MANUALE ISTRUZIONI
INSTRUCTION MANUAL

GEOHAMMER®

Versione 1.01
Gennaio 2012

Indice Generale

1. Please Note ▼

This manual contains instructions on how to use the rebound hammer and the subsequent elaboration of data obtained, as well as the necessary safety precautions to be taken.
In order to make full and safe use of this tool, we advise reading all the instructions in this manual very carefully.
The serial number of the rebound hammer is located on the outside surface of the shell of the instrument (see exploded diagram on page NN). The calibration label is on the back of the shell.
This manual is an integral and essential part of the product. It should be kept carefully for the life of the equipment. If lost or damaged (for reasons for which DRC is not responsible), a replacement copy may be purchased.
When contacting DRC representatives or customer service centres, please have the following information available:

Modello	Numero di Serie	Data Verifica

2. General Safety Standard ▼

In order to avoid damaging the equipment and causing injury to the operator or others, read the following safety precautions carefully before operating the rebound hammer. These precautions should be kept with the equipment so that anyone who intends using it may consult them beforehand.
The manufacturer assumes no responsibility whatsoever for direct or indirect damage to persons, property, or animals caused as a consequence of not having observed the safety precautions contained in this manual.

- The instrument must be used by adequately trained personnel in order to avoid improper use.
- The instrument must be used exclusively for the purpose for which it was designed.
- The tampering with or modification of the instrument shall be considered unauthorised and therefore release the manufacturer from any responsibility. If the equipment has been tampered with and/or modified, the guarantee for eventual spare parts or calibration verification shall be considered null and void.

- Do not carry out any testing on any parts of the human body or animals in order to avoid causing permanent and/or serious injury.

3. Reference Standard ▼

At present, it is assumed that the only standard which exhaustively regulates the assessment of the surface hardness of natural rocks by means of rebound analysis is the ASTM D5873-00 *"Standard test method for determination of rock hardness by rebound hammer method" American Society for testing and materials*.

For information regarding the "principle–equipment–procedure–result of the test", kindly refer to UNI standard EN 12504-2:2001 (*Non-destructive tests–determining the rebound hardness number*).

4. Aim, Limitation and Areas of Application ▼

The rebound hardness number determined with this method is primarily of use for on site tests carried out for engineering, design and construction purposes, and more specifically for:

a. the qualitative survey of the state of homogenization of the rock materials;
b. measuring the resistance of rock materials through the calculation of unconfined uniaxial compressive strength;
c. evaluating the state of alteration of the rock materials through the relationship between the rebound values on the joint walls (discontinuities for which there is no marked creeping between the surfaces) and on a fresh surface of the same rock obtained by segregation;
d. calculating the JCS coefficient (Joint wall compressive strength);
e. estimating penetration rates for tunnel boring machines.

The testing method is not intended to be an alternative for determining compression strength of rock material but, with suitable correlations, it can provide an estimate of the on site resistance.
This method is based on the correspondence between the compression breaking unit load and the surface hardness of rock material, measuring the remaining elastic energy (rebound method).

It must be considered that in rock masses, the state of localized stress is that of "confined elements" and therefore multiaxial, in that for a correct reading of the rebound values, further correlation curves between the uni- and multiaxial tensions are necessary.

The results obtained through the use of the method described in this manual depend on the members of staff carrying out the testing and the suitability of the equipment used.

5. Operating Systems ▼

The principle for the function of the instrument is that a mass launched from a spring strikes a piston in contact with the surface and the result of the test is expressed in terms of the bouncing distance of the mass.

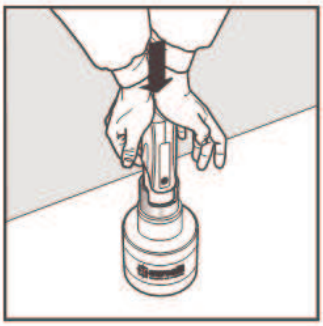
The equipment is constituted by a mobile mass with a certain initial energy, which strikes the surface of a concrete mass. There is a redistribution of the initial kinetic energy following the strike and namely a part is absorbed by the concrete in the form of plastic or permanent deformation energy and another part of the energy is returned to the mobile mass which bounces for a tract in proportion to the remaining energy.
An essential condition for the distribution of such energy is that the concrete mass is practically in infinite relationship with the mass of the mobile equipment, otherwise a part of the initial energy, being independent from the relative masses of the two bodies that will collide, would be transferred to the concrete in the form of kinetic energy.
The condition for infinite mass for the concrete is realized by using very small impact masses.
In order to obtain the necessary energy for the impact a spring system is used.
The bounce run is determined by the energy of the bounce following the strike with the concrete and by the characteristics of the spring system.

