S-450

TERRALOAD CONSOLIDATION SYSTEM

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. We reserve the right to make changes at any time without notice and without incurring any obligation.

GENERAL INFORMATION

Consolidation is the process of gradual transfer of an applied load from the pore water to the soil structure as pore water is squeezed out of the voids. The amount of water that escapes depends on the size of the load and compressability of the soil. The rate at which it escapes depends on the coefficient of permeability, thickness and compressability of the soil. The rate and amount of consolidation with load is usually determined in the laboratory by the one-dimensional consolidation test. In this test, a laterally confined soil is subjected to successively increased vertical pressure allowing for drainage from the top and bottom surfaces.

A consolidometer consists of a rigid base, a consolidation ring, porous stones, a rigid floating plate and a support for a dial indicator. It may be either the fixed-ring or the floating ring type. The fixed-ring type can be used to measure the coefficient of permeability of the sample as it is being tested. This is essentially the only advantage to the fixed-ring consolidometer. The floating-ring consolidometer has an advantage over the fixed-ring type in that it reduces the friction between the inside of the ring and specimen, plus the test rate is about four times faster.

The **TerraLoad** is a pneumatic loading device designed to apply loads instantaneously and to maintain the loads indefinitely on a consolidation test specimen. A constant load is maintained regardless of the rate of compression or the magnitude of consolidation.

Components of a **TerraLoad** system:

1) A pneumatic loading device

2) A fixed-ring or floating-ring consolidometer

3) A digital or conventional dial indicator for measuring consolidation

4) A digital indicator or a bourdon type pressure gauge for measuring applied air pressure

5) An air source with a maximum pressure capacity of 120 psi and a maximum free-air capacity at 125 psi of 0.2 cfm per **TerraLoad** (That is to say, if you were operating a total of 6 **TerraLoads** from the same air source, you would need 6 x 0.2 cfm of a total of 1.2 cfm.)

6) In the event that a single digital indicator (or bourdon pressure gauge) is to be used to gauge several **TerraLoad** units, a switching unit would be required to route the gauge to the respective **TerraLoad** on which a load is being set. Once the load has been set, you are free to switch the gauging unit to another **TerraLoad.** It is not recommended to use the switching unit in conjunction with a bourdon pressure gauge. In this situation we recommend using the quick connect fitting, connecting the gauge to the **TerraLoad** on which the load is to be set.

TERRALOAD FEATURES

The **TerraLoad** has two precision air regulators. Precision regulators always bleed air. The left-hand low pressure regulator has a capacity of 0 to 10 psi. The right-hand regulator has a capacity of 2 to 100 psi. The primary function of the regulators is to control the air pressure acting on the piston. To maintain the load, a constant supply of air is required. The pressure should always be at least 20 psi higher than the highest pressure that is to be read on a particular B-K gauging unit. No more than 160 psi should be applied to the system. In a typical installation, it is advisable to place a regulator and pressure gauge at the compressor which would limit the down-stream air in accord with the previous maximum situation. This regulator need not be a precision bleed type regulator. It is also advisable to place a conventional air filter in the line close to the compressor. The regulators used in the **TerraLoad** employ a dynamic balancing of valve seat forces by a compensating diaphragm which means that the regulator is virtually unaffected by changes in supply pressure. At full output under dead end service, the amount of air bleed through the regulator will approach 0.2 cfm.

Clockwise rotation will increase the load on the sample. Counter-clockwise rotation of the regulator will decrease the load on the sample. The piston diaphragm is essentially similar to any piston which serves to multiply force with the major exception that normal seals are not employed. A rolling neoprene diaphragm is used to effect the seal. It has the following characteristics:

1) It is friction free
2) There is no need for lubrication
3) There is no break-away friction
4) It has a very high sensitivity
5) It has an extremely long life
6) It is leak-proof
7) Under normal usage, it will not require any service. It is not recommended that the piston cover plate be removed.

PRESSURE READING DEVICES

Either a precision test gauge or a digital indicator with sufficient range and accuracy compatible with the requirements needs to be employed for measuring the pressure that is to be applied to the piston through the air regulator.

