C O N T E N T S Page

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Hilti Drilling and Anchoring Line

DPG Digital Test Gauge

1. Background

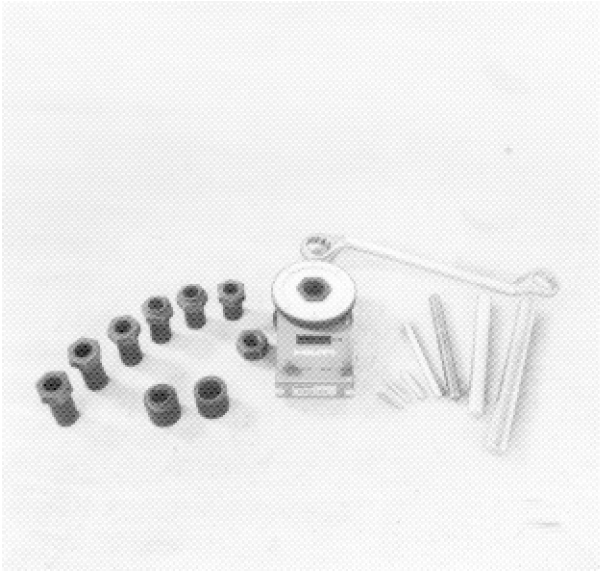
To enable anchor fastenings to be inspected or tested a gauge to measure the holding power was called for to meet the following specifications.

- It should be capable of loading internally and externally threaded anchors having thread sizes from M6 to M24.
- Loading range from 0 to 100 kN.
- It should be possible to test anchors with both male and female threads.
- Internally threaded anchors should be tested without the part being fastened or the secured structural component being in place.
- Externally threaded anchors should be tested with the part being fastened in place or removed.
- Gauge accuracy of 5% of max. range of the scale. An additional instrument should not have to be used to obtain the reading. It must be possible to read off the load directly.
- The gauge should compensate for the longitudinal axis of the anchor being tilted by up to 5%.
- The gauge should be of robust design and designed as a single component as far as possible.
- It should have a scale to enable the slip to be determined.
- The gauge should be of slim design (small height).
- The gauge should be light.
- It should be possible for all types of anchors i.e. HSL heavy-duty anchor, HVA adhesive anchor, HSA (HKB) stud anchor, HKD (HDI) flush anchor and TDD (HSS) self-drilling anchor to be tested.
- The gauge should be suitable for use at temperatures between - 5 and + 40°C.
- The gauge should be powered by a battery and thus be independent of an electric supply.
- The gauge should be protected against spray and drip water.

I INTRODUCTION Offered product

2. Offered Product

A gauge has been developed which is a single unit with which thread adapters and threaded rods for all thread sizes to be tested from M6 to M24 are used. The max. load that can be applied is 100 kN. The load is measured by a strain gauge and the value is converted to an electrical impulse by a Wheatstone bridge after which it is computed by the electronic module and the results shown on a digital indicator.