All the test devices that are based on the use of the results from the impact energy, must be equipped with a calibration control in that, after prolonged use, the springs modify their elastic constants.

The ROCK HAMMER rebound hammer has an impact energy of 0.735 N/m.
The regression curves in this instruction manual were constructed with reference to samples tested under unconfined axial compression and may be applied only to the ROCK HAMMER rebound hammer produced by DRC.
Therefore DRC does not guarantee the validity of the regression curves for application to other types of rebound hammers.

6. Testing Anvil ▼

The stainless steel calibration anvil TAM100 for the sclerometer verification is characterized by a hardness of 57.60 HRC (Rockwell Hardness type C), by a mass of 16 kg and a diameter of about 150mm.
The calibration verification on an anvil does not guarantee that different rebound hammers produce the same results in other points of the rebound scale. In order to verify the calibration of the rebound hammer, the steel anvil must be placed on a flat, level surface that provides firm and rigid support, like, for example, a reinforced concrete floor.
Operate the instrument at least three times prior to initiating the readings from the calibration anvil, to ensure that the mechanics are operating correctly.
Then, following this procedure, insert the sclerometer in the anvil guide ring and carry out a series of strikes (no. ≥ 10).
The average bounce index of the sclerometric strikes performed with the sclerometer ROCK HAMMER to the calibration anvil TAM100 must be 70 ± 2.



7. Selection and Preparation of the surface for Testing ▼

Rock mass surfaces tested in situ, including natural outcrops or prepared surfaces such as tunnel walls or floors, shall have a smooth test area of at least 15 cm in diameter.
In the event of surface outcrops, avoid sampling or testing any material which has been weakened by aggressive weathering, or alteration or which for some reason is deemed not representative of the material of interest.
The test surface of all the specimens, whether in situ or in the laboratory, shall be smooth to the touch and free from joints, fractures or other localised discontinuities to a depth of at least 6 cm. On site, the rock must be flat and free from surface grit over the area involved in the functioning of the piston.
If the test surface is very rough, gently smooth it using the abrasive stone supplied with the instrument.

8. Performing Test ▼

With an end to facilitating testing, a distance template is supplied with the instrument which permits a regular grid with lines 25 to 50mm apart to be drawn onto the material to be sampled. The intersections of the lines may thus be considered as the test stations.
After taking the rebound hammer out of its case, gently push the percussion rod inwards, pressing it against a rigid surface. The shaft will be released and come out of the shell of the instrument, which will thus be ready for testing.
Then press the percussion rod against the surface of the natural rock to be tested, keeping the instrument perpendicular to the surface itself. Apply gradual and increasing pressure until the hammer is released. Keep the instrument pressed firmly against the surface examined and press the stop device. Then read off the rebound value number.
Do not touch the lateral stop device whilst the percussion rod is being pressed.
After impact, record the rebound number.
Use at least nine measurements to obtain a reliable estimate of the rebound number of a test area. Record the position and orientation of the rebound hammer for each series of measurements.
Examine all the marks left on the surface after impact. If the impact has shattered or pierced the rock owing to a nearby hollow then discard the result.

After testing, carry out the calibration of the rebound hammer once again, using the steel anvil. If the result does not conform to the limits recommended by the manufacturer, annul the test and contact DRC's assistance laboratories.
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It must also be remembered that:

i. Rebound testing must be avoided along edges and corners, which would result in inaccurate, lower values.
ii. Rebound numbers obtained by operating on wet rock correspond to lower resistance values than those registered on dry rock.
iii. The data obtained are only indicative of a given rock mass and its superficial structure, being the rebound values related to the latter and to the hardness of the mass.
iv. Rock masses at a temperature of ≤ 0° C may result in very high rebound numbers.
v. For readings to be compared, the direction of impact, horizontal, upward, downward and so forth, must be the same.
vi. It is advised to carry out various tests with the same rebound hammer in order to compare the results.
vii. If more than one ROCK HAMMER mechanical rebound hammer is to be used, a sufficient number of tests must be carried out on typical rock mass surfaces to determine the magnitude of the differences to be expected (including rebound hammers with a discard of 1-3 units).

