OPERATING INSTRUCTIONS

Concrete Test Hammer

35-1480

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Contents

1 General

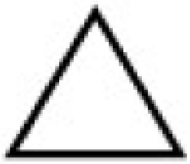
The concrete test hammer is a mechanical device used for performing rapid, non destructive quality testing on materials in accordance with customer’s specifications; in most cases, however, the material involved is concrete. The device is to be used exclusively on surfaces to be tested and on the testing anvil.

2 Safety

2.1 Safety icons

The following safety icons are used in conjunction with all important safety notes in these operating instructions:-

Danger!
This notice indicates a risk of serious or fatal injury should certain rules of behaviour be disregarded.



Warning!
This notice warns you about the risk of material damage, financial loss and legal penalties (e.g. loss of warranty rights, liability case, etc.).

⇒ This denotes important information.

2.2 Standards and regulations applied

• ISO/DIS 8045	International
• EN 12 504-2	Europe
• BS 1881, part 202	Great Britain
• DIN 1048, part 2	Germany
• ASTM C805	USA

3 Measuring

3.1 Measuring principal

The device measures rebound value R. There is a specific relationship between this value and the hardness and strength of the concrete

The following factors must be taken into account when ascertaining rebound values R:

- The impact direction: Horizontal, vertically upwards and vertically downwards.
- Age of the concrete.
- Size and shape of the comparison sample (cube, cylinder).

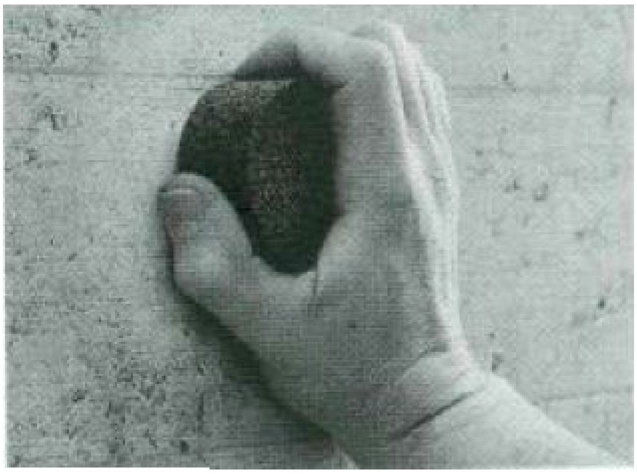
⇒ If necessary, clamp the items to be tested prior to measurement in order to prevent material from movement.

- Items made from artificial stone which are sensitive to impacts

⇒ Preferably perform measurements at temperatures between 10ºC and 50ºC.

3.2 Measuring procedure

The numbered items in brackets below are illustrated in Figure 2.4, page 5. Perform a few test impacts with the concrete test hammer on a smooth, hard surface before taking any measurements which you are going to evaluate.



- Use a grind stone to smooth the test surface.

Figure 2.1 Preparing the test surface

Warning!
The impact plunger (1) generates a recoil when it deploys. Always hold the concrete test hammer in both hands!

- Position the concrete test hammer perpendicular to the test surface.
- Deploy the impact plunger (1) by pushing the concrete test hammer towards the concrete surface until the pushbutton springs out.

Figure 2.2 Deploying the impact plunger (1)

Danger!
Always hold the concrete test hammer in both hands, perpendicular to the test surface, before you trigger the impact!

Wear safety glasses when using the device.

⇒ Each test surface should be tested with at least 10 impacts. The individual impact points must be spaced at least 20 mm apart.

- Position the concrete test hammer perpendicular to the test surface.
- Push concrete test hammer against the test surface at moderate speed until the impact is triggered.

Figure 2.3 Performing the test

- Press the pushbutton (6) to lock the impact plunger (1) after every impact. Then read off and note down the rebound value R indicated by the pointer on the scale (19).