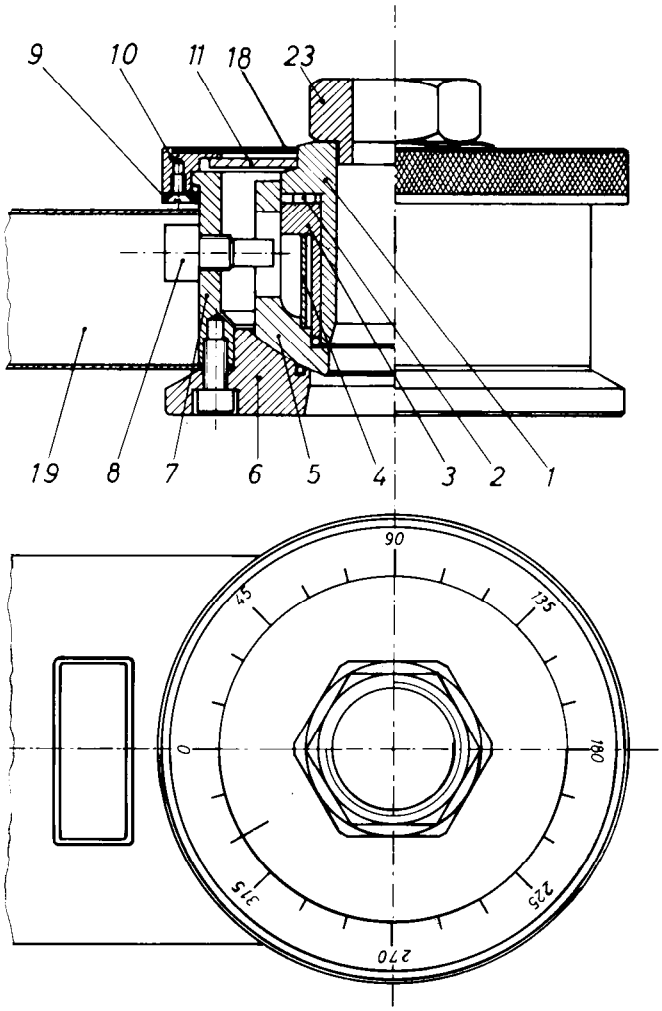


Anchor test gauge with thread adapters and threaded rods, a ring wrench, spacer and intermediate spacer.

II TECHNICAL DESCRIPTION Design and working principle

1. Design and Working Principle

1.1 Cross-sectional Drawing of Mechanical Parts of DPG 100 Test Gauge



1.2 Mechanical Working Principle

The applied load acts on measuring ring (4) via the screwed-on thread adapter (23), sleeve (1), needle bearing (2) and pressure sleeve (3). On tightening the adapter, any tilt of the anchor is compensated for by the spherical section of the housing (6) and the support ring (5). The anchor is always loaded in the direction of its longitudinal axis. The hexagon on sleeve (1) moves the indicator disc (11). The rotatable scale ring (10) then shows the rotary movement that has been carried out in degrees on scale (18). This measurement of the movement is relatively inaccurate for two reasons:

II TECHNICAL DESCRIPTION Design and working principle

a) There are changes in the surface of the base material beneath the bearing surface of the test gauge and

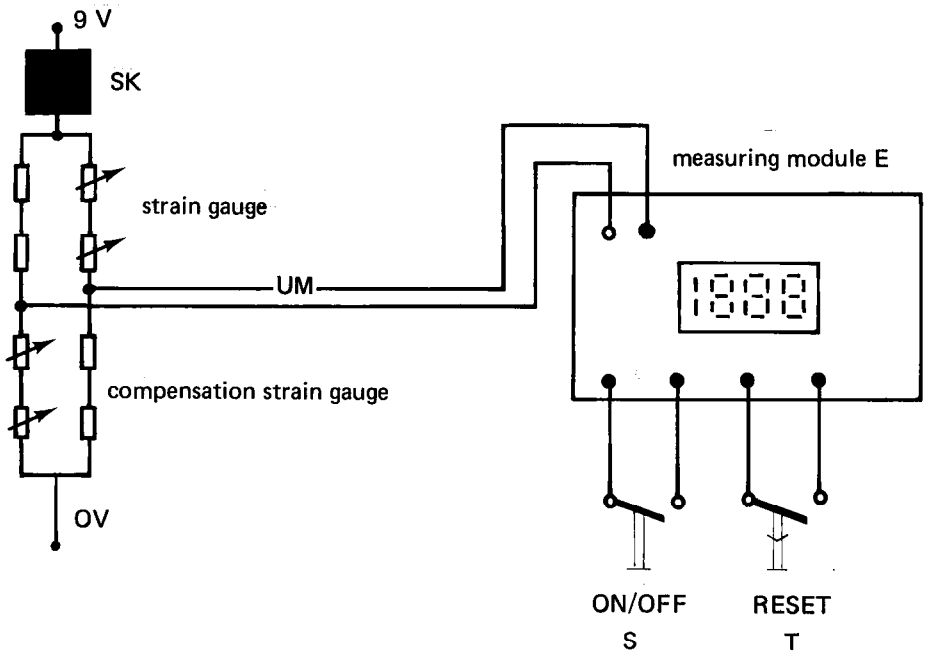
b) there is some deformation of the metal of the thread adapters.

These two influencing factors increase the reading. If more accurate measurement of the movement is necessary, it is recommended that a dial gauge is put on the thread adapter (23).

The applied load is transmitted to the measuring ring (4) via the pressure sleeve (3) and support ring (5). The movement (the collective term for metal deformation, slip etc.) produced by this load is measured by four strain gauges, that are bonded in place, processed by the electronic circuit (9) shown below.

