INSTRUCTION MANUAL

POINT LOAD TESTER

Model PIL-7

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

E1048A-110530

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1 INTRODUCTION

Point load tester model PIL-7 is a simple portable apparatus used for testing rock samples or cores.

The PIL-7 has a maximum loading capacity of seven tons metric and accepts drill cores or rock lumps of different sizes having a maximum length of 102 mm.

The point load strength index obtained from a point load test is correlated with the uniaxial compressive strength of the rock tested. Being rapid and simple to perform, the point load test allows the user to easily delineate zones of rock of different strength properties. It then becomes a most useful tool in large-scale mining as well as civil engineering projects for classifying rock types from a mechanical perspective.

2 DESCRIPTION

The PIL-7 point load tester basically consists of the following components:

- a rigid loading frame onto which a fixed hydraulic jack provides the load for bringing a rock disc to failure in between two conical end platens;
- a high-pressure hydraulic coupler onto which a numerical pressure gage is mounted for failure load determination.

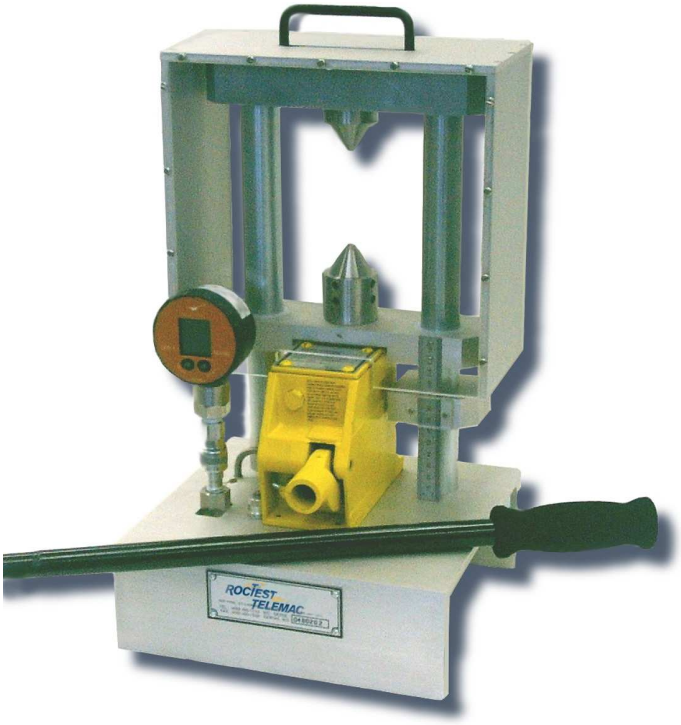


Figure 1: Point load tester model PIL-7

The top conical end is fixed on the loading frame and the bottom one is mounted on the piston of the hydraulic jack. A removable spacer is installed between the lower conical platen and the jack piston in order to prevent the sagging of the piston during test with core of small diameter. Other spacers are available upon request to suit specific core diameters.

A small graduated scale fixed on the side of the loading frame permits an easy determination of the diameter of the core.

The conical platen shape and tip radius follow the ISRM (International Society for Rock Mechanics) “Suggested method for determining point load strength”. A copy of the document is provided in appendix A, which is an integral part of this manual. The user should refer to the ISRM suggested method for details concerning the point load strength test.

The capacity of the hydraulic jack is seven tons metric, which corresponds approximately to a pressure of 72.412 MPa on the pressure gage. The gage has a pressure range of 100 MPa and features a peak mode, which permits the determination of the failure load for the rock sample tested. Using this mode, the manometer takes 5000 measurements per second.

In order to avoid projection of rock pieces at the moment of failure, a transparent plastic shield, which fits over the top of the tester, is provided.

3 TEST PROCEDURE

3.1 TYPES OF POINT LOAD TESTS

Three point load test configurations are available for core logging.

Diametral test

This test is the most reproducible and is independent of the core length provided that the length/diameter ratio is equal to or greater than 1.0.

Axial test

When only rock discs are available or when discs are produced with the diametral test, the axial test can be performed on core specimens with length/diameter ratios between 0.3 and 1.0. This test is useful to evaluate strength anisotropy.

Irregular lump test

If irregularly shaped rock pieces are the only specimens available, tests can still be performed on lumps having an equivalent core diameter close to 50 mm and an overall approximately cubical shape. In order to fit this requirement, specimens may be prepared from larger pieces by trimming or saw or chisel cutting.

3.2 POSSIBLE ADJUSTMENT

When delivered, the PIL-7 apparatus is set for testing 78 mm samples. Proceed as follows to adjust the apparatus to test longer samples (up to 102 mm).

