OPERATING INSTRUCTIONS

ELE-Hoek Cells

70-0910, 70-1710

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Contents

1 Introduction

1.1 One of the most important characteristics of rock, from the design engineer's point of view, is the significant increase in strength with increasing confining pressure. An adequate description of this strength behaviour requires a number of triaxial tests over a range of confining pressures.

1.2 Ideally, these tests should be carried out in the field, as soon as possible after the recovery of a core sample from a borehole. This procedure minimises the physical changes which occur during transportation of the core sample to a laboratory and it also permits a close correlation between the triaxial test result and ***in situ*** geological observations.

1.3 Any triaxial cell developed for this purpose must be so arranged to accept specimens of rock of diameter as obtained from the borehole.

1.4 The ELE range of Hoek Triaxial Cells are designed to allow the operator, after facing the ends of the core sections of various diameters, to place them directly in the cells, apply the appropriate confining pressures, and determine the compressive strength of the rock under these conditions.

1.5 By the use of additional items, it is also possible to conduct permeability tests and determine the strain of the specimen using suitable strain gauges.

2 Specification

Part no.	**70-0910**	**70-1710**
Size	1.5 in	NX
Core diameter (nominal) mm	38.1	54.74
Diameter tolerance mm	± 0.75	± 0.75
Jacket inside diameter (nominal) mm	38.86	55.50
Overall length assembled with 2.1 ratio specimen and spreader pads mm	252	321
Jacket length mm	99.1	130.8
Cell inside diameter mm	63.5	79.4

Confining pressure fluid Shell Tellus T150 or ISO equivalent, ISO viscosity oil.

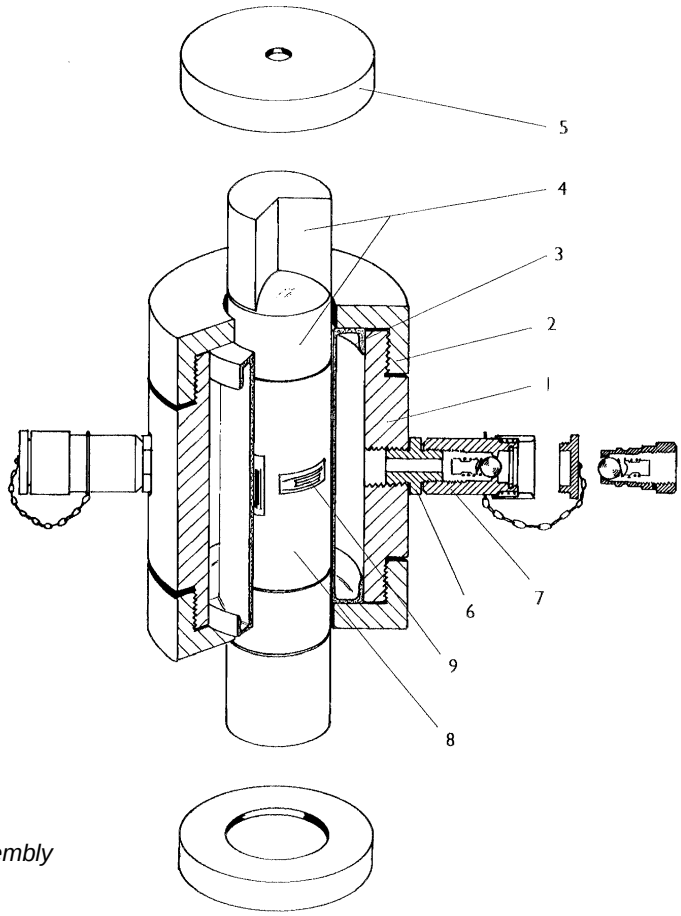

Figure 1
Base Cell Assembly

3 Description

3.1 Basic cell assembly (figure 1)

An ELE-Hoek Cell for determining the triaxial compressive strength of rock comprises:

1 Steel cell body
2 Steel end cap (2 no.)
3 Urethane rubber jacket
4 Hardened steel spherical seat piston assembly (2 no.)
5 Load spreader pad with centring socket
6 Pressure sealing half coupling (2 no.)
7 Half coupling bleed valve
8 Specimen 2:1 length/diameter ratio (not supplied)
9 Strain gauge assemblies (not supplied)

4 Installation

4.1 General

4.1.1 The ELE-Hoek triaxial cell for rock mechanics is designed for both mobile and static laboratory functioning. Under either situation it is important to set up the equipment carefully and to have available the necessary items to prepare the test cores to fit the appropriate sized triaxial cell.

4.2 Compression machine

4.2.1 To test rock specimens under triaxial conditions for compressive strength requires a suitable compression machine with the upper spherical seating **REMOVED**.

4.2.2 A suitable load spreader (see figure 1) must be fitted in place of the removed spherical ball seating.

Note: when purchasing it is important to check the required distance between upper and lower spigots of the load spreader pads of cell assembly (see section 2) so that the machine can be matched using distance pieces manufactured to suit the compression machine (see table 1).

Table 1 Distance piece requirements for compression machines

Cell Size	37-5050 80 mm	37-5020 60 mm	37-4980 20 mm
1.5 in	1	-	-
NX	-	-	1

4.3 The confining pressure

4.3.1 The confining pressure of up to 70 MPa (10,000 lbf/in/2) is achieved using a suitable pressure generator. Two types of hydraulic pressure generator are available from ELE.

4.3.2 Where the deviation of the test is not expected to extend over long periods, the hand operated system (70-5000) will be adequate. This unit (figure 2) comprises a hand pump and hydraulic reservoir which is connected to the triaxial cell using a flexible hose and half coupling to mate with one of the half couplings on the triaxial cell body (figure 1).

4.3.3 The half coupling enables rapid change between different cell sizes to allow various core diameters to be tested without draining oil from the confining pressure system.

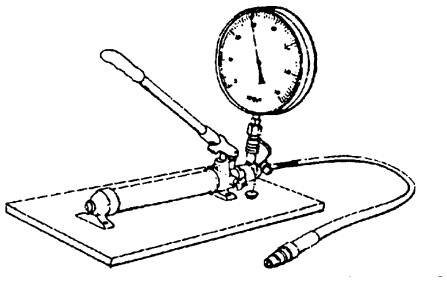

Figure 2
Hand-operated Hydraulic Pressure Generator for confining pressure 70-5000

5 Extruder (figure 3)

5.1 A feature of the Hoek Triaxial Cell is that there is access to the specimen before and after testing without emptying the confining pressure chamber.

5.2 Providing the distortion or rapid expansion of the specimen is not too excessive and damage to the membrane has not occurred, it is possible to extrude the remains of the specimens from one end of the cell using an extruder.

5.3 Designed for this work is 70-2725 Specimen Extruder (see figure 3) which is available with adaptor sets comprising an end cap (13), a support bracket (14), and a plunger end (15) to encompass the range of triaxial cells.

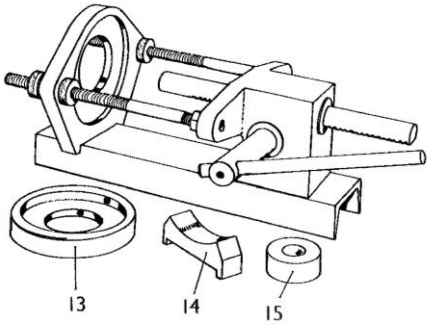

Figure 3 Extruder

6 Cell Assembly

6.1 Before assembling the triaxial cell, remove both end caps and piston and clean off the corrosion preventative grease.

6.2 Carefully slide a urethane jacket onto one end of the cell body.

Important: do not use any sharp implements to ease the second end of the jacket into the cell. Careful distortion and use of the finger nail is all that is required, or perhaps a little confining pressure oil will ensure satisfactory assembly.