A 30 psi test gauge will permit measurement of loads up to 9.5 TSF on a 2-1/2" diameter sample. This, in reality, is 649.2 pounds of total force that can be applied within the range of the 30 psi gauge. The gauge has 300 divisions which means that the least division that can be read is 0.1 psi or 2.164 pounds of applied force. It logically follows that on a 60 psi test gauge we would be able to apply a total force within the range of that gauge of 1298.4 pounds. Inasmuch as there are still 300 divisions on the gauge face, the least readable pressure measurement is 0.2 psi or 4.328 pound of force.

The Durham Geo digital indicator is capable of measuring to the limit of the pressure regulators which, of course, is only 100 psi. One hundred psi will permit a total load of 32 TSF on a 2-1/2" diameter sample. Inasmuch as the digital indicator can be read to the nearest 0.01 psi, the least load that can be read is 0.216 pounds.

PRESSURE READING DEVICES

We perhaps should now address ourselves to the accuracy of the pressure measuring device. Accuracy should not be confused with sensitivity. Sensitivity implies the lease reading that can be observed. Accuracy implies the maximum deviation from actual that can occur at any point on the curve from an absolute value. With respect to the consolidation test, it is more meaningful to have repeatability of a reading than it is to have absolute value. Any of the 3 pressure measuring devices that are offered have excellent accuracy within the requirements of complying with ASTM. When we refer to a gauge as having an accuracy of 1/4 percent full scale and full scale is 30 psi, we are suggesting that the device is guaranteed to be accurate anywhere between 0 and 30 psi within 0.75 psi. With respect to a comparable 60 psi gauge, it would be guaranteed to be accurate anywhere within its 0 to 60 psi range within 0.15 psi. This guarantee relates only to the gauge itself and does not involve itself with the balance of the system.

GENERAL SUGGESTIONS WITH REGARD TO THE USE OF PRESSURE GUAGES AND DIGITAL INDICATORS

It is noteworthy for you to know that when your **TerraLoad** was shipped, whichever type of pressure measuring device you choose, the indicator or the gauge, was calibrated specifically to the **TerraLoad**. The precision manufacturing used in the construction of the **TerraLoad** and the particular design components make all **TerraLoads** essentially identical. Should you choose to use another pressure measuring device, it would be advisable that it be sent to be calibrated in conjunction with a **TerraLoad**.

It is good practice to always take pressure readings regardless of the device being used in precisely the same fashion for consistent results. It is recommended that the pressure settings be made by approaching the value on the gauging device slowly from below the number. This is true even for unloading sequences.

When using test gauges (Bourdon type gauges) there is an inertia present in the components of the Bourdon tube and its mechanical system. A sharp blow or vibration or even a light tapping may cause the gauge needle to move from its present position. This does not indicate a change in load since a load change can only be accomplished by changing the air regulator setting. Tapping of the gauge should only be resorted to at the start of a test when it is necessary to return the gauge pointer to exact zero.

The test gauges supplied with this instrument have a mirrored strip to correct for paralax in reading the gauge. Your line of sight should be such that there is no reflection of the needle on the mirrored surface that is obvious. If you can see the pointer plus a reflection, it is evident that your line of sight is inappropriate and the reading will be taken incorrectly.

With respect to the digital indicator, it is strongly recommended that you read the operating instructions for that device before connecting it or attempting to use it.

TERRALOAD CONTROLS: There are only four controls on the face of the **TerraLoad**. These are labeled SELECTOR, LOW PRESSURE REGULATOR, HIGH PRESSURE REGULATOR, and LOAD-OFF-UNLOAD.

The SELECTOR valve should be positioned such that it will point to either the LOW PRESSURE REGULATOR or the HIGH PRESSURE REGULATOR. The LOW PRESSURE REGULATOR should be used for pressure settings ranging between 0 and 10 psi. The HIGH PRESSURE REGULATOR should be used for pressure settings between 10 and 100 psi. Anytime you anticipate that the next pressure setting will be above 10 psi, you should switch the selector from the LOW PRESSURE REGULATOR to the HIGH PRESSURE REGULATOR. It is good practice to make this switch with the LOAD-OFF-UNLOAD valve positioned in the OFF position.