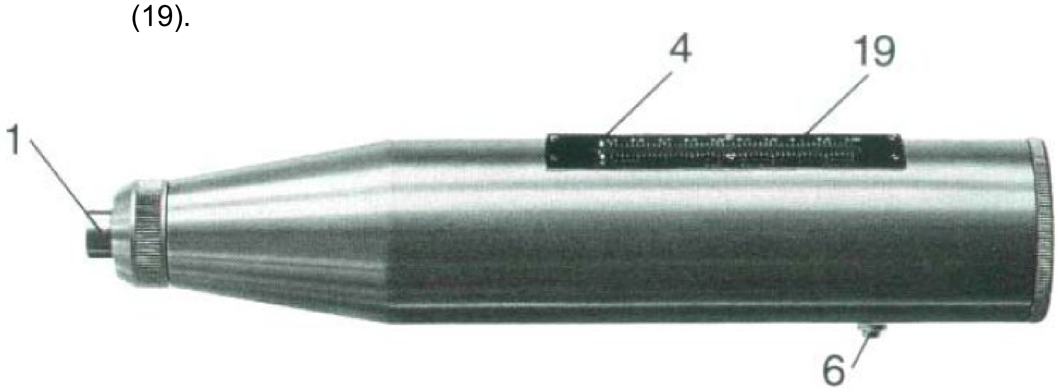


Figure 2.4 Reading the test result from the scale (19)

3.3 Recording and evaluating data

3.3.1 Recording procedure

After every impact, the rebound value R is displayed by the pointer (4) on the scale of the device.

3.3.2 Evaluation of results

Take the average of the 8-10 rebound values R which you have measured.

⇒ Do not include values which are too high or too low (the lowest and the highest values) in your calculation of the average value.

- Determine which conversion curve is appropriate for the selected sample and shape (see Figures 2.5 - 2.7, pages 6 – 8). Then, using the average rebound value R_m and the selected conversion curve, read off the average compressive strength.

⇒ Note the impact direction!

The average compressive strength is subject to dispersion (± 4.5N/mm^2 to $^{\pm}$8 N/mm^2).

3.4 Conversion curves

3.4.1 Derivation of the conversion curves

The conversion curves (Figures 2.5 - 2.7) for the concrete test hammer are based on measurements taken on many sample cubes. The rebound values R of the sample cubes were measured using the concrete test hammer. Then the compressive strength was ascertained on a pressure testing machine. In each test, at least 10 test hammer impacts were performed on one side of the test cube which was lightly clamped on the press.

3.4.2 Validity of the conversion curves

- Standard concrete made from Portland cement or blast furnace slag cement with sand or gravel (maximum particle size dia. ≤ 32mm).
- Smooth, dry surface.
- Age: 14 – 56 days.

3.4.3 Empirical values

The conversion curve is practically independent of the:

- Cement content of the concrete.
- Particle graduation.
- Diameter of the largest particle in the fine gravel mixture, providing the diameter of the maximum.
- Water/cement ratio.

Conversion Curves, Concrete Test Hammer

Concrete pressure resistance of a cylinder after 14 – 56 days

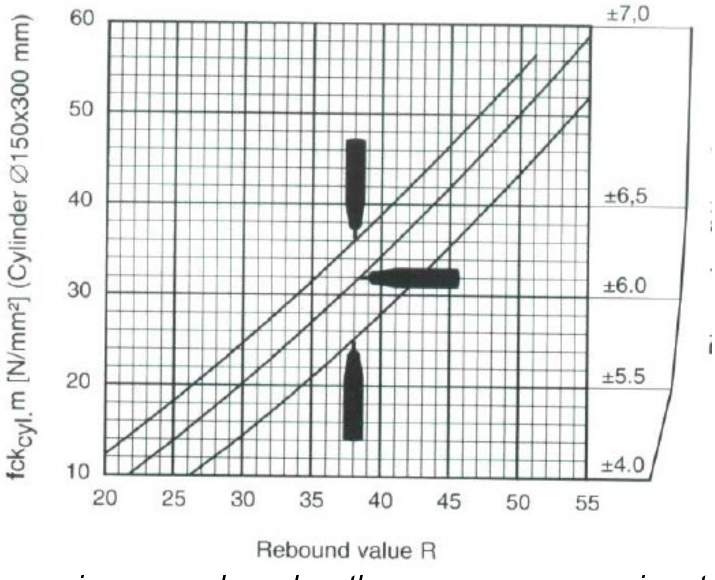


Figure 2.5 Conversion curves based on the average compressive strength of a cylinder and the rebound value R.

fck$_{cyl}$.m: Average pressure resistance of a cylinder (probable value).

⇒ The concrete test hammer in Figure 2.5 indicates the impact direction.

Limits of Dispersion

fck$_{cyl}$.m: The max. and min. values are set so 80% of all test results are included.