1. With the pump lever, raise the jack piston until the lower platen reaches the upper one.

2. Untie the Allen screw located behind the scale support. Slide the scale support down until the reading reaches 0 and tie the Allen screw.

3. Push on the plunger to its retracted position.

4. Unscrew the bottom platen and the spacer and place the bottom platen back on the plunger.

The apparatus is now ready for longer samples. Remember that the scale has now an offset.

3.3 OPERATION

Note: At reception, the apparatus is saturated with oil and ready to be used.

The following procedure is used to conduct the point load test with the PIL-7 tester.

1. Connect the manometer to the quick-connect connector mounted on the base of the PIL-7 frame.

2. Tighten the relief valve located beside the handle support by turning it clockwise.

3. Set the manometer using the manometer guide provided in appendix C. Enter into the function menu, then:
   - select the pressure unit,
   - choose the peak on,
   - and set the zero.

Note: The manometer can display numbers up to 19999. If an OFL (overflow) message appears, change unit for a bigger one to decrease the value displayed. This operation can be done during the test itself (while raising pressure) without loosing any information.

4. Place the rock sample on the lower platen and, using the pump lever, raise the jack piston until the sample is in contact with the two conical platens. The contact location depends on the type of the test:
   - for a diametral test, the platens must make contact with the core along its diameter;
   - for an axial test, contact with the core is made along a line perpendicular to its end faces;

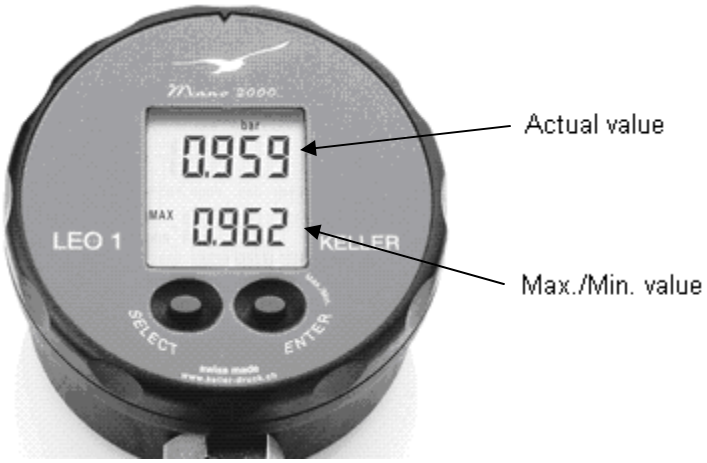
- for a lump test, contact is made along the smallest dimension of the lump, away from edges and corners.

5. Make sure the reference plate fixed on the lower platen indicates a zero reading when the two conical platens are in contact. If not, adjust it.

6. Read the distance separating the two contact point on the graduated scale fixed on the side of the loading frame.

7. Place the protective shield over the top of the tester.

8. Place the jack handle in its support and increase steadily load such that failure occurs within 10 to 60 seconds. Record the pressure at failure as shown on the bottom number of the LEO 1 manometer (the bottom number as to be set to MAX). The top number of the LEO 1 manometer is the actual value in real time and should not be used for calculations. The test is considered invalid and rejected if the fracture surface passes through only one loading point.



9. When the test is over, wipe off dust from jack piston with a lint-free cloth. Lubricate the seal at the base of the piston jack with a few drops of Enerpac oil when needed.

10. When the piston jack is cleaned, push on the plunger to its retracted position.

Note: Ensure to reset the manometer to zero between each test

4 INTERPRETATION

The load at failure is obtained thanks to the following relation.

$$P = L \cdot A_e$$

where P = load at failure in MN

L = reading of maximum pressure in MPa

A_e = effective area of the jack piston in m²

Note: The effective area of the jack piston for model PIL-7 is 9.48 cm² (9.48 x 10^{-4} m²).

The uncorrected point load strength index is calculated using the following relation and the load value previously calculated.

$$I_S = \frac{P}{D_e^2}$$

where I_S = point load strength index in MPa

P = load at failure in MN

D_e = equivalent core diameter in m

The index I_S may also be obtained graphically using the nomogram shown below presented by Broch and Franklin (1972).

The I_S index varies as a function of the diameter of the core D in the diametral test and as a function of the equivalent diameter D_e in axial, block and irregular lump tests.

A size correction must be applied to obtain a unique point load strength value for the rock sample and one that can be used for purposes of rock strength classification. Please refer to the size correction procedure explained in the ISRM Suggested method given in appendix A. The same document also provides the method for evaluating the uniaxial compressive strength of the rock tested from the corrected point load strength index $I_S(50)$.