1.3 Electronic Working Principle

Schematic diagram of measuring circuit



II TECHNICAL DESCRIPTION Design and working principle

The four strain gauges that are bonded to the measuring ring combined with the four compensation strain gauges that are adhered to a square section, form a Wheatstone bridge. The diagonal voltage, that is described as the measuring voltage, UM, is amplified by the measuring module, E, and shown in kN by the LCD indicator, A. The voltage stabilizer, SK, reduces the variable battery voltage to a stabilized bridge voltage of 2.6 V. As a result the life of the battery is considerably extended and the accuracy of the reading considerably improved.

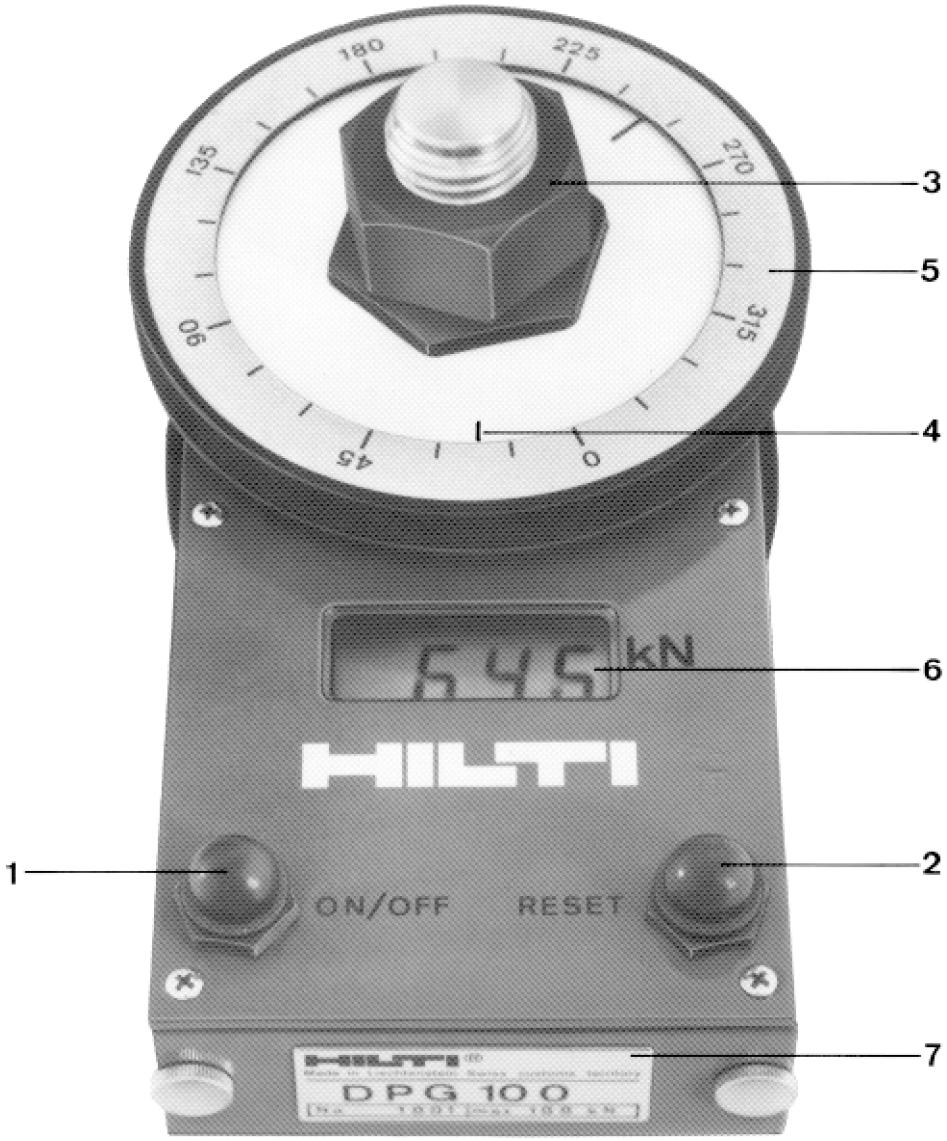
The on/off switch, S, switches the electronic circuit on and the gauge is then ready for use. The reset button, T, is used to set the gauge at zero after it has been connected to an anchor and the adapter has been tightened slightly. As a result of the noise of the circuit and the digitalization, the zero reading can also be shown as 0.1 kN.