9. TEST Resoult ▼

If over 20% of all the measures fluctuates from the average by more than 6 units, the entire set of measurements taken will have to be discarded.

10. Test Report ▼

Il resoconto di prova dovrà includere:
a) identificazione dell'elemento/struttura di calcestruzzo;
b) posizione della/e area/e di prova;
c) identificazione dello sclerometro;
d) descrizione della preparazione della/e area/e di prova;
e) dettagli sul calcestruzzo e sua condizione;
f) data e ora di esecuzione della prova;
g) risultato della prova (valore medio) e orientamento dello sclerometro per ciascuna area di prova;
h) eventuali deviazioni dal metodo di prova normalizzato;
i) dichiarazione della persona tecnicamente responsabile della prova, che attesti che la prova è stata effettuata in conformità alla UNI EN 12504-2:2001, eccetto per quanto riferito al punto h).

Se necessario, il resoconto può includere le singole misure dello sclerometro.

11 Regression Curves ▼

Theoretically speaking, correct application of the rebound hardness method should call for plotting of the correlation curves with reference to the material in question. As this operation cannot actually be carried out owing to the huge variety of existing natural rocks, it is sufficient to plot the regression curves based on the cubic sample blocks of rock belonging to certain "types". For this purpose, the following types of common rock masses have been tested:

Denominazione	**Tipologia**	**Località Provenienza**
Porphyry	Porphyry	Valtellina porphyry quarry
Gritstone (pietra serena)	Sandstone	Fiorenzuola (FI)
Travertine	Travertine	Tivoli (RM)
Pietra Leccese	Soft Limestone	Lecce
Trani (Apricena)	Compact Limestone	Apricena
Marbles	Marbles	San Pietro Mussolini (VI)
Tuff	Tuff	Tuff quarries (Lazio)

Moreover, an approximate estimate of the resistance of the material may only be made where there is an experimental calibration curve which correlates the resistance of that particular material with the rebound number.
In its absence, a far more general curve may be used; this is supplied as a support by the rebound hammer manufacturer.
To this end, Eurosit has conducted experiments involving destructive (crushing in a press) and non-destructive testing (rebound testing) on 60 cubic samples with a width of 75mm of each natural rock selected in accordance with the following standards

UNI 9724, part 2, July 1990, part 3, October 1990
UNI 8458 part 2-7
UNI EN 1926

Each cubic sample was subjected to:

- thorough dimensional checks and relative weighing
- execution of rebound testing

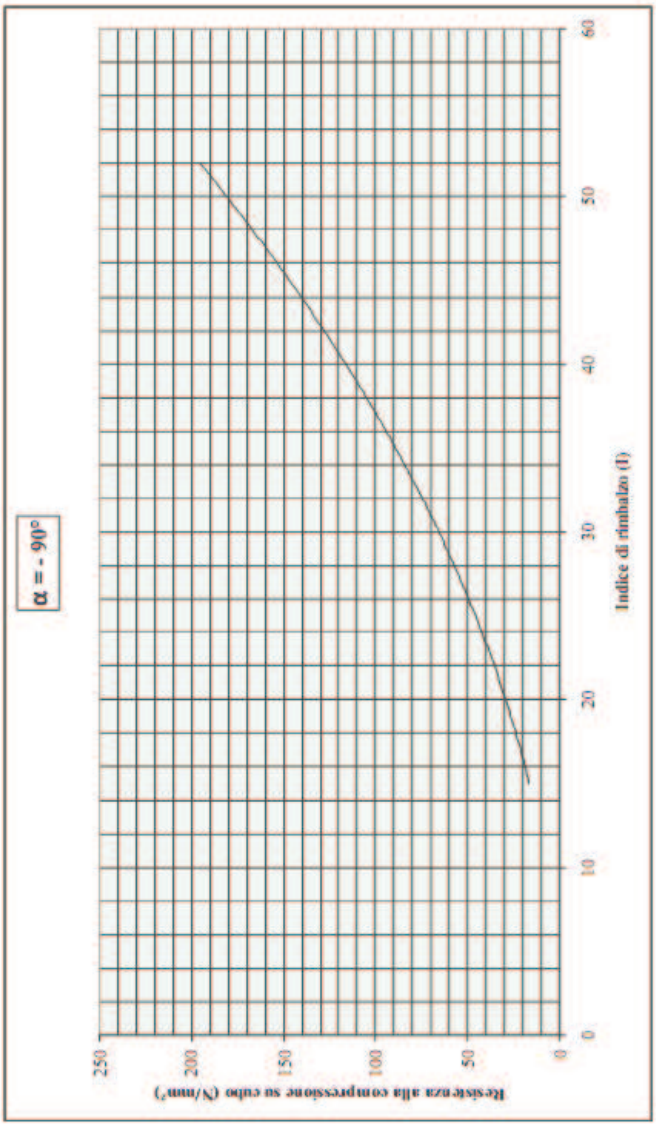
In order to render the results of the rebound testing as independent from the operator as possible, Eurosit has designed and built a tool named ATHR (Alfa Test Hammer Robot – patent No. AN2002A000028) which consents the cubic samples to be gripped automatically between the two plates of a press with stress of 1 N/mm², so that they are held firmly together, impeding any movement during impact. In this way, it was possible to carry out a sequence of four rebound tests per side, observing them with a video camera and external monitor, where the instrument's conditions of inclination were $\alpha = -90°$, 0° and +90° (where α is the angle that the axis of the rebound hammer forms with the horizontal axis).