6.3 When the jacket is tightly fitted, reassemble the two end caps.

6.4 Connect one of the cell half couplings to the flexible hose of the confining pressure system. Hold the cell so that oil will enter from underneath. Screw the air bleed (7) into the other half coupling (figure 5).

6.5 Steadily allow oil to fill the chamber until oil escapes from the bleed valve. Immediately remove valve (7).

Important: do not allow pressure to build up in the cell chamber.

6.6 Stand the cell on a bench and remove an end cap. This will enable the operator to check for evidence of trapped air. Any trapped air should be removed by use of the bleed valve (7).

6.7 Replace the end cap and the cell can be stored ready for use.

6.8 Test procedure

6.8.1 Specimen preparation

The operator will select the triaxial cell to suit the core diameter. Reference should be made to the diameter limits (section 2).

Ensure that the ends of the specimen are flat and perpendicular to its length.

6.8.2 With the triaxial cell on a bench, slide the specimen into the cell and position the piston at either end so that the assembly is symmetric about the centre line of the cell.

6.8.3 With the cell connected to the confining pressure system, apply a minimum pressure to hold the components together.

Note: the specimen and pistons must be held closely together.

6.8.4 Place the load spreader pad on the lower platen and position the triaxial cell assembly.

6.8.5 Place the upper load spreader pad onto the assembly and operate the compression machine to raise the lower platen until the assembly is locked into position ready for testing.

6.9 Confining pressure

6.9.1 The required confining pressure will be appropriate to the test conditions.

6.9.2 With the assembly set up in the compression machine, apply the confining pressure.

Note: due to the small strain involved, the volume changes in the cell are minimal and therefore the changes for confining pressure expected during standard testing when using the manual hydraulic confining pressure system can be ignored.

6.10 Compression test

6.10.1 The rate of loading for the compression test constitutes a variable that can affect the results. It was reported by Wuerher* that using loading rates between 7 and 70 kPa/s will minimise any such effects.

*Wuerher R G (1959) 'Influence of stress rate on the strength and elasticity of rocks' Q Colorado, Short Mines, 54, No. 3.

6.10.2 The required pace rate can be controlled by indicating time per unit load on the load gauge of the test machine. Thereafter, the operator will control the compression machine to load the specimen to failure in the appropriate time.

6.11 After test

6.11.1 Immediately the test is concluded, allow the axial load to come off the specimen and take care to prevent the cell assembly falling over.

6.11.2 Release the confining pressure and remove the cell chamber, the piston assemblies and one end cap.

Note: after use at high confining pressure, the use of a rubber mallet or similar implement may be needed to unstick the cap. The use of the release agent when assembling will minimise this problem.

6.11.3 Place the appropriate extruder end cap (13) in place of the cell end cap and position the cell on the support (14) in the extruder.

Note: if this operation is not successful, it is recommended that the cell chamber is drained of oil before using other methods of extraction.

6.11.4 Position the appropriate plunger (15) on the end of the extruder piston. Steadily apply pressure to push the broken specimen out of the triaxial cell assembly.

Note: if this operation is not successful, it is recommended that the cell chamber is drained of oil before using other methods of extraction.

6.12 Strain measurements

6.12.1 The extent of strain of a rock specimen when subjected to compressive forces will be very small. Work has been conducted using suitable strain gauges bonded to the side of the specimen.

6.12.2 No details can be given for proven work on this field but the following points are raised to assist the operator.

6.13 Installation

6.14 The main difficulty when considering the attachment of strain gauges will be the electrical connections.

6.15 The use of fine shellac coated copper wire will enable insulated electrical connections to be made to the strain bridges.

6.16 As there will be differential movement between the piston and the chamber jacket, the area adjacent to the wires should be lubricated during assembly.

6.17 It is of utmost importance to observe very good joints between specimen and piston to prevent damage to the wires when applying confining pressure.