Conversion Curves, Concrete Test Hammer

Concrete pressure resistance of a cube after 14 – 56 days

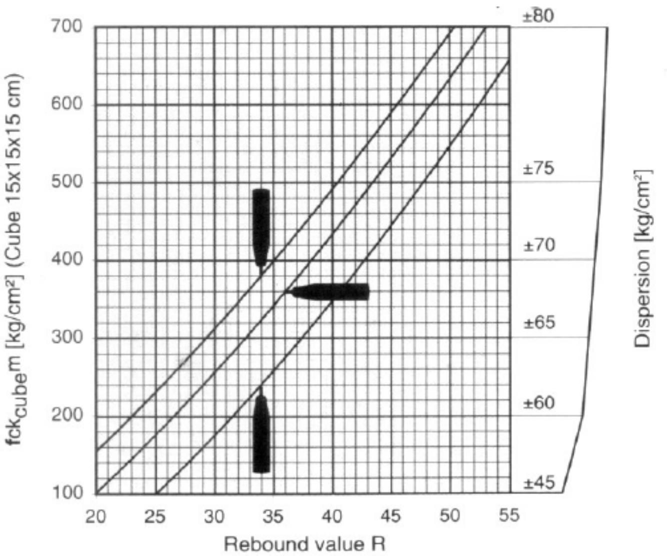


Figure 2.6 Conversion curves based on the average compressive strength of a cube and the rebound value R.

fck$_{cube}$.m: Average pressure resistance of a cube (probable value).

⇒ The concrete test hammer in Figure 2.6 indicates the impact direction.

Limits of Dispersion

fck$_{cube}$.m: The max. and min. values are set so 80% of all test results are included.

Conversion Curves, Concrete Test Hammer

Concrete pressure resistance of a cylinder after 14 – 56 days

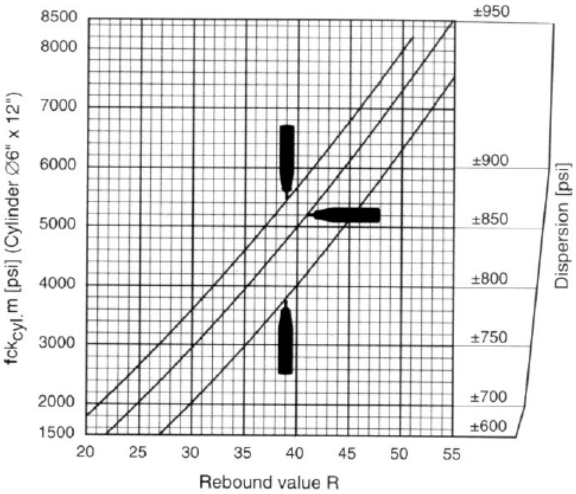


Figure 2.7 Conversion curves based on the average compressive strength of a cylinder and the rebound value of R.

fck$_{cyl}$.m: Average pressure resistance of a cylinder (probable value).

⇒ The concrete test hammer in Fig 2.7 indicates the impact direction.

Limits of Dispersion

fck$_{cyl}$.m: The max. and min. values are set so 80% of all test results are included.

3.5 Factors affecting the values

3.5.1 Direction of impact

The measured rebound value R is dependent on the impact direction.

Shape coefficient

The compressive strength measured in a pressure testing machine depends on the shape and size of the sample.

⇒ The sample prescribed for use in a particular country must be taken into account when converting the rebound value R into compressive strength.

In the conversion curves on pages 6 - 8, the values of the compressive strength are specified for cylinders (Ø 120 x 300mm or Ø6” x 12”) and for cubes (length of side 150mm). The following shape coefficients are familiar from the literature:-

Cube	150 mm	200 mm	300 mm
Shape	1.00	0.95	0.85
Coefficient	1.25	1.19	1.06

Cylinder	Ø150x300 mm	Ø100x200 mm	Ø200x200 mm
Shape	0.8	0.85	0.95
Coefficient	**1.00**	1.06	1.19

Drill core	Ø50x56 mm	Ø100x100 mm	Ø150x150 mm
Shape	1.04	1.02	1.00
Coefficient	1.30	1.28	1.25

Example:
A cube with a length of side of 200 mm is used for the determination of the compressive strength with the pressure testing machine. In this case the strength values shown in the conversion curve Figure 2.7 on page 8 (for cylinders Ø8”x8”) must be multiplied by shape coefficient of 1.19.

