



User Manual

Penetrometro Malta SRM

Version 1.0

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1. About us

About us

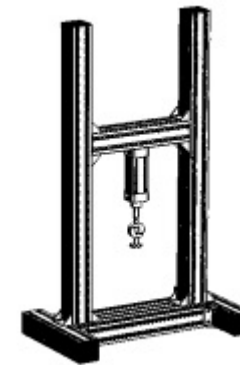
DRC Srl designs, manufactures and markets equipment for non-destructive testing and investigations in the field of civil engineering since 1978.
DRC Srl is divided into three different area:



[Products](#)



[Training](#)

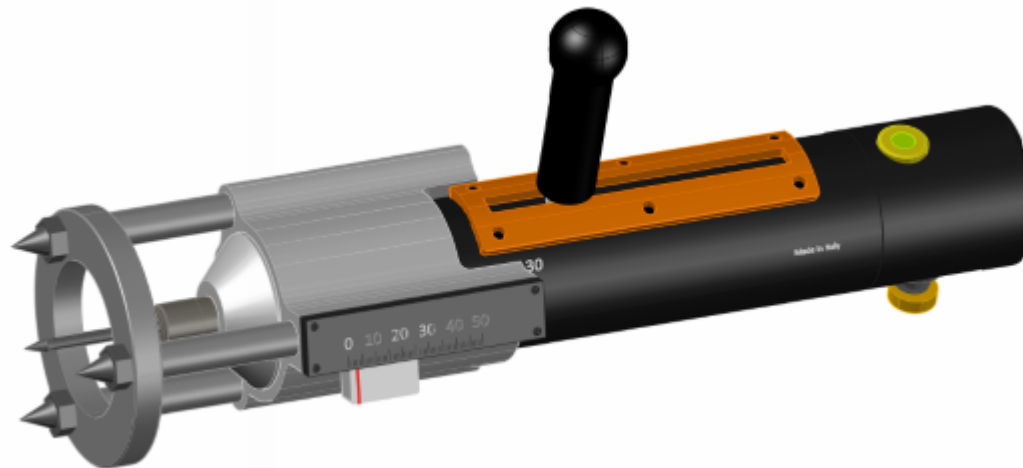


Fatigue Test Machine

to get more info, visit www.drcitalia.it/en

2. Equipment

Equipment



RSM_15 is a new mechanical penetrometer for mortar constructed by **DRCSrl** with **LIFE Srl** technical personnel.

This tool combines the long history of **DRC** instrument production with **LIFE** technical field experience. The **RSM** instrument was tested and developed on masonry structures following the earthquake of 2012 in Emilia - Romagna.

Research and development have been conducted by Rachele Ferioli, Sergio Tralli for **LIFE** and by Michele Massaccesi for **DRC Srl**.

The **RSM** penetrometer is a Non-Destructive instrument.

This instrument measures the response of mortar to needle penetration and correlates this response to the mechanical performance of the material

3. Support

Support

For any trouble or assistance of DRC equipment, contact DRC Srl assistance service writing at assistenza@drcitalia.it

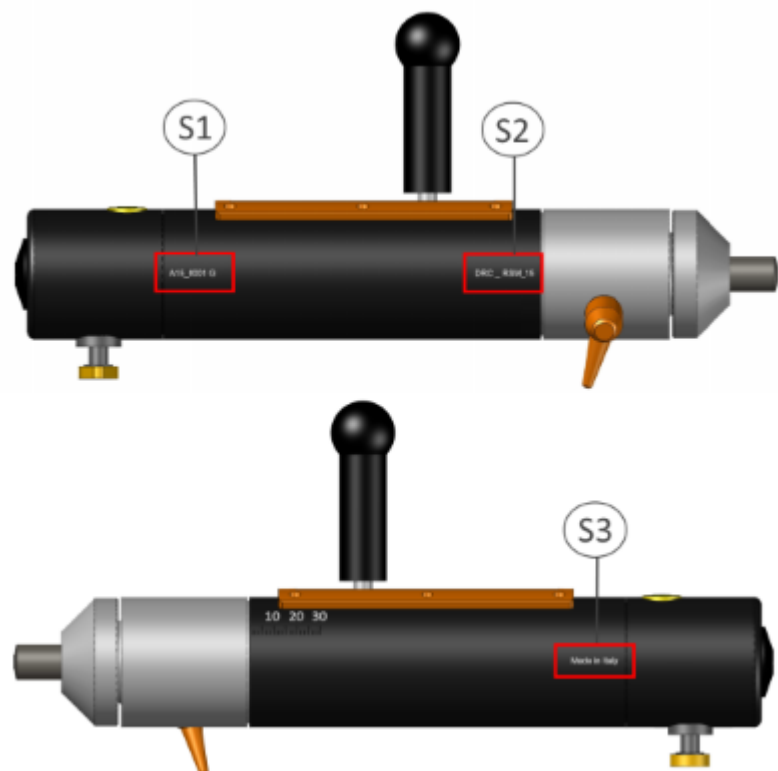
Fill in RMA Form for any assistance or maintenance of **RSM** penetrometer and enclose it with the equipment when send it back for repair or maintenance.