A calibration sheet is sent with each pressure gauge or digital indicator. This calibration sheet will enable you to translate the psi reading on the indicator or gauge to pounds that are applied on the sample. Sequentially the procedure is as follows: from the curve or by formula[1] arrive at the load you want applied to the sample. Determine the psi that should shown on the gauging device. Move the LOAD-OFF-UNLOAD selector valve to OFF. Slowly rotate the appropriate pressure regulator clockwise until the desired psi shows on the gauging device. Turn the LOAD-OFF-UNLOAD valve to the LOAD position. The load is now instantaneously applied to the specimen. There is no need to keep the gauging device connected to the **TerraLoad** for the regulator will indefinitely maintain that particular load provided there is a continuous source of air at the required pressure. When an additional load increment is desired simply repeat the above procedure. For unloading sequences you follow the identical procedure by turning it counter-clockwise to decrease pressure. Once you have established the appropriate psi reading simply turn the LOAD-OFF-UNLOAD valve to the LOAD position and it will instantaneously release the load previously held to the new reduced load. If you turn to UNLOAD, the unit will automatically release all the pressure.

1Note: Once you are familiar with your digital pressure readout, you will be able to make it read directly in tons/sq. ft. on any desired unit.

PRESSURE OF SPECIMENS: Specimens should be prepared in a humid room to prevent evaporation of soil moisture. Extreme care should be taken in preparing specimens of sensitive soils to prevent disturbance of their natural structure. Specimens of relatively soft soils may be prepared by progressively trimming in front of a ring shaped specimen cutter. Both the floating-ring and the fixed-ring B•K consolidometers have a self trimming ring allowing the specimen to be trimmed into the consolidation ring. It would also be satisfactory to use a trimming turn table for trimming the sample into the consolidation ring. Procedures for cutting off the portion of the specimen remaining above the ring. Procedures for cutting off the portion of the specimen remaining above the ring, recording identifying information, weight and other such pertinent matters appears in several references. For the sake of these instructions we will not develop the sample preparation discussion further.

THE CONSOLIDOMETER: The B•K fixed-ring consolidometer is designed in an identical fashion to all fixed-ring consolidometers excepting the one difference being that the consolidation ring is a self trimming ring. It is assumed that the user is conversant with the assembly procedure for a fixed consolidometer in preparation for testing.

The B•K floating-ring consolidometer is unlike conventional floating-ring consolidometers. The principal difference lies on the fact that there is an alignment sleeve to assure perfect alignment of the porous stones, consolidation ring and loading head. This alignment feature avoids the potential of the stones dragging on the inside of the consolidation ring. Additionally, the lower rigid platen and the loading disc have undercut to permit total and/or differential consolidation of the specimen within the ring. The consolidometer is built in such a fashion that it can be totally disassembled, however most people choose to leave the outer inundation ring in place at all times, unless they are working with a particularly difficult sample set-up.

CROSS HEAD POSITIONING: Use a 1" spacer or a spacer of the same height as the sample to be tested to set the cross head position. Place the spacer on top of the bottom stone (where the sample will go), place the loading cap on top of the spacer and then the ball on the top of the loading cap. Lower the cross head to bring it in contact with the ball in such a fashion that the ball carries the load of the cross head. Raise the two adjusting nuts in the two tie rods to just bring them into contact with the cross head.

CAUTION: Be sure to level the cross head in the operation so that it is parallel to the lower platen. It is recommended that this be done with an actual level. Now you may raise the cross head and remove the consolidometer from below the cross head. Remove the spacers from the consolidometer. Do not tighten down either of the upper jam nuts, for it will be necessary to raise the cross head slightly when you install the loaded consolidometer.