1.4 Maximum Load

The max. load that can be applied is 100 kN. If this figure is exceeded the measuring system can be damaged. It must be pointed out with all emphasis that the DPG 100 gauge is not intended to be used to load anchor fastenings up till failure. If the gauge is misused in this way it will be damaged and give incorrect readings.

II TECHNICAL DESCRIPTION Using the gauge

2. Using the Gauge



1	On/off switch	S	ON/OFF
2	Zero reset/battery check	T	RESET
3	Thread adapter		
4	Indicator disc		
5	Ring scale		
6	Digital display	A	kN
7	Battery cover and nameplate		

II TECHNICAL DESCRIPTION

Using the gauge

Sequence of operations when testing:

1. The gauge is switched on at the on/off switch (S). When this is done rapidly changing digits will appear on the display (A).

2. The gauge is screwed on to the anchor using the correspondir thread insert and spacer or intermediate spacer, depending on the type of anchor to be tested and the application it was used for. By combining the spacers and intermediate spacers with the threaded sleeves, more favourable lengths to be screwed in can be obtained. To test the HSL heavy-duty anchor the screw must be replaced by the supplied threaded rod.

3. The reset button (T) is now pressed to bring the display to zero.

4. The thread adapter is tightened lightly by hand (approx. 0.3 to 0.5 kN).

5. The ring scale is turned to bring the beginning of the scale in line with the mark on the indicator disc.

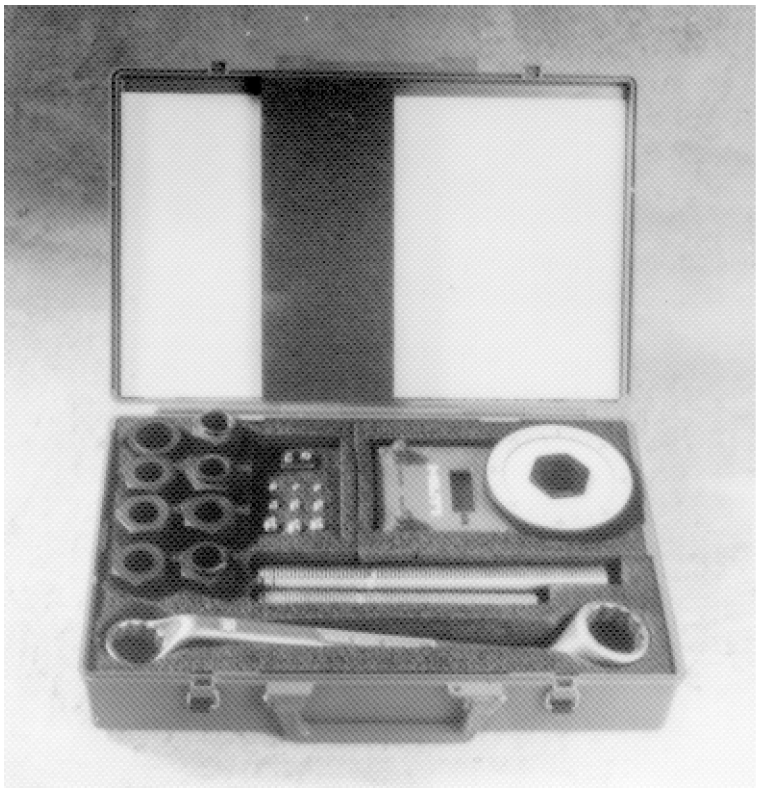
6. The thread adapter is now tightened, using the ring wrench, until the load being checked is reached. The testing load that is required cannot be given as a general specification. We therefore recommend that the inspection loads given on appendix 1 are used for all anchors that are used for normal applications.
(In West Germany the anchor approval sets down the inspectic load.)

7. The amount the ring scale shifts gives an idea of the movement of the anchor. In this respect, however, deformation of the threaded rod and base material must be taken into account when carrying out more accurate measurements. Any loosening of the anchor when the test load is applied can be clearly felt through the ring wrench.