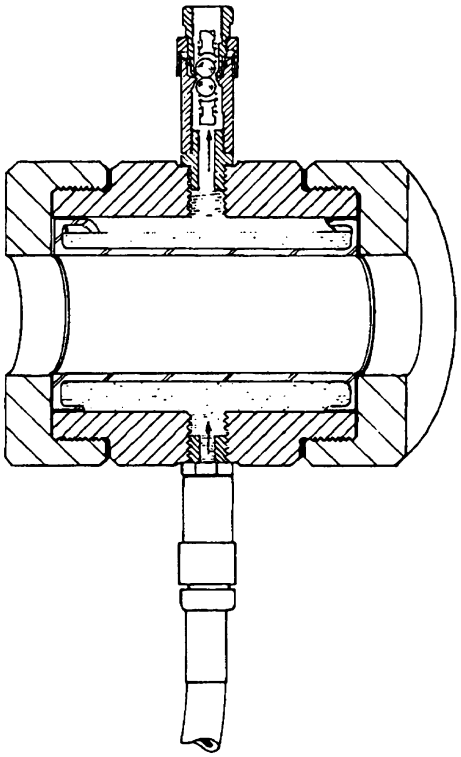

Figure 4 Filling the cell

7 Permeability Optional Extra

7.1 General

7.11 Where information is required regarding permeability of rock under conditions appertaining to that insitu, it is important to confine the specimen in a manner to create the conditions and also ensure that there is no path enclosing membrane. The Hoek Triaxial Cell has been developed to encompass this work.

7.2 Assembly (figure 5)

7.3 The permeability end caps are designed to leave a distance between the end pads of twice the diameter of the specimen.

7.4 A standard spacer block is provided to enable the use of a 1:1 ratio diameter/length specimen.

Note: by providing alternative spacer blocks, specimens of any desirable length can be used providing the total length of spacer, specimen and filter paper just fits the distance between the end pads so that there are no gaps that would cause damage to the membrane when pressurised.

The filter paper is optional to provide a water path over the ends of the specimen.

The connectors are suited to receive 6 mm outside diameter nylon tubing.

7.5 The specimens should be saturated before assembly. Confining pressure should only be applied to the system after the specimen has been positioned in the cell and both end caps are correctly assembled.

Permeability pressure should only be applied after the confining pressure has been applied.

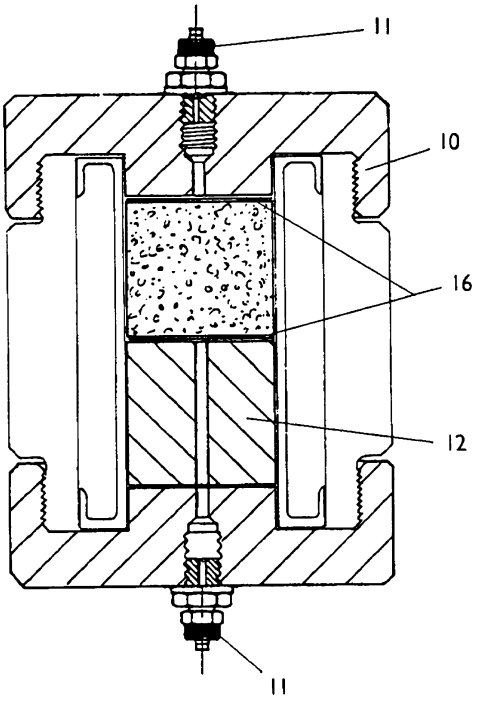

Figure 5
Permeability end caps

Key

10 A pair of end caps to replace the standard end caps
11 1/8 BSP 6 mm OD tubing connector
12 Standard distance block when using a 1:1
16 Coarse filter paper

8 Spares

Cell part no.	70-0910	70-1710
Nominal core size	1.5 inch	NX
Spare jacket	70-0912	70-1712
Spare piston set (pair required)	0562B0023	0564B0023
Bleed valve	5028A0002	
Cell half coupling	5028A0001	