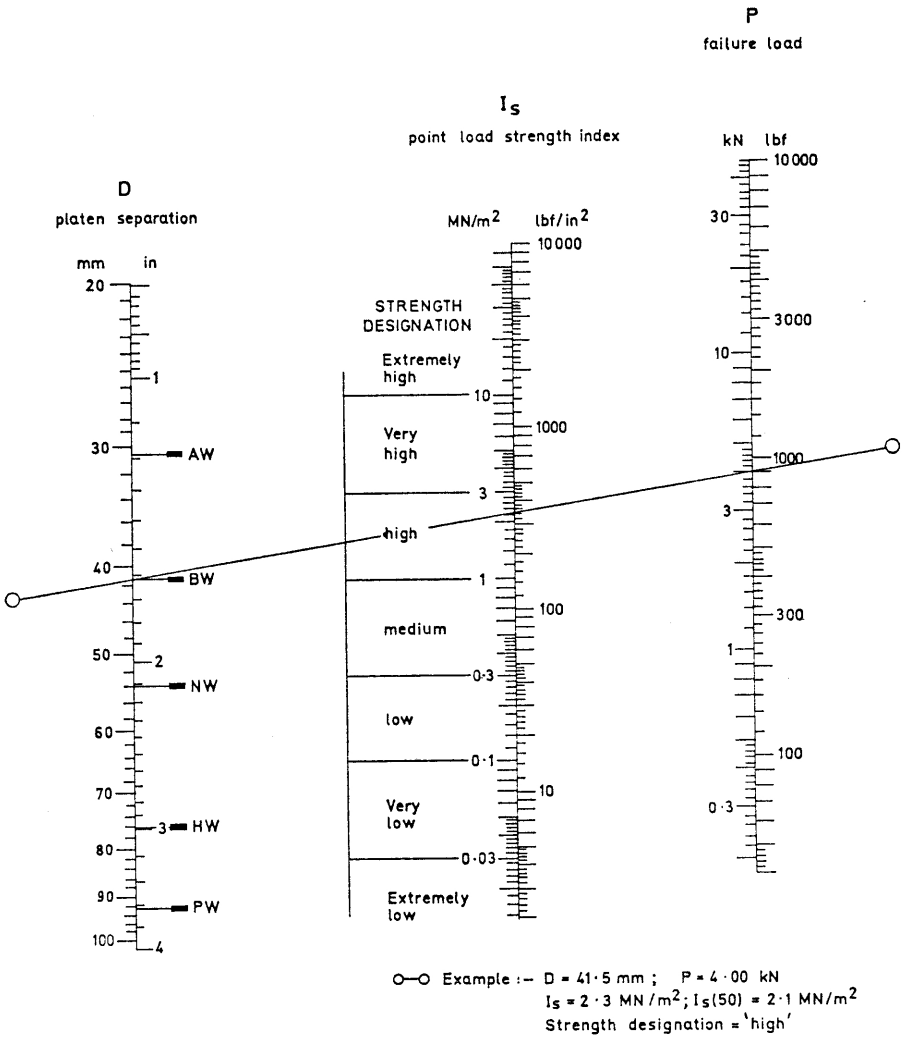


Figure 2: Nomogram for computing point load strength

For testing machines that employ gages calibrated in terms of hydraulic pressure, the pressure reading should be multiplied by the effective ram area to obtain load; the nomogram can be adjusted for direct readings by a vertical displacement of the failure load scale.

5 MAINTENANCE

5.1 PLUNGER CLEANING AND OIL CHANGE

The piston jack needs to be cleaned frequently. Wipe off dust on piston jack using a lint-free cloth and lubricate seal at the base of the piston jack with a few drops of Enerpac hydraulic fluid regularly. This regular maintenance will prevent dust from entering oil reservoir.

Oil change on the jack should be performed every 500 tests or when oil is contaminated (turning black) to prevent components wear.

Do not use any grease with the apparatus.
Grease on the plunger will damage internal components of the jack.

5.2 RE-FILLING THE JACK RESERVOIR

To re-fill the reservoir of the jack, make sure first that the plunger is fully retracted or the system will contain more fluid than the reservoir can hold.

Follow the procedure below.

1. Use wrench end of jack handle to open release valve by turning counter-clockwise.

2. Place jack on its front face with the filler plug on top. Remove fill plug.

3. Slowly add Enerpac hydraulic fluid.

   Use only Enerpac hydraulic fluid
   otherwise damages can occur to the jack and its plunger.
   Another type of fluid will void the warranty.

   Hydraulic fluid can be provided by Roctest – Telemac or directly from Enerpac (www.enerpac.com). Contents are model HF-100 to HF-104 depending on their capacities. Content HF-100 represents about 3 complete refills.

