



INSTRUCTION MANUAL

HOEK TRIAXIAL CELL

Model HTC

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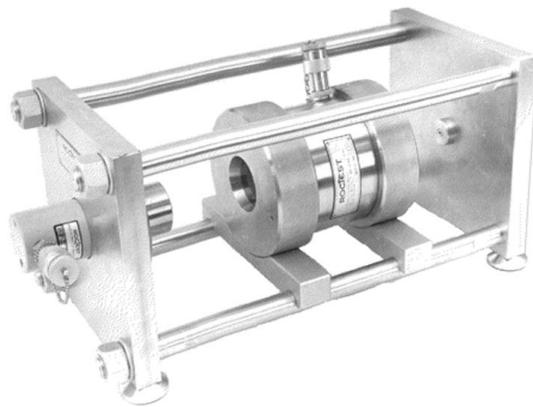
Tel. : 1.450.465.1113 • 1.877.ROCTEST (Canada, USA) • 33 (1) 64.06.40.80 (Europe) • www.roctest.com • www.telemac.com

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HOEK cell in a compression testing frame

1 INTRODUCTION

The HOEK Triaxial Cell is designed to determine the triaxial strength of diamond drill cores of rock or concrete. Tests carried out on a series of samples under different confining pressure allow the user to determine:

- The strength and elastic properties
- Shear strength at different confining pressures
- Angle of shearing resistance and cohesion
- Modulus of elasticity and Poisson's ratio

One of the most convenient method for determining triaxial strength of rock is to apply a uniform hydraulic pressure to the curved surface of a cylindrical specimen and then to apply a compressive axial load to the rock specimen until failure occurs. Tests are normally done on a series of samples under different confining pressure to study the strength properties of the sample under various stress conditions which simulate natural or arranged levels. Test data may be used to determine the strength and elastic properties of rock, shear strength at various confining pressures, the angle of shearing resistance, cohesion intercept and deformation moduli.

2 DESCRIPTION

The HOEK cell consists of a hollow steel cylinder with threaded removable end caps. A urethane rubber membrane with U-shaped end seals, form a pressurization chamber for hydraulic fluid. The rubber membrane has a tensile strength of over 38 MN/m² and a durometer of 95, compared with values of about 21 MN/m² strength and a hardness varying from 30 to 90 in the case of natural rubber. The cell comprises an inlet fitted with a 3/8" NPT male quick-connect and an air outlet plug to saturate the pressurization chamber.

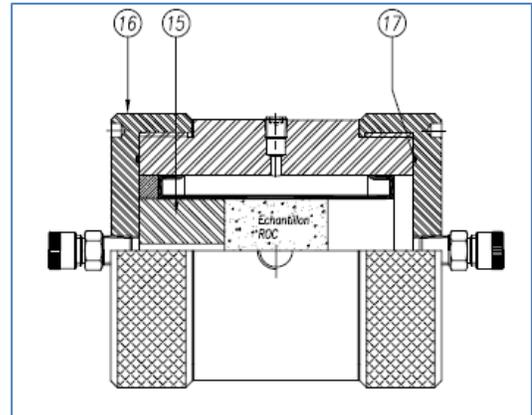
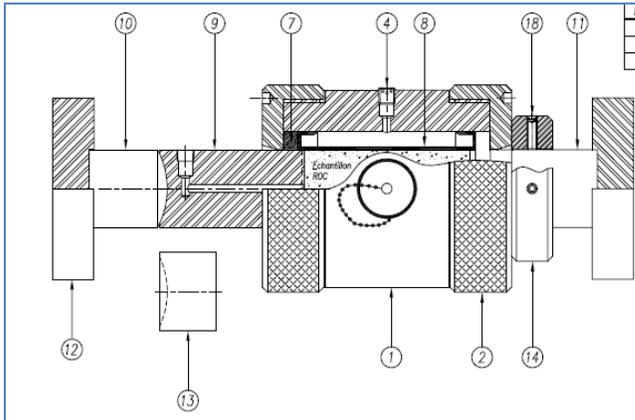


The cell is supplied with a pair of spherical platens (optional) to apply the axial load to the flattened ends of the sample. These platens are made of tool steel hardened and ground to ASTM (D2664) standard.