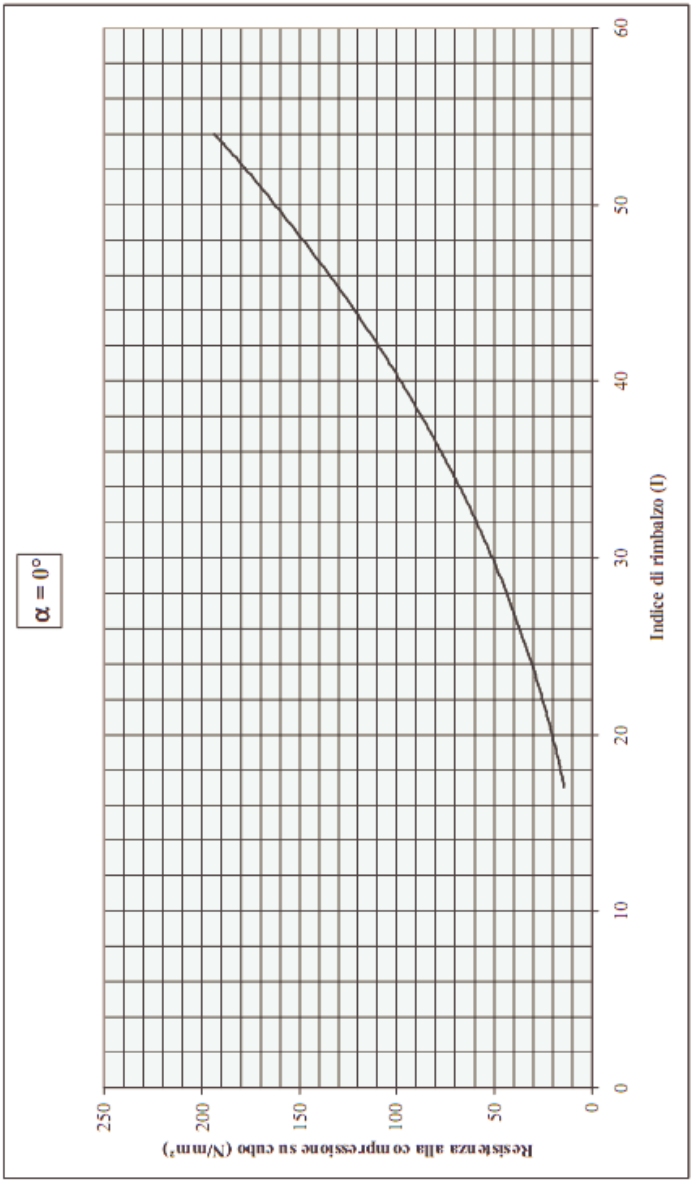
- crushing of test specimens.