4. Once the reservoir is filled, extend the plunger out approximately 4 cm. Add enough fluid to fill the reservoir.

5. Insert the fill plug and turn in about half way, leaving the bleed hole in the fill plug exposed.

6. Push plunger to its fully retracted position. Excess oil and air will be expelled through the fill plug bleed hole.

7. Tighten fill plug.

8. Use wrench end of the jack handle to close the release valve by turning clockwise.

9. Pump the handle. If plunger does not advance to full travel, repeat the whole procedure.

5.3 CLEANING AIR VENT HOLE (EXCEPTIONAL)

Always keep the air vent hole surface free of debris.

To remove dust or debris from the hole, remove the four screws of the top plate and clean the little bowl in black rubber.

Take care when putting the bowl back: it should stay at its initial location. Replace the top plate with the screws.

5.4 FIXING SMALL OIL LEAKS

When small oil leaks occur, it generally happens near the manometer.

1. Check that the ball of the quick-connect at manometer side is free to move.

2. Check that the quick-connect is free of debris. Plug the manometer and do not hesitate to firmly tight the coupling ring by hand.

3. If the problem is not fixed, check the other couplings for oil leakage. Unscrew the defective one, add some Teflon tape, and tight it well.

6 MISCELLANEOUS

6.1 REFERENCES

Appendix A

BROCH, E., and J.A. Franklin. The Point Load Strength Test, International Journal of Rock Mechanics, Min. Sci., Vol. 9, 1992, pp. 669-697.

Appendix B

Hoek E., and Brown E., Underground Excavations in Rock, Institution of Mining and Metallurgy, MAA, 1980, pp. 14-37.

6.2 CONVERSION FACTORS

	To Convert From	To	Multiply By
LENGTH	Microns	Inches	3.94E-05
	Millimetres	Inches	0.0394
	Meters	Feet	3.2808
AREA	Square millimetres	Square inches	0.0016
	Square meters	Square feet	10.7643
VOLUME	Cubic centimetres	Cubic inches	0.06101
	Cubic meters	Cubic feet	35.3357
	Litres	U.S. gallon	0.26420
	Litres	Can–Br gallon	0.21997
MASS	Kilograms	Pounds	2.20459
	Kilograms	Short tons	0.00110
	Kilograms	Long tons	0.00098
FORCE	Newtons	Pounds-force	0.22482
	Newtons	Kilograms-force	0.10197
	Newtons	Kips	0.00023
PRESSURE AND STRESS	Kilopascals	Psi	0.14503
	Bars	Psi	14.4928
	Inches head of water*	Psi	0.03606
	Inches head of Hg	Psi	0.49116
	Pascal	Newton / square meter	1
	Kilopascals	Atmospheres	0.00987
	Kilopascals	Bars	0.01
	Kilopascals	Meters head of water*	0.10197
TEMPERATURE	Temp. in °F = (1.8 x Temp. in °C) + 32 Temp. in °C = (Temp. in °F – 32) / 1.8		

* at 4 °C

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Table 1: Conversion factors

APPENDIX “C”

GUIDE OF DIGITAL MANOMETER KELLER MODEL LEO 1

KEY	FUNCTIONS		KEY
SELECT	ON Wait for the instrument measuring mode (about 3 s).		
SELECT	RESET Max. / min. value and peak value are set to the actual pressure.		ENTER
SELECT	OFF Turns off the manometer.		ENTER
SELECT	MANO Enter into manometer functions.		ENTER
	SELECT	PEAK OFF / PEAK ON Peak off: Normal measuring mode with 2 measurements per second. Peak on: Fast measuring mode with 5000 measurements per second.	ENTER
	SELECT	ZERO SET Sets a new zero reference.	ENTER
	SELECT	ZERO RES Sets the zero to factory setting.	ENTER
	SELECT	CONT ON / CONT OFF Cont on: Deactivates the automatic turn-off function. Cont off: Activates the automatic turn-off function.	ENTER
	SELECT	UNIT SELECTION Bar	ENTER
	SELECT	UNIT SELECTION hPa (mBar)	ENTER
	SELECT	UNIT SELECTION kPa	ENTER
	SELECT	UNIT SELECTION MPa	ENTER
	SELECT	UNIT SELECTION psi	ENTER
	SELECT	UNIT SELECTION kp/cm²	ENTER

Example: Setting a new zero reference

- Turn on the manometer by shortly pressing the SELECT key.
- Press the SELECT key 3 times: MANO appears.
- Press ENTER: PEAK ON or PEAK OFF appears.
- Press SELECT: ZERO SET appears.
- Press ENTER: The new Zero reference is set.
- The manometer returns to the measuring mode.