Typical Setup

Test with axial compression

Permeability test without axial compression



Items that RocTest can provide :

Essential items	Common accessories	Other accessories
1 triaxial cell with standard end caps (1, 2)	1 set of spherical seat platen (10, 13)	1 concave pore pressure platen (9) for a drained test
1 cell membrane (8)	1 flat platen (11)	1 flat pore pressure platen used instead of (11) for a drained test (not shown)
	1 support collar (14)	2 spacing platen for permeability test (15)
	1 set of 2 load spreaders (12)	2 permeability end caps (16)

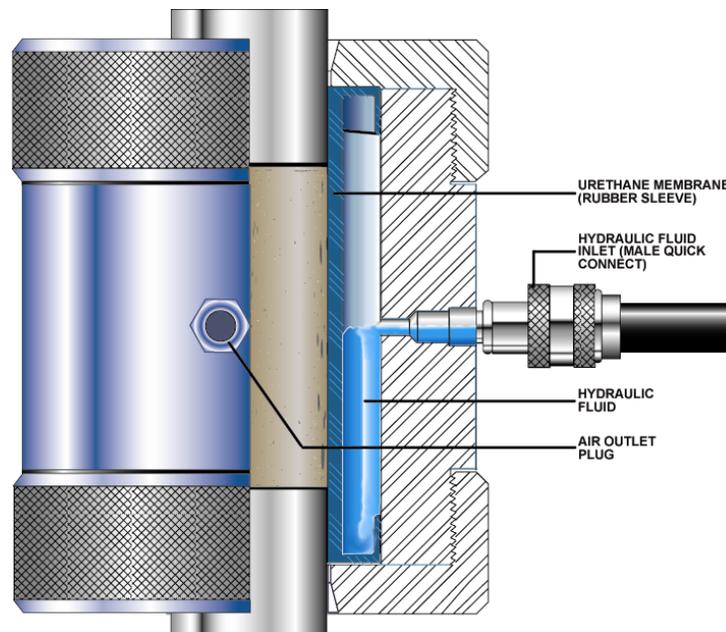
Other equipment required for testing (loading bench, hydraulic pump, pressure gauge, pressure maintainer, lines, valves, strain gauges and readout...) should be acquired from other suppliers.

Note that with some custom cell sizes, available membranes can be too short. In that case, a special spacer ring (7) can be used.

DESCRIPTION	STANDARD SIZE ¹				
	AWG	BWG	NQ	NWG	HQ
Triaxial cell complete with one quick connect and one plug	1.185 in. (30.1 mm)	1.655 in. (42.0 mm)	1.875 in. (47.6 mm)	2.155 in. (54.7 mm)	2.500 in. (63.5 mm)
SPECIAL HOEK CELLS					
5.7 in. (144.7 mm) diameter membrane					
6.0 in. (152.4 mm) diameter membrane					

1 Other sizes available upon request.

As illustrated below, hydraulic fluid is retained within the annular space created between the rubber membrane and the cylinder. The membrane has integrated "U" seals at each end and a threaded steel cylinder. This configuration makes it possible to test and remove the rock specimen without having to replace the seals.



Assembled HOEK Cell (details)

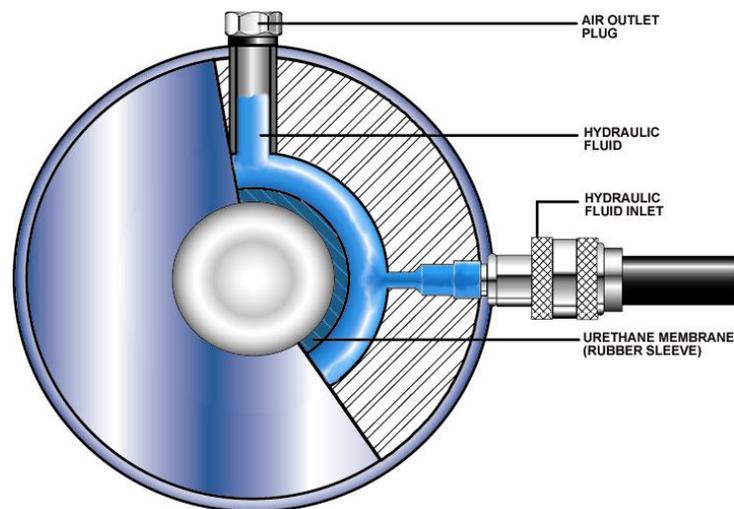
The spherical seat platens are manufactured from high quality steel, are used without lubrication so that, once under a load, they are effectively locked together, and react as one. In this manner, they compensate for any initial misalignment of the specimen ends.