INSTALLATION OF THE DIAL INDICATOR TO THE CROSS HEAD: On the back side of the cross head there is a special fixture which is designed to accommodate a conventional dial indicator in the center hole. Th hole, which is offset to the left as you face the front of the **TerraLoad**, is designed for the installation of the digital dial indicator. There is an extension and a 3/8" flat foot which must be installed to either a conventional dial indicator or the digital dial indicator. The extension plus the foot is designed to permit the foot to rest on the alignment ring in the floating consolidometer. One must be cautious when installing the consolidometer to raise the dial stem to raise the cross head complete with dial indicator to avoid bumping and bending the dial indicator extension. Once the loaded consolidometer is in position and the dial indicator foot located on the alignment ring you should zero the dial indicator.

TAKE NOTE: There is a grooved circle on the lower loading platen. When the consolidometer is set in position, it should be centered on the grooved circle.

As previously described, the consolidometer has been appropriately loaded with the sample, centered on the lower platen of the **TerraLoad**, the cross head has been positioned appropriately and leveled, the dial indicator zeroed and the spacers securely positioned against the cross head. The entire assembly is not ready for the application of the initial load.

1). Turn the REGULATOR SELECTOR valve towards the LOW PRESSURE REGULATOR.

2). Turn the LOAD-OFF-UNLOAD valve to the OFF position.

3). Open any valving required to allow air to flow from the main supply system.

4). Adjust the regulator sot hat the gauge or digital indicator reads zero. If you cannot get a zero reading on the indicator, disconnect the indicator from the **TerraLoad** and follow the proper zeroing instructions from the instruction manual on the digital indicator. Replug the indicator to the **TerraLoad** and you are ready for the first load.

5). Adjust the regulator to produce the desired pressure corresponding to your first load.

6). Turn the LOAD-OFF-UNLOAD valve to the LOAD position. This will apply an instant load. When the load is applied, immediately begin the process of taking readings form the dial indicator. The time interval between readings will depend on the specifications that the operator is following.

7). Once this increment of load has been completed, turn the LOAD-OFF-UNLOAD valve back to the OFF position, adjust the regulator to the new desired pressure and proceed as before.

CALIBRATION ADDENDUM

This unit has been calibrated without a load on the bottom platen, as any dead weight added to the platen causes the reading on the pressure readout to increase.

Since oedometers containing various types of soils will not have a constant weight that can be incorporated into a general formula, the end user must make the final determination.

1. Weigh the consolidation cell (oedometer) in pounds or kilograms.

2. Multiply this by 0.05 psi or 0.759Kpa.

3. Add this product to the indicated reading on the manometer.

4. Draw a parallel line on the calibration chart if desired.

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 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 have been determined by the manufacturer to be faulty. No claims in excess of component replacement value will be recognized. Durham Geo Enterprises, Inc. 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 from normal wear and tear, improper use, or abuse of the equipment.

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

ITEM	QTY	QTY	QTY	QTY	PART NUMBER	DESCRIPTION	SUPPLIER / MANUFACTURER
1	X				2440-01	LOAD FRAME CYLINDER ASSEMBLY	
2	1				1336-01	BOTTOM PLATE	
3	1				1337-01	CYLINDER	
4	1				1338-01	PISTON	
5	1				1330-05	ROLLING DIAPHRAM,	
6	1				2448-01	TOP PLATE	
7	1				2440-07	BEARING, LINEAR BALL BUSHING	
8	1				2446-01	PISTON SHAFT	
9	1				2451-01	BEARING HOUSING, TOP PLATE	
10	16					1/4" - 20 UNF SOCKET HEAD CAP SCREW X 1" LONG	
11	2					1/2" - 20 UNC SET SCREW X 1" LONG	
12	5					#10 - 32 SOCKET HEAD CAP SCREW X 3/4" LONG	
QUANTITY FOR PART NO.	2440-01						

PROJECT	TERRALOAD				TITLE: LOAD FRAME CYLINDER ASSEMBLY
REVISION	A				
DATE	05/15/91				
DATE		SHEET 1 OF 1			DRAWING NO. 2440