3.5.2 Time coefficient

The age of the concrete and its carbonate penetration depth can significantly increase measured rebound values R. It is possible to obtain accurate values for the effective strength by removing the hard, carbonate-impregnated surface layer using a manual grinding machine over a surface of about Ø 120 mm and performing the measurement on a non carbonate-impregnated concrete. The time coefficient, i.e. the amount of the increased rebound values R, can be obtained by taking additional measurements on the carbonate-impregnated surface

Time coeff. $Z_f = \frac{R_M carb}{R_M n.c.} \Rightarrow R_m n.c. = \frac{R_M carb}{Z_f}$

R_m carb: Average rebound value R, measured on carbonate-impregnated concrete surface.

R_m n.c.: Average rebound value R, measured on carbonate-impregnated concrete surface.

R_m n.c: Average rebound value R, measured on non carbonate-impregnated concrete surface (factor is based on the Chinese standard JGJ/T23-2001).

3.5.3 Special cases

Experience has shown that the deviations from the normal conversion curves are under the following circumstances:-

- Artificial stone products with an unusual concrete composition and small dimensions. It is recommended that a separate series of tests should be performed for each product in order to determine the relationship between the rebound value R and the compressive strength.
- Aggregates made from low strength, lightweight or cleavable stone (e.g. pumice, brick rubble, gneiss) result in a strength value lower than those shown on the conversion curve.
- Gravel with an extremely smooth, polished surface and a spherical shape result in values for compressive strength which are lower than those ascertained by the rebound values R.
- A strong dry concrete (i.e. with low sand content) which has not been adequately processed may contain lumps of gravel which are not visible from the surface. These affect the strength of the concrete, however without influencing the rebound values R.

- The concrete test hammer gives inadequate rebound values R on concrete from which the mould has just been removed while still wet, or which has been hardened under water. The concrete must be dried before the test.
- Very high values of compressive strength (> 70N/mm^2) can be achieved by adding pulverized fuel ash or silica fume. However, these strengths cannot be reliably ascertained using the rebound value R measured by the concrete test hammer.

3.5.4 Conversion curves for special cases

The recommended course in special cases is to prepare a separate conversion curve.

- Clamp the sample in a pressure testing machine and apply a preload of about 40kN vertically in the direction in which the concrete was poured in.
- Measure the rebound hardness by applying as many tests as possible to the sides.

The only way to achieve a meaningful result is to measure the rebound values and compressive strength of several samples.

⇒ Concrete is a very inhomogeneous material. Samples made from the same batch of concrete and stored together can reveal discrepancies of ±15% when tested in the pressure testing machine.

- Discard the lowest and highest values and calculate the R_m.
- Determine the compressive strength of the sample using the pressure test machine and ascertain the average value **f**ckm. The pair of values R_m / **f**ckm applies to a certain range of the measured rebound value R.

  It is necessary to test the samples of differing qualities and/or ages in order to prepare a new conversion curve for the entire rebound values from R=20 to R=55.
- Determine the curve with the pairs of values R_m / **f**ckm (e.g. excel).

4 Maintenance

4.1 Performance check

If possible, carry out a performance check every time before you use the device, however at least every 1000 impacts or every three months.

- Place the test anvil on a hard, smooth surface (e.g. stone floor).
- Clean the contact surfaces of the anvil and impact plunger.
- Perform 20 impacts with the concrete test hammer and check the result against the calibration value specified.

Figure 3.1 Performance check of the concrete test hammer

⇒ Proceed as described in “Maintenance” section on page 10 if the values are not within the tolerance range on the test anvil.

4.2 Cleaning after use

- Deploy the impact plunger (1) as described in Figure 2.2, “Measuring Procedure” on page 4.
- Wipe the impact plunger (1) and housing (3) using a clean cloth.

Warning!
Never immerse the device in water or wash it under a running tap! Do not use either abrasives or solvents for cleaning!

4.3 Maintenance

We recommend that the concrete test hammer should be checked for wear after 2 years at most and be cleaned. Do this as described below.

⇒ The concrete test hammer can either be sent to a service centre authorised by ELE or maintained by the operator according to the following procedure.

The numbered items in brackets below are illustrated in Figure 3.3, “cross sectional cut through the concrete test hammer” on page 14.

4.3.1 Stripping down

Warning!
Never strip down, adjust or clean the pointer rod (4), otherwise the pointer friction may change. Special tools would be required to readjust it.

- Position the concrete test hammer perpendicular to the surface.

