressure valve situated on the Triaxial Cell base pedestal.

To measure the volume change, you need to fit an LSCT with bracket or Digital Gauge to the top of the Volume Change Unit.

With the left hand valve set to VOLUME CHANGE position and the right hand valve set to FLOW UP position, slowly fill the top chamber with de-aired water with the top bleed valve open to release any entrapped air. Once the chamber is full and all the air has been bled, tighten the air release valve at the top of the chamber. To fill the bottom chamber repeat the above procedure with the two chamber assembly rotated 180° (i.e. upside down) and the Right Hand Valve to FLOW DOWN.

It is advisable to leave this apparatus for at least 8 hours with an internal pressure of 700 kPa (102 psi) so that any remaining trapped air can be absorbed into the water. It is then necessary to flush out the Volume Change unit with fresh de-aired water. It may be necessary to carry out this procedure more than once if there are any signs of air pockets in the system.

## Volume Change Measurement & Bypass

In order to measure the volume change, the left hand valve of the Volume Change Apparatus must be set to VOLUME CHANGE position and the right hand valve must be set to FLOW UP position or FLOW DOWN position.

During a test, water fills one of the chambers, while the other chamber is opened and water drains out. As one chamber is filling and the other draining, the piston will move inside the cylinder and the lever arm will move up or down depending on which chamber is filling. The lever arm acts on the LSCT or Digital Gauge which indicates the distance the piston has moved.

This information is then converted by the computer to volume change. During the test, if the capacity of the sample exceeds the volume in one of the chambers, it may be necessary to increase the volume change capacity. This is done by reversing the flow direction. The flow direction is changed by switching the FLOW UP/FLOW DOWN valve to the opposite direction. **Note:** *When using the reverse flow for greater capacity during a test, certain precautions should be carried out when calibrating the apparatus (see calibration instructions).*

By setting both valves to the BYPASS position, de-aired water can flow through the change over valves system directly to the Triaxial Cell. Volume is not measured when the valves are in the Bypass position.

## Calibration

Switch on the power supply to the logger or monitoring readout unit with the LSCT or Digital Gauge connected to it for at least one hour before attempting calibration. **Note:** *Some older monitors or loggers require a longer warm up period.* Please refer to your logger or read out unit guide.

With the probe of the transducer or Digital Gauge set to its maximum downward position, set the monitor or logger to zero (if using a Digital Gauge, set it to zero also).

**Note:** *The probe must still be in contact with the lever arm.*

Adjust the right hand valve to the FLOW UP position until the maximum upward movement has been achieved. Accurately measure the amount of water flowing out with a measuring cylinder.

Alternatively you could work out the volume change by weighing the volume of water displaced from the draining chamber. Weigh a beaker or other suitable container with which to collect the water. Collect the water displaced when one chamber is filled and the other drained. Weigh the beaker again with the water displaced after the maximum upward movement has been achieved. Subtract the empty container weight from the weight of the container and displaced water. If the weight is measured in grams, this number will be the same as the volume in milliliters or cubic centimeters.

Once the volume has been determined, the Digital Gauge should be set to show the volume displaced and the logger or monitor should be adjusted to the same volume. This procedure should be carried out at least three times or until an acceptable agreement between the measured volumes and the digital displays are achieved.

**Note:** *You should only attempt to calibrate in one direction.*

When more than 100cc of volume change occurs, you will need to reverse the flow. You must therefore check the reverse displacement against the calibrated readings. If necessary you may need to use a correction factor to overcome any small hysteresis.

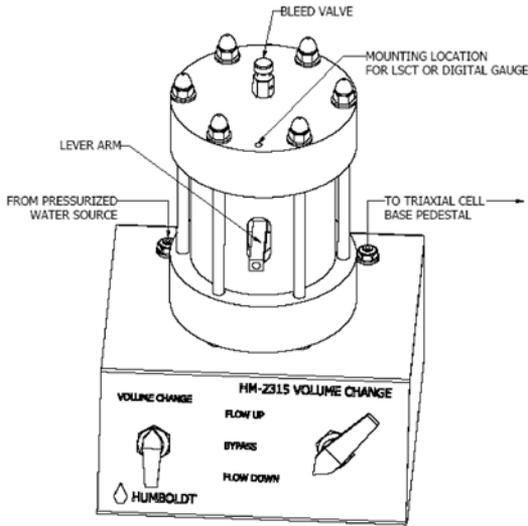


FIGURE 1. VOLUME CHANGE APPARATUS

## Warranty

Humboldt Mfg. Co. warrants its products to be free from defects in material or workmanship. The exclusive remedy for this warranty is Humboldt Mfg. Co., factory replacement of any part or parts of such product, for the warranty of this product please refer to Humboldt Mfg. Co. catalog on Terms and Conditions of Sale. The purchaser is responsible for the transportation charges. Humboldt Mfg. Co. shall not be responsible under this warranty if the goods have been improperly maintained, installed, operated or the goods have been altered or modified so as to adversely affect the operation, use performance or durability or so as to change their intended use. The Humboldt Mfg. Co. liability under the warranty contained in this clause is limited to the repair or replacement of defective goods and making good, defective workmanship.

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