ITEM	QTY	QTY	QTY	QTY	PART NUMBER	DESCRIPTION	SUPPLIER / MANUFACTURER
1	X				2527-01	TERRALOAD CONSOLIDOMETER ASSEMBLY	
2	1				1277-01	PLATEN	
3	2				1279-01	TIE ROD	
4	1				2450-01	CROSS BAR	
5	2				1281-01	HALF NUT	
6	2				1282-01	WHOLE NUT	
7	2				1329-27	LATEX RUBBER BOOT	
8	1				2440-01	CYLINDER ASSEMBLY	
9	1				1834-01	CASE & BACK PANEL	
10	1				1835-02	FRONT FACE	
11	4				1586-02	5/8" OD X 9/32" ID ROUND SPACER	
12	1				2151-005	MALE CONN, 1/4 TB X 1/8 MPT	
QUANTITY FOR PART NO.	2527-01						

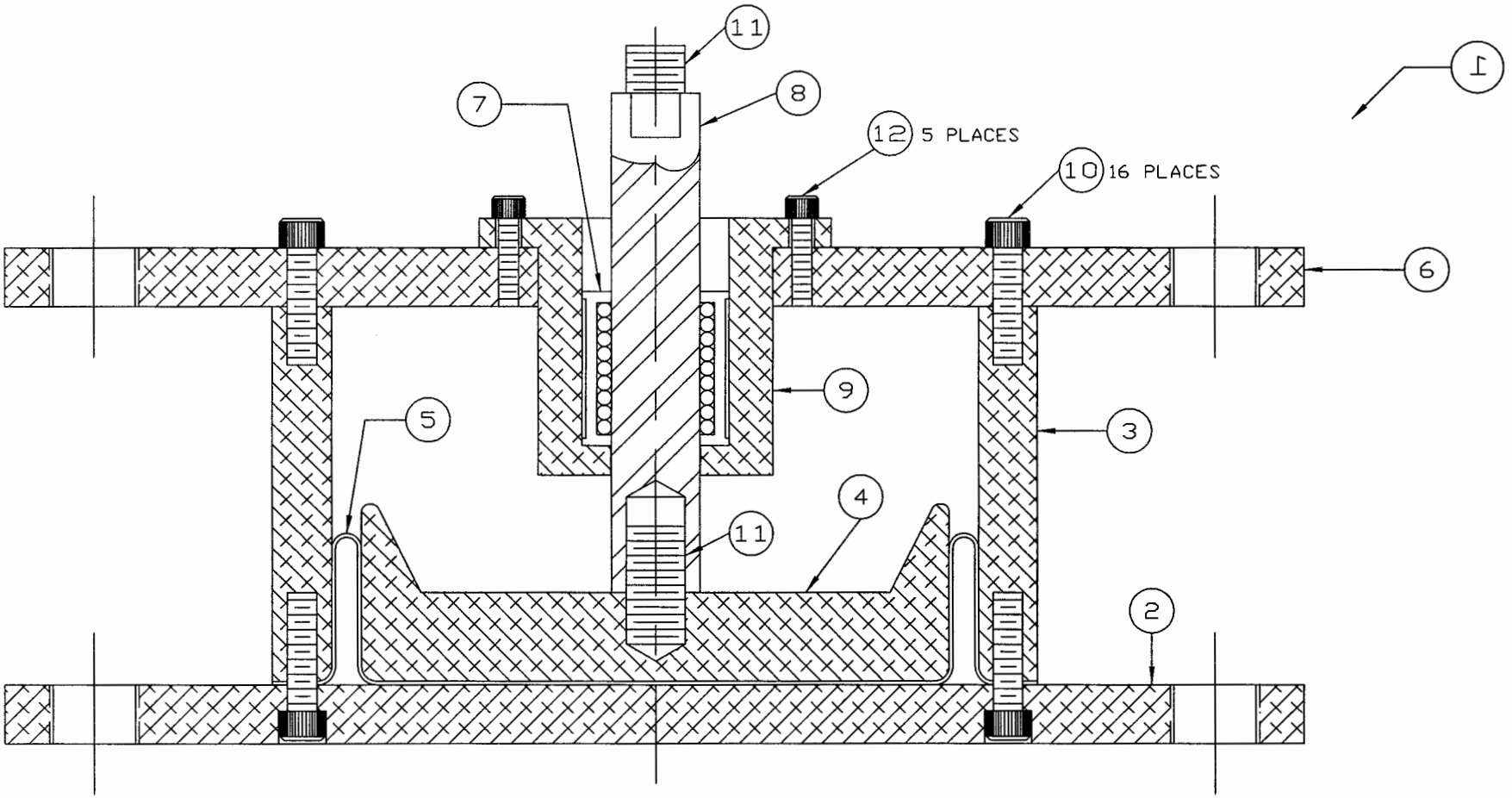
PROJECT					TITLE
REVISION	A	B	C		TERRALOAD CONSOL. ASSEMBLY
DATE	08/20/91	9/18/96	1/7/97		
DATE					SHEET 1 OF 3 / DRAWING NO. 2527