Send the document first by email and then enclose the document with equipment.

When you contact the DRC srl for maintenance issue, please use a follows data to identify the unit

Type of hammer	Serial Number	Calibration date

Serial number of **RSM** penetrometer is on the shape of concrete, see image below [S2] while the calibration date is on the label on the opposite site of serial number.



DRC
Diagnostic Research Company
PARTY CONSULTANTS - TRAINING

Mod. 7.5.3.S.01 Rev.01

**RAPPORTO DI TARATURA
CALIBRATION REPORT**

Serial No.	
Ref. Equipment	
Operator	
Date of Calibration	
Report Quality No.	

**Penetrometro Meccanico RSM
Mechanical Penetrometer RSM**

La Società DRC srl certifica che questo strumento è stato testato ed ha superato il controllo di qualità interno procedura RSM_Q_001.
DRC srl Company certifies that this instrument has been tested and passed our internal quality control- procedure RSM_Q_001

La calibrazione è stata eseguita utilizzando l'incudine strumentata TAM_SD_001 collegata al Sistema di acquisizione DaTa 500 C. Tutti i valori rilevati rientrano nelle tolleranze specifiche, in accordo con le nostre specifiche interne.
Calibration has been carried out according to Instrumented Testing Anvil TAM_SD_001. All the measured values are within specified tolerance to according with international quality test control Report

DRC srl
Via Monteskudo, snc - 60131 Ancona - Fax +39 071 2205 318 -
www.drcitalia.it info@drcitalia.it

4. Registration

Registration

DRC Srl innovates and updates continually their hardware and software products.
It's DRC commitment to provide a continuous and long-term support to its customer and user.

In order to receive information and updates, please register your instrument through the [registration area](#).
Receive technical communications and updates regarding exclusively the product purchased and registered.
For information and clarification on this service, feel free to contact our staff at info@drcitalia.it.

5. Order

Order

DRC Srl offer and sell its own range of product directly to the end user in order to maintain and ensure pre and post sales support. DRC Srl product range is also available from our [distributor network](#). Assistance and support are always guaranteed.

For commercial request fill a [Form](#) or visit a [product web page](#).

6. Mortar Penetrometer RSM

Mortar Penetrometer RSM

DRC Srl thanks you for choosing the **RSM** penetrometer . The operating manual that follows has been designed to help you get maximum use from the **RSM** penetrometer and to provide information and suggestions regarding instrument potential and fields of application.

This document contains a general guide to **RSM** penetrometer use, including safety regulations, descriptions, images, standards, procedures, and operating instructions.

To get the most out of your **RSM** penetrometer, please read all the instructions given in this operating manual carefully.

This manual is available in the following formats:

- ▶ .pdf format manual
- ▶ .html (web help) format manual

This manual is available in the Web Help - **RSM** penetrometer support section - [Download area](#)

6.1 Safety regulations

Safety regulations

To prevent the risk of damaging the equipment or provoking damages to the operator or third parties, carefully read the following general safety standards prior to using the instrument. These standards should always be provided with the instrument, so that it may be consulted at any time by the user/operator. The manufacturer will not assume any responsibility for direct or indirect damages to persons, objects or domestic and non-domestic animals, due to the non-compliance of the safety standards contained in the present documentation.

- ▶ The instrument must be used by adequately trained personnel, in order to avoid the improper use of the equipment.
- ▶ The instrument must be solely used for its destined use for which it was designed.
- ▶ The tampering and modification of the instrument is to be considered as negligent and isolates the manufacturer from any responsibility deriving from the misuse.

In such a situation the guarantee for eventual spare parts or calibration verification will immediately cease to exist.

- ▶ Do not perform or carry out any type of test with the instrument on any body part of person/s or animal/s: permanent damage and even grievous bodily harm may be caused by the use of the instrument on certain parts of the human/animal body.

6.2 Aims and Limits

Method Aims and Limits

The non-destructive testing performed through use of the RSM penetrometer has the aim of providing information regarding the resistance of mortar joints to a steel needle driven using strikes generated by a mass moving with constant energy.

The result that RSM penetrometers provide therefore regard penetration depth expressed in mm on the number of strikes defined as Nr. 10 for procedure type A defined as RPM and of Nr. 5 [for 4 series] for procedure type B defined as RAPM.