Danger!
The impact plunger (1) generates a recoil when it deploys. Therefore always hold the concrete hammer with both hands! Always direct the impact plunger (1) against a hard surface!

- Deploy the impact plunger (1) by pushing the concrete test hammer towards the surface until the push button (6) springs out.
- Unscrew the cap (9) and remove the two part ring (10).
- Unscrew the cover (11) and remove the compression spring (12).
- Press the pawl (13) and pull the system vertically up and out of the housing (3).
- Lightly strike the impact plunger (1) with the hammer mass (14) to release the impact plunger from the hammer guide bar (7). The retaining spring (15) comes free.
- Pull the hammer mass (14) off the hammer guide bar together with the impact spring (16) and sleeve (17).
- Remove the felt washer (18) from the cap (9).

4.3.2 Cleaning

- Immerse all parts except for the housing (3) in kerosene and clean them using a brush.
- Use a round brush (copper bristles) to clean the hole in the impact plunger (1) and in the hammer mass (14) thoroughly.
- Let the fluid drip off the parts and then rub them dry with a clean, dry cloth.
- Use a clean, dry cloth to clean the inside and outside of the housing (3).

4.3.3 Assembly

- Before assembling the hammer guide bar (7), lubricate it slightly with a low viscosity oil (one or two drops is ample; viscosity ISO22, e.g. Shell Tellus oil 22).
- Insert a new felt washer (18) into the cap (9).
- Apply a small amount of grease to the screw head (20).
- Slide the hammer guide bar (7) through the hammer mass (14).
- Insert the retaining spring (15) into the hole in the impact plunger (1).
- Slide the hammer guide bar (7) into the hole in the impact plunger (1) and push it further until noticeable resistance is encountered.

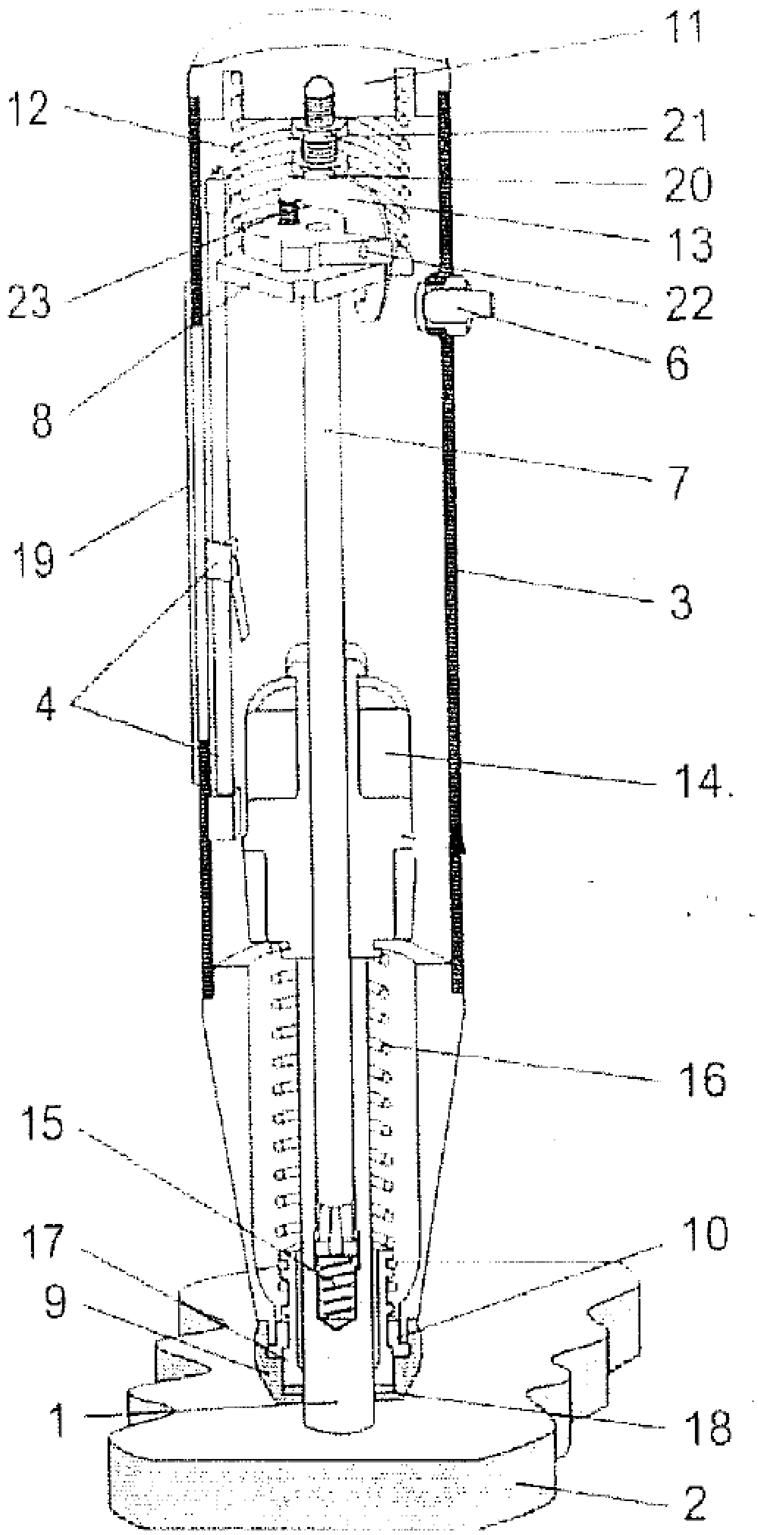
Prior to and during installation of the system in the housing (3), make sure that the hammer (14) does not get held by the pawl (13). Hint: For this purpose press the pawl (13) briefly.