ITEM	QTY	QTY	QTY	QTY	PART NUMBER	DESCRIPTION	SUPPLIER / MANUFACTURER
13	3				2151-018	MALE ELBOW, 1/4 TB X 1/4 MPT	
14	1				2151-024	MALE BRANCH TEE, 1/4 TB X 1/4 MPT	
15	1				2151-041	BULKHEAD UNION, 1/4 TB X 1/4 TB	
16	1				2151-050	UNION TEE, 1/4 TB	
17	1				2151-055	PORT CONNECTOR, 1/4"	
18	1				2151-094	QUICK CONNECT, MQC X 1/4 TB	
19	1				2151-095	QUICK CONNECT, FQC X 1/4 TB	
20	2				2152-008	3 WAY VALVE, 1/4 TB	
21	1				E-651	0-10 PRESSURE REGULATOR	
22	1				E-655	2-150 PRESSURE REGULATOR	
23	1				S-450IM	INSTRUCTION MANUAL, TERRALOAD	
24	1				2447-01	ADJUSTABLE SPINDLE	
QUANTITY FOR PART NO.	2527-01						

PROJECT					TITLE
REVISION					TERRALOAD CONSOL. ASSEMBLY
DATE					
DATE					SHEET 2 OF 3 / DRAWING NO. 2527

ITEM	QTY	QTY	QTY	QTY	PART NUMBER	DESCRIPTION	SUPPLIER / MANUFACTURER
25	1				2469-01	LOCKNUT, ADJUSTABLE SPINDLE	
26	2				2463-01	INDICATOR SUPPORT ROD	
27	1				301142	INDICATOR SUPPORT BAR, TERRALOAD	
28	1				2566-04	0.050" ALLEN WRENCH	
29	AS REQ'D					1/4" NYLON HOSE	
30	4					1/4" - 20 BUTTON HEAD CAP SCREW X 1/2" LONG	
31	4					1/4" - 20 HEX HEAD CAP SCREW X 1" LONG	
32	4					1/4" FLAT WASHER	
33	REF				2583-01	PLUMBING DIAGRAM	
34							
35	1				432631	DECAL, TERRALOAD	
36							
QUANTITY FOR PART NO.	2527-01						