II TECHNICAL DESCRIPTION

3. Program

In the basic set of gauge equipment there is a thread adapter and threaded rod for each size of thread. This means that all Hilti metal anchors can be tested. If an MO has to carry out any special testing of anchor fastenings for which there are no parts in the basic set of equipment, additional adapters can be easily made by the marketing organization.



II TECHNICAL DESCRIPTION Technical data

4. Technical Data

Weight	3 kg
Gauge + equipment in plastic case	10 kg
Loading range	max. 100 kN
Overload tolerance	10 kN
Thread size	M6 to M24
Width across flats	36 mm
Max. variance of readings at room temperature	max. ± 1.0 kN typical ± 0.3 kN
Power supply	9 V transistor battery e.g. Mallory Alkaline MN 1604
Current	7 mA
Life of battery	50 hours actual operation
Working temperature range	- 5°C to + 60°C
Storage temperature	- 20°C to + 80°C

5. Changing the Battery

The gauge is assembled and calibrated as well as checked for accuracy at the manufacturing plant.

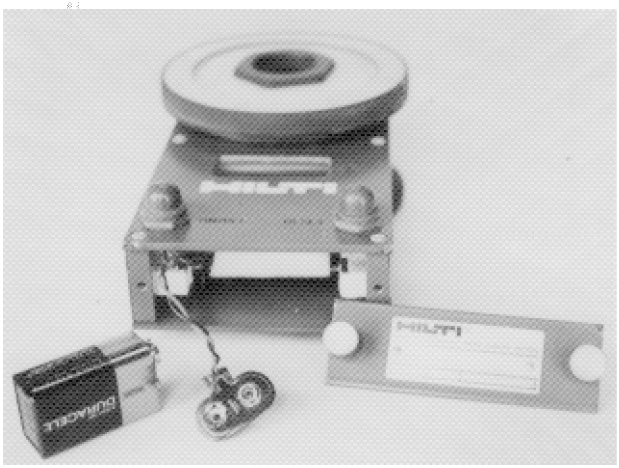
The DPG 100 gauge is a precision measuring instrument and must be treated as such. The only "maintenance" required of the user is that he changes the battery when it runs down.

It is time to replace the battery if the figure on the display changes very rapidly when the reset button (T) is pressed and the gauge is switched on. It is still possible to continue testing with the gauge until the battery is replaced, using the indicated zero figure. To change the battery the cover at the front of the gauge bearing the nameplate has to be removed. Care must be taken to ensure the battery is connected correctly (the right pole).

II. TECHNICAL DESCRIPTION

Changing the battery

Opened gauge for battery replacement



We would like to draw your attention once again to the following points to ensure that your DPG 100 gauge remains in good working order for precision measurement for as long as possible.

a) The temperature range in which the gauge may be used and stored, as shown in the technical data, must be kept to. The display must be kept out of direct sunlight.

b) The gauge may not be overloaded.

c) The gauge should only be carried around in the supplied case, as far as this is possible.

d) Anchors may not be tested until failure with this gauge.

e) If for any reason the gauge ceases to function, it may only be repaired at HAG, Schaan.