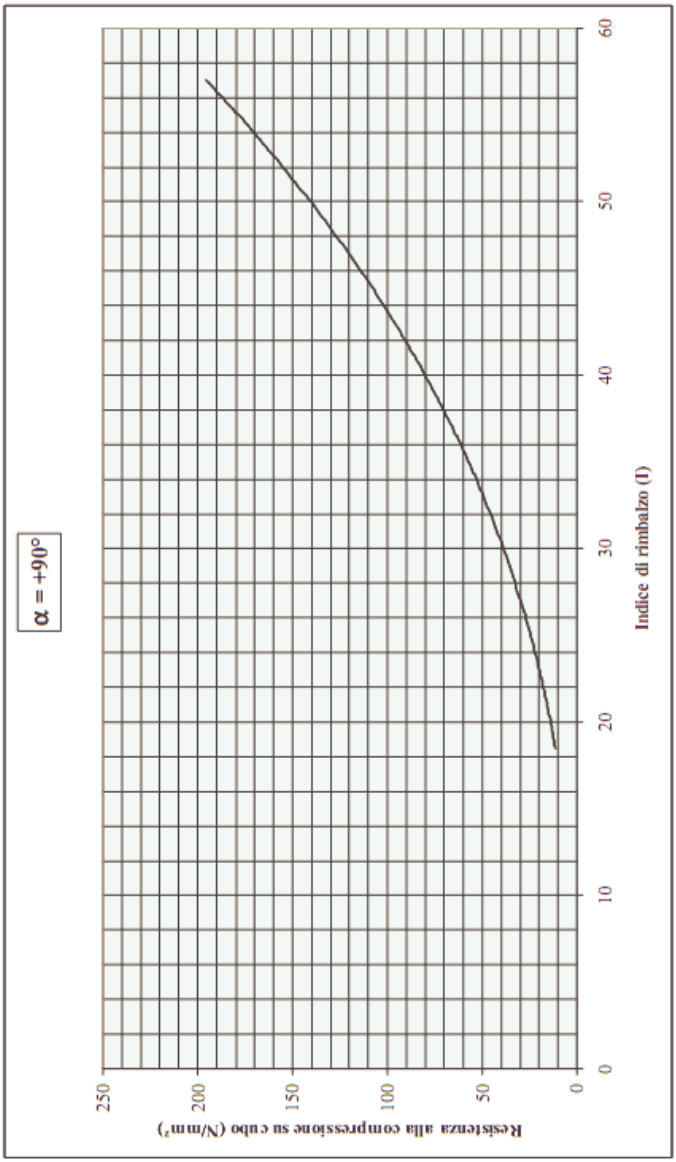
A scattergram of experimental points between surface hardness and breaking unit load was obtained.

The series of experiments were entirely carried out at the Research and Development Centre of DRC s.r.l

Below are the three correlation curves for which the ROCK HAMMER equipment is calibrated. These curves were obtained by the experiments carried out and classified according to the various impact inclinations of the equipment.


α = - 90°
Indice di rimbalzo (I)
0
10
20
30
40
50
60
Resistenza alla compressione su cubo (N/mm²)
0
50
100
150
200
250


α = 0°
Indice di rimbalzo (I)
0
10
20
30
40
50
60
Resistenza alla compressione su cubo (N/mm²)
0
50
100
150
200
250


α = +90°
Resistenza alla compressione su cubo (N/mm²)
0
50
100
150
200
250
Indice di rimbalzo (I)
0
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20
30
40
50
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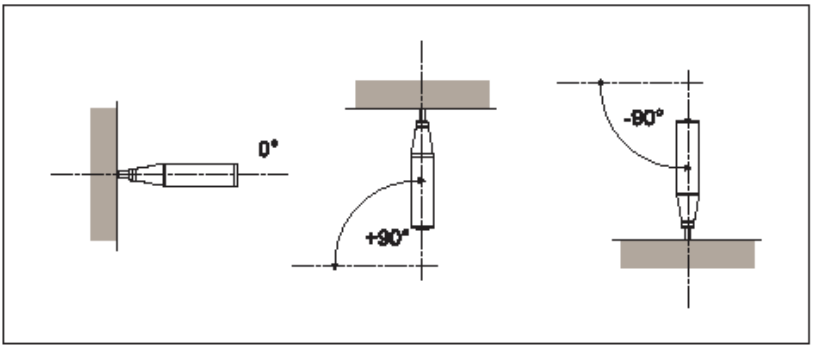


12.Accessories ▼

No.	Description	Cod. Articolo
	Wheel center – upper/lower	S0042
	Abrasive grinding wheel	S0040
	Measuring station template – distance 30mm	S0100
	Measuring station template – distance 25mm	S0101
	Instruction booklet GEOHAMMER	S0102
	Note book for GEOHAMMER	S0103
	Padded bag for sclerometer GEOHAMMER	S0105