PROJECT					TITLE	TERRALOAD CONSOLIDOMETER ASSEMBLY
REVISION						
DATE						
DATE					SHEET 3 OF 3	DRAWING NO. 2527


11
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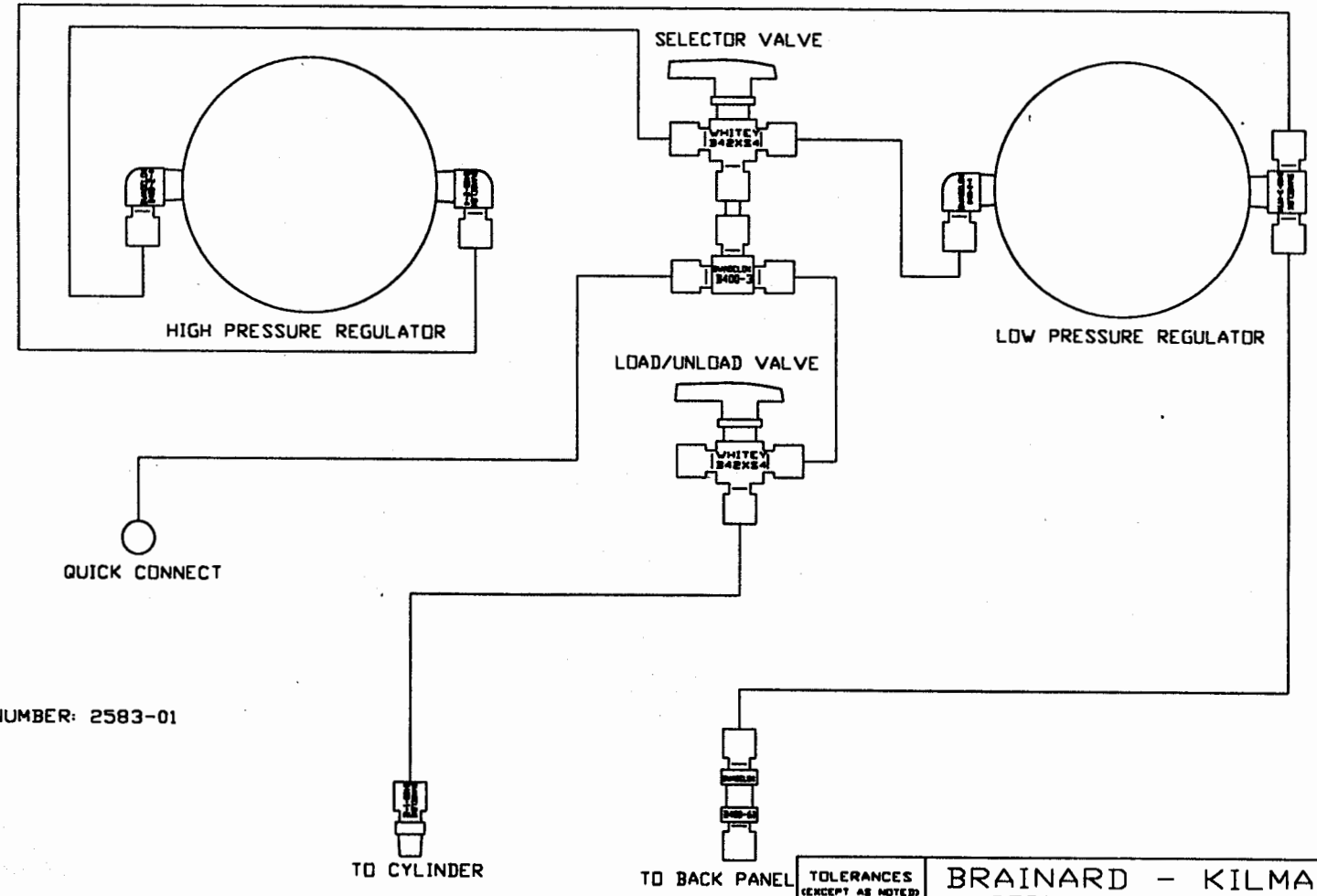
PART NUMBER	REV.
2583-01	A



NOTES:

1. PART NUMBER: 2583-01

DATE	SYM	ECO#	BY	REVISION RECORD	DATE	SYM	ECO#	BY	REVISION RECORD	DATE	SYM	ECO#	BY	REVISION RECORD
										08/20 1991	A		SBAII	RELEASED FOR PRODUCTION

TOLERANCES (EXCEPT AS NOTED)	BRAINARD - KILMAN DRILL CO. STONE MOUNTAIN, GEORGIA 30086				
DECIMAL .X ± .060 .XX ± .020 .XXX ± .004	DATE: 08/20/91	SHEET 1 OF 1	SIZE B	SCALE: NONE	DRAWN BY: S ADKINS II
FRACTIONAL ± 1/16					APPROVED BY:
ANGULAR ± 1/2°	TITLE: PLUMBING DIAGRAM				
RADII ± 1/32	TERRALOAD CONSOLIDOMETER				DRAWING NUMBER 2583