- Install the system vertically downwards in the housing (3).
- Insert the compression spring (12) and screw the rear cover (11) into the housing (3).

- Insert the two-part ring (10) in the groove in the sleeve (17) and screw on the cap (9).
- Carry out a performance check.

⇒ Send the device for repair if the maintenance you perform does not result in correct function and achievement of the calibration values specified on the test anvil cannot be achieved even if the calibration procedure in section 4.3.5 is performed.

4.3.4 Concrete Test Hammer



Key:

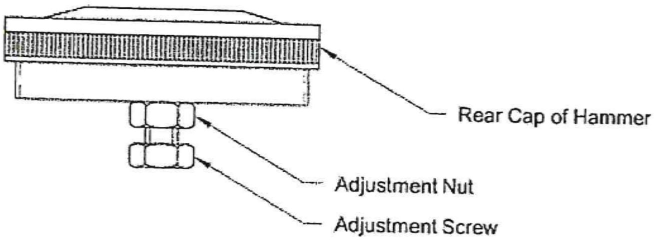
1. Impact plunger
2. Test surface
3. Housing
4. Rider with guides
5. Not used
6. Push button, complete
7. Hammer guide bar
8. Guide disk
9. Cap
10. Two part ring
11. Rear cover
12. Compression spring
13. Pawl
14. Hammer mass
15. Retaining spring
16. Impact spring
17. Guide sleeve
18. Felt washer
19. Plexiglas window with scale
20. Trip screw
21. Locknut
22. Pin
23. Pawl spring

Figure 3.3 cross sectional cut through the concrete test hammer

4.3.5 Calibrating your concrete test hammer

When tested against the anvil, the impact energy level of the test hammer must be .227 kilograms-meter or 1.64 foot-pounds, and the test hammer must be a value of 80 ±2. As the test hammer approaches 2,000 uses, it may start to read outside of the range of 80 ±2 on the test anvil. At this point you should calibrate it.

With the piston fully extended, twist the cap on the top of the test hammer to open it. Keep your hand positioned against the cap. Set the test hammer aside and examine the cap. The cap has an adjustment screw and nut which are used to calibrate the test hammer.



Using a 10 mm spanner, loosen the adjustment nut away from the cap. If the test hammer is reading low, tighten the adjustment screw (clockwise) into the cap. If the test hammer is reading high, loosen the adjustment screw (counter-clockwise) away from the cap. When you are finished, tighten the adjustment nut to lock the screw in this new position.

Put the test hammer back together and test it on the anvil again to get a calibrated reading. If it reads 80 ±2, the test hammer is calibrated. If the readings fall outside of this range, take the test hammer apart and try to adjust it again. Keep adjusting and testing the test hammer until it reads 80 ±2.

Clean the test hammer with a clean cloth, referring to section 4.3.2 for details.

The springs in the test hammer may become worn and ineffective after more than 8,000 tests. Therefore, if you have an older test hammer that is no longer providing accurate measurements, and you tried to recalibrate it but it still doesn’t work properly, send it back to ELE International, or an authorised service centre, for an evaluation and/or repair.