With best regards

HILTI AKTIENGESELLSCHAFT
Anchor Product Management

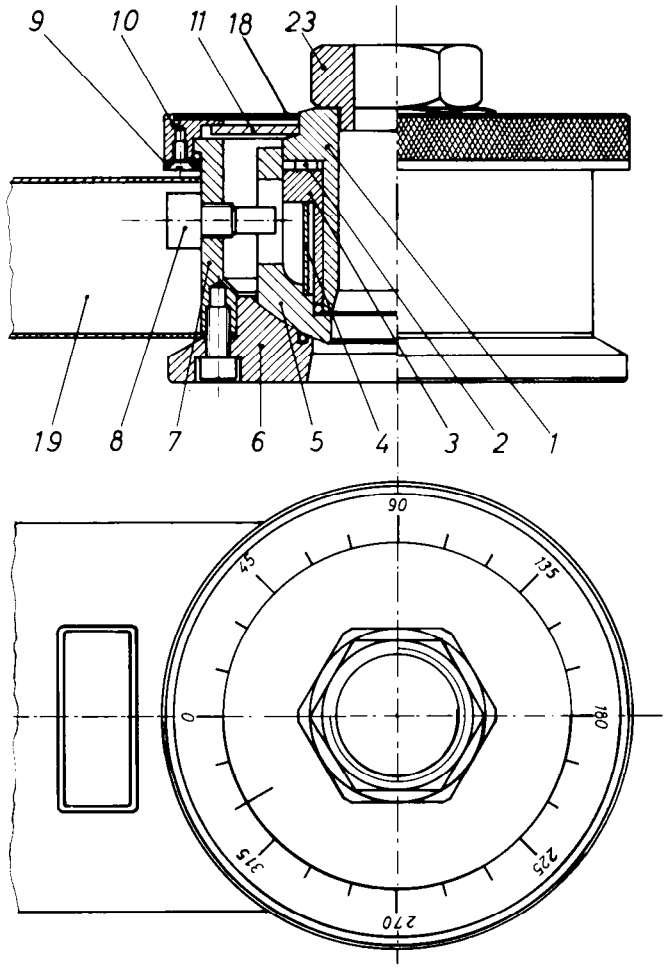
H. Jost J. Entner

Appendix 1: Testing loads in kN
Appendix 2: Operating instructions

DPG 100 TEST GAUGE
TESTING LOADS IN kN
(Test Load = 1.5 times rec. load)

Anchor	Concrete strength (N/mm2)	M6	M8	M10	M12	M16	M20	M24
HSL	25		9.6	14.1	20.3	31.5	48.5	61.2
	45		13.2	20.0	29.1	49.7	75.0	87.6
HVA	25		5.7	10.1	12.5	23.7	39.9	65.0
	45		8.9	15.0	20.0	36.0	57.9	82.2
HSA	25	4.2	5.6	7.2	12.8	18.8	24.2	
	45	5.3	9.3	10.5	18.8	22.5	34.1	
HKD	25	4.4	5.7	8.3	13.4	21.2	25.4	
	45	5.1	7.2	8.7	16.2	28.5	38.0	
TDD	25	3.2	3.9	6.2	8.7	11.4	15.9	
	45	4.5	6.2	8.6	11.9	14.0	21.0	

Technical Description



Mechanical Working Principle

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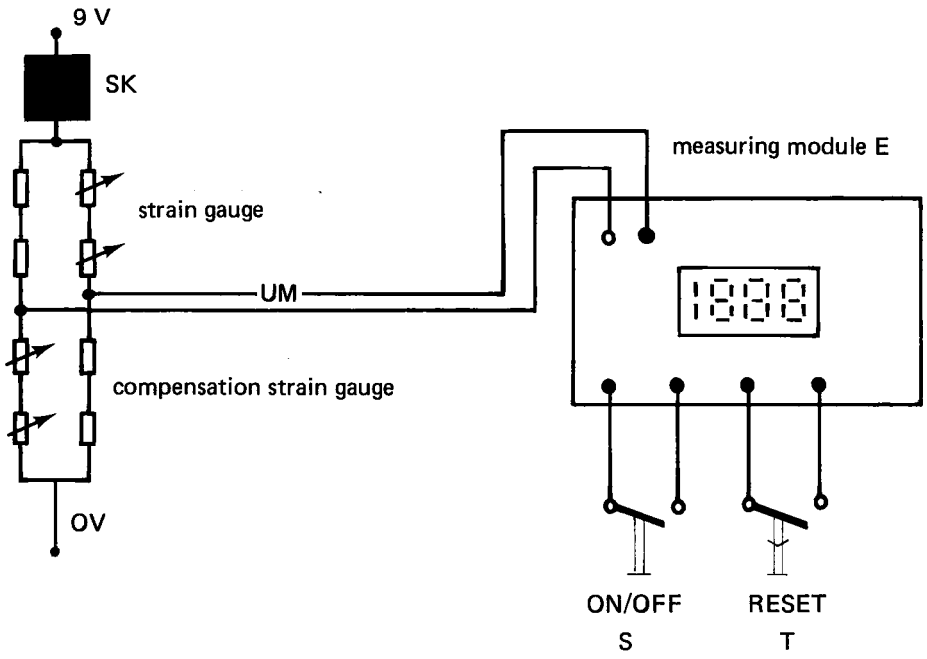
Electronic Working Principle

Schematic diagram of measuring circuit



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The on-off switch, S, switches the electronic circuit on and the gauge is then ready for use. The reset button, T, is used to set the gauge at zero after it has been connected to an anchor and the adapter has been tightened slightly. As a result of the noise of the circuit and the digitalization, the zero reading can also be shown as 0.1 kN.

