Rock Unconfined Compressive Strength

Rock strength can be measured using a variety of method. Generally, the UCS (Unconfined Compressive Strength) is the most common form of assessment. Direct measurement is undertaken similarly to concrete cylinders i.e. a core of rock must be extracted from the rock mass you wish to assess. Extracting a rock core requires specialised coring equipment. The UCS can be significantly affected by defects in the rock giving erroneous "low" results. It is a relatively expensive method with requires a number of resources.

Non-destructive methods offer several advantages:

- They can be completed in the field on the rock without a sample
- When used on a rock core the core can be used for other testing (i.e. UPV)
- The tests can be correlated with other factors (e.g. comminution factors

In literature Van der Waal and Mulder found:

"The Equotip seems to be a convenient portable tool for estimating the UCS of rock material. The possibility to make diametral measurements on rock cores makes the Equotip very useful for core logging"

Hack goes on to say "the battery operated Equotip can be used in the field or laboratory at any angle and is very easy to use". Further research in Australia by both tertiary institutions and commercially have reinforced these initial findings

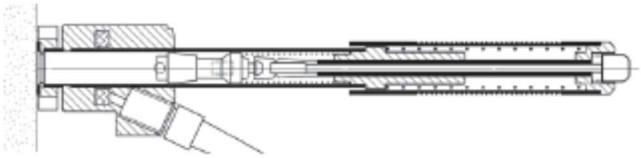
Equotip for Rock UCS

The Equotip provides the user with a highly portable, accurate tool to test rock hardness. The instantaneous results can be stored and saved on the indicating device. Whilst designed and used to determine the hardness of metal a new application in determining the compressive strength rock (UCS) and logging rock core sample has been researched. This allows the Equotip to be used as a rock strength testing machine without destroying sample (ie non-destructively)

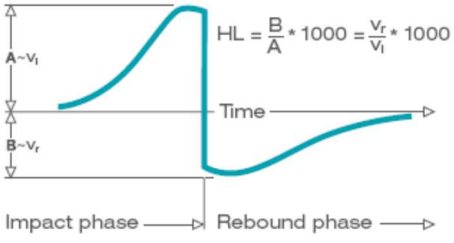
Equipment

The Equotip instrument consists on the Impact device and the control/logging box. Seen below the impact device consists of a 3mm dia. Spherical shaped tungsten carbide test tip which is spring mounted in an impact body. The test tip impacts on the test surface under spring force from which it rebounds.

The velocity that the impact body is impelled and rebounds with is measured by the passing of a permanent magnet through a coil of wire. This induces a voltage proportional to the device's velocity.

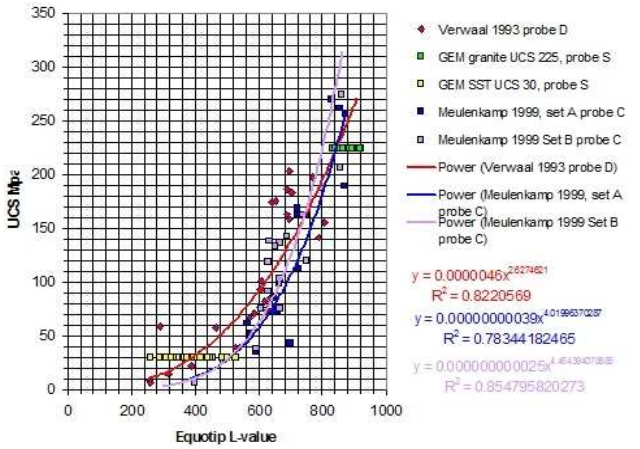


The LEEB hardness value is the quotient of the impelled velocity over the rebound velocity multiplied by 1000. Harder materials will rebound the impact device giving higher LEEB hardness values.



There are a number of options when purchasing the Equotip. The Equotip 550 offers the user a range of Impactor types, whilst the Equotip 540 can only be used with the D type impactor. Similarly, the Equotip Live is only capable of measuring the Leeb D scale, however it has a number of features such as Cloud syncing of data and a log of information about the data set.

Rock Unconfined Compressive Strength



Ring Supports

Accurate testing using the Equotip relies on the test specimen being immobilized. This can be achieved using a simple test jig firmly connected to a heavy vibration resistant base. Furthermore, the Support Ring (part 6) is designed to give a firm connection between the Impact Device and the core. The standard support ring I ideal for cores with radius greater than 60mm and flat surfaces. The Z14.5 to 30 support ring allows testing of cores between 29 and 60mm dia.

References

1. Verwaal, W & Mulder, A 1993 'Estimating Rock Strength with the Equotip Hardness Tester', International Journal of Rock Mechanics, Mineral Science and Geomechanics, vol. 30, no. 6, pp. 659-62.

2. Hack, R, Hingira, J & Verwaal, W 1993 'Determination of Discontinuity Wall Strength by Equotip and Ball Rebound Tests', International Journal of Rock Mechanics, Mineral Science and Geomechanics, vol. 30, no. 2, pp. 151-5.

3. Hack, R & Huisman, M 2002 'Estimating the Intact Rock Strength of a Rock Mass by Simple Means', Proceedings of 9th Congress of the International Association for Engineering Geology and the Environment, Durban SA, pp. 1971-7.

4. Meulenkamp, F & Grima, M 1999 'Application of neural networks for the prediction of the unconfined compressive strength (UCS) from Equotip hardness', International Journal of Rock Mechanics and Mining Sciences, vol. 30, pp. 29-39.

Impact Device Type S

The S type impact device uses highly durable material in the test tip in the impact body of the standard D type Impact Device. This improved durability is ideal for core logging because it prolongs the usage of the Impact Device between servicing. It is only used with the Equotip 550

About PCTE

PCTE have over 30 years' experience in the measurement and testing of construction materials. PCTE can provide more than just the equipment, they can provide expert training. PCTE have a service centre in Sydney in which they can provide calibration, repairs and warranty repairs.

PCTE supply three main ranges: NDT, Lab and Geotech Instrumentation.

- NDT includes: Rebound Hammers, Covermeters, Ultrasonics, GPR, Corrosion Testing, Coating Testing and Foundation Testing
- Lab includes equipment for: Concrete, Cement, Aggregate, Soil, Asphalt and Metal
- Geotech Instrumentation includes: Strain Gauges, Piezometers, Inclinometers, Extensometers, Tiltmeters, Load Cells and Dataloggers