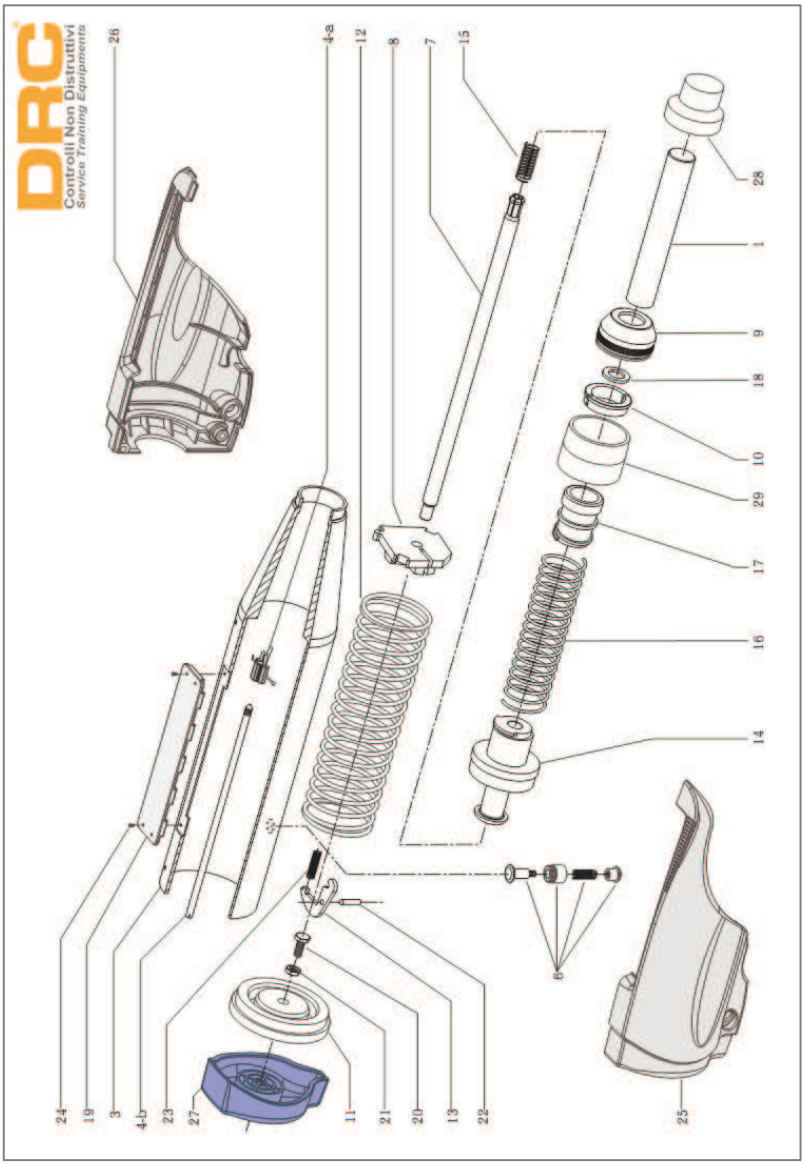
13. Exploded ▼

No. Posizione	Descrizione	Cod. Articolo
1	Percussion Beam	S0053
3	Shell	S0061
4-a	Index	S0065
4-b	Index small beam	S0013
6	Pawl	S0063
7	Sliding beam	S0011
8	Drive disk	S0052
9	Ring not push rod	S0066
10	Block segment	S0051
11	Rear cap	S0067
12	Pressare spring	S0019
13	Hook	S0056
14	Hammer	S0062
15	Shock absorber spring	S0059
16	Percussion spring	S0086
17	Ring nut spring holder	S0050
18	Felt kasher	S0060
19	Index plate	S0069
20	M6x14 TE Screw	V0027
21	m6 Bolt	V0001
22	Ratchet gear pin	S0057
23	Hook spring	S0022
24	M1.7x4.5 Screw	V0031
25	Right side shell	S0097
26	Left side shell	S0098
27	Shell closing cap	S0099
28	Transport blocking cap	S0096
29	Aluminium distance piece	S0028

14. Guarantee ▼

The mechanical organs of the sclerometer are guaranteed for 12 months from the date of purchase of the sclerometer.
The cost of the calibration check and issue of the relative report will be evaluated from time to time according to the condition of the instrument.
The guarantee loses its validity at such time as tampering with/or attempts at opening the instrument is/are verified.

All the products may be subject to modification without warning.


DRC
Controlli Non Distruttivi
Service Training Equipments
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