The voltage stabilizer, SK, reduces the variable battery voltage to a stabilized bridge voltage of 2.6 V. As a result the life of the battery is considerably extended and the accuracy of the reading considerably improved.

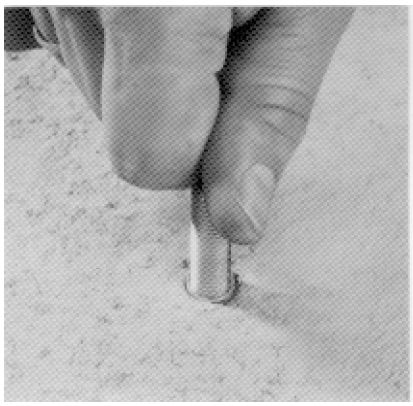
Technical Data

Weight:	3 kg
Thread size:	M6 to M24
Loading range:	max. 100 kN
Max. variance of readings at room temperature:	max. ± 1.0 kN typical ± 0.3 kN
Power supply:	9-volt transistor battery e.g. Mallory Alkaline MN 1604
Temperature range:	
Storage temperature	- 20°C to + 80°C
Working temperature	- 5 °C to + 60°C

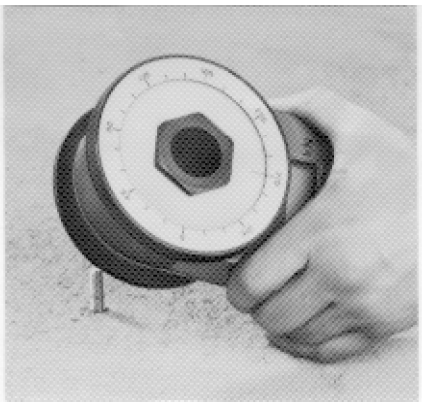
Testing Operations

1. Switch on the gauge at the on/off switch. The digits in the display will change rapidly and then remain constant.

2. Connect the gauge to the anchor.



Screw the threaded rod in internally threaded anchors such as the HKD (HDI) or TDD (HSS). In the case of the HSL replace the bolt by the threaded rod.

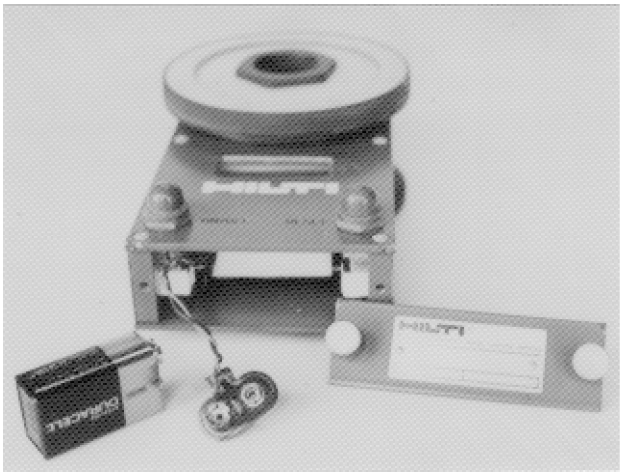


The gauge can be connected straight to the HSA (HKB), HVA (adhesive) and HSLG heavy-duty stud anchor. The central bore is placed over the protruding threaded section of the anchor.

The thread adapter is screwed on and connects the anchor to the gauge.

3. Press the reset button to obtain the zero reading on the digital display. A figure of 0.0 or 0.1 kN will be indicated.

Opened gauge for battery replacement



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d) Anchors may not be tested until failure of this gauge.

e) If for any reason the gauge ceases to function, it may only be repaired at HAG, Schaan.

Warranty

Hilti provides a warranty for the proper manufacture of the gauge within the scope of the currently valid warranty ruling existing between HAG and the marketing organizations. However, Hilti accepts no liability for any damage that arises through the non-observance of the operating instructions, incorrect operation when inspecting anchors, misuse of the gauge or any other factors beyond Hilti's control.

All gauges bear our nameplate and may only be repaired, checked or recalibrated at HAG, Schaan.