The RSM series mortal penetrometer provides information regarding the quality and homogeneity of mortar both along its thickness and compared at different points of the structure under examination.

It is possible through the use of correlation curves to obtain an indicative estimate of the mechanical resistance of the mortar in relation to the depth of penetration. The correlation curves provided with the instrument have been obtained through experiments carried out on site. The mechanical characteristics of tested materials [mortars] are not representative of all mortars present at the site.

The RSM series mortal penetrometer must be used for:

1. ***Measuring the homogeneity of the mortar joint layer from the outside layer to the inside layer in order to check for any degradation, carbonation, and subsequent applications and interventions***
2. ***Measuring the homogeneity of different portions of the mortar arranged in different parts of the same structure or adjacent structures***
3. ***Estimating the mechanical resistance of mortar***

In relation to point 3, DRC Srl recommends taking measurements on-site and simultaneously proceeding with extracting a sample of the same for destructive testing in order to correctly calibrate the method.

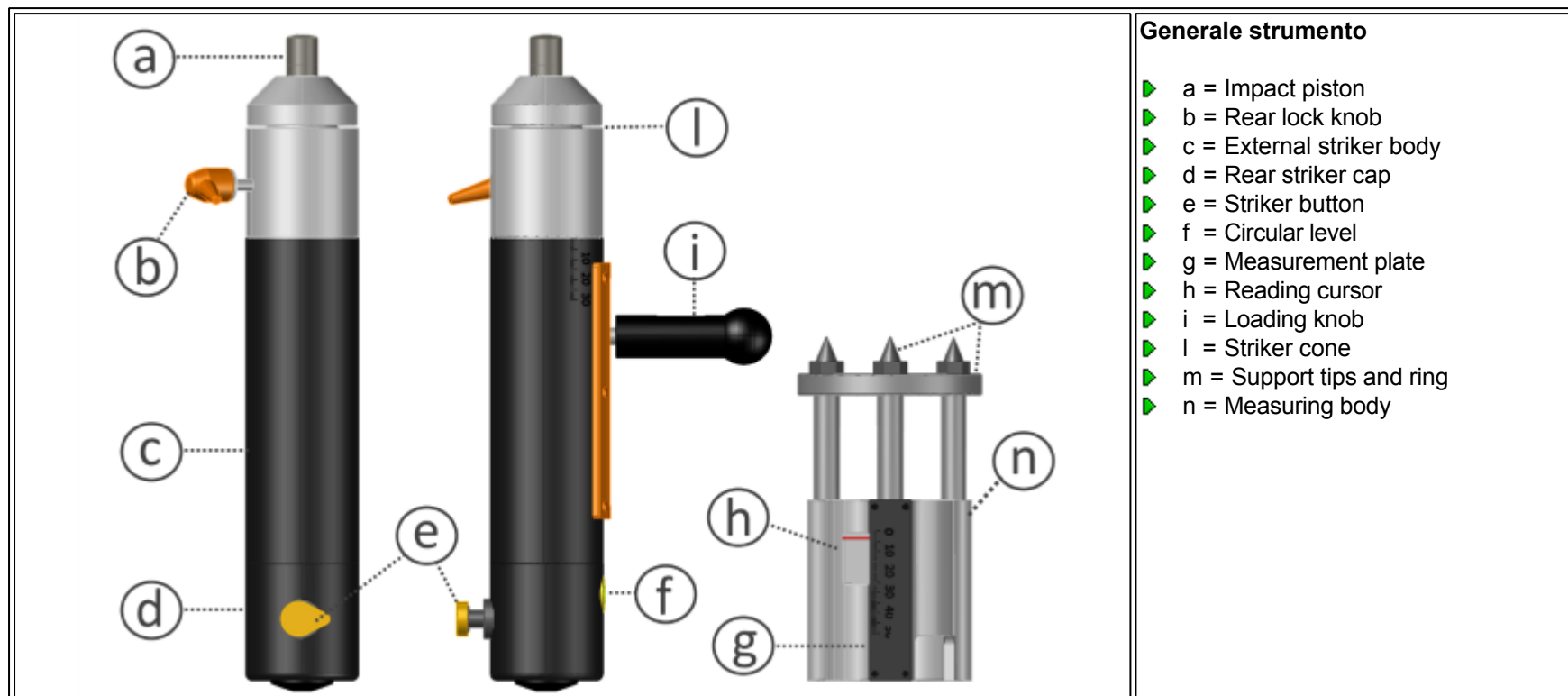
Penetrometer testing is classified as non-destructive as it is possible to derive an estimate of the mechanical resistance of the mortar by means of the value of depth of penetration of the needle.

6.3 Getting to know the instrument

Getting to know the instrument