To achieve consistent and reliable test results, it is recommended that cylindrical samples having a length to diameter ratio of at least two are tested (in references 1, 2 and 3) and the ends be ground flat to within 0.025 - 0.012 mm dependant of sample diameter. Reference 4 concisely describes the tolerance of specimen preparation for sample laboratory testing in uniaxial compression and is equally applicable to this situation

3 OPERATING INSTRUCTIONS

3.1 ASSEMBLY

1. Remove end caps from cell, inspect cell and make sure that all internal surfaces on both cell and end caps are clean and free from surface irregularities.
2. Make sure the rubber membrane is clear from all blemishes.
3. Coat the inside of body cell with hydraulic oil to give rubber membrane an easy fit. The rubber is slightly oversized and must be installed carefully inside the cell.
4. After rubber membrane installation, put end caps back on cell (when all mating surfaces are clean and free of grit). Hand tightness is all that is required.
5. Hold cell with the air outlet upwards, unscrew the plug lightly, and using hand pump, saturate the cell with hydraulic fluid. The cell should be completely air free. Tighten back the plug.
6. The cell is now ready to be used.



Filling HOEK cell with hydraulic fluid

3.2 TEST PROCEDURES

1. The ends of the rock specimen (a minimum length to a diameter ratio of 2) must be ground flat within a parallelism of 0.025 mm to 0.012 mm depending on the diameter of the sample.

MAKE SURE ROCK SPECIMEN IS WELL CENTERED INTO THE CELL'S RUBBER MEMBRANE.

2. After saturation of the pressurization chamber, the cylindrical rock sample is inserted into the chamber within the confining membrane. The two spherical seats are positioned so that the rock core lies centrally in the triaxial chamber.

DIAMETER OF THE SAMPLE SHOULD NOT BE SMALLER THAN THE CELL NOMINAL SIZE BY MORE THAN 0.05 IN. (1.25 mm). FOR INSTANCE, A SAMPLE USED IN A AW CELL SHOULD BE BETWEEN 1.135 AND 1.185 INCHES. IF IT IS SMALLER, WE RECCOMEND SHIMMING IT IN A FLEXIBLE FILM (CELLOPHANE WRAPPING OR ACETATE SHEATS FOR INSTANCE).

3. After applying a small confining pressure to hold the rock core in place, the cell with its spherical seats is placed in the loading frame and a small axial load is applied to hold the system firmly in place.
4. To determine Poisson's ratio, two orthogonal strain gages are glued on the rock core. The strain gages are read during the test with a Wheatstone bridge readout. The triaxial test may then be run after adjustment of the confining pressure to the required value.

GAP BETWEEN THE HTC CELL AND THE PLATENS IS VERY SMALL. IT IS RECOMMENDED TO USE STRAIN GAUGES WITH VERY SMALL WIRES (LESS THAN 10 MILS). GROUNDING OR MACHINING SMALL GROOVES IN THE PLATEN EDGE MIGHT BE REQUIRED TO ALLOW FOR THE WIRES TO BE FED PAST.

5. With the use of strain gages, triaxial tests run on the same type of rocks at different confining pressures allow the determination of the failure envelope with the angle of friction and cohesion, the modulus of elasticity and Poisson's ratio.
6. Axial load of rock sample may begin.

3.3 POST TEST PROCEDURE

1. Once rupture is reached and completed, release confining pressure and axial load while making sure the cell does not fall from the load frame.
2. Remove the cell and spherical platens from the load frame, then remove platens seats from the cell.
3. Unless the specimen is severely deformed, it may be removed from the cell with little force without dismantling the cell. However, if the sample is severely deformed, then the cell should be dismantled, and the sample debris removed. The use of excessive forces to remove fractured rock sample is not recommended, and may damage the rubber membrane.

4 MAINTENANCE

It is important to maintain the HOEK cell clean and to regularly inspect all components especially all platen and seat surfaces. Non-observance will lead to premature failure of the membranes, and general reduction of mating tolerance resulting in hydraulic fluid leaks and sample contamination.

Furthermore, rock debris left on spherical seatings or on the cylinder ends may lead to stress concentration during loading, producing premature sample failure and platen deterioration.

5 REFERENCES

- 1) **Hoek E. & Franklin J.A. Simple.** Triaxial Cell for Field or Laboratory Testing of Rock. Trans. Inst. Min. Metall. (Sect. A: Min. Industry), 1968, A22-26.
- 2) **Jaeger J.C. & Cook N.G.** Fundamentals of Rock Mechanics. (London: Methuen, 1969, USA distributors: Barnes & Noble Inc.).
- 3) **Jaeger J.C.** Brittle Fracture of Rocks. In Failure and Breakage of Rock. (Fairhurst C. ed. (New York: AIME 1067), 3-57.
- 4) **Hawkes I. & Mellor M.** Uniaxial Testing in Rock Mechanics Laboratories. Eng. Geol., 4, (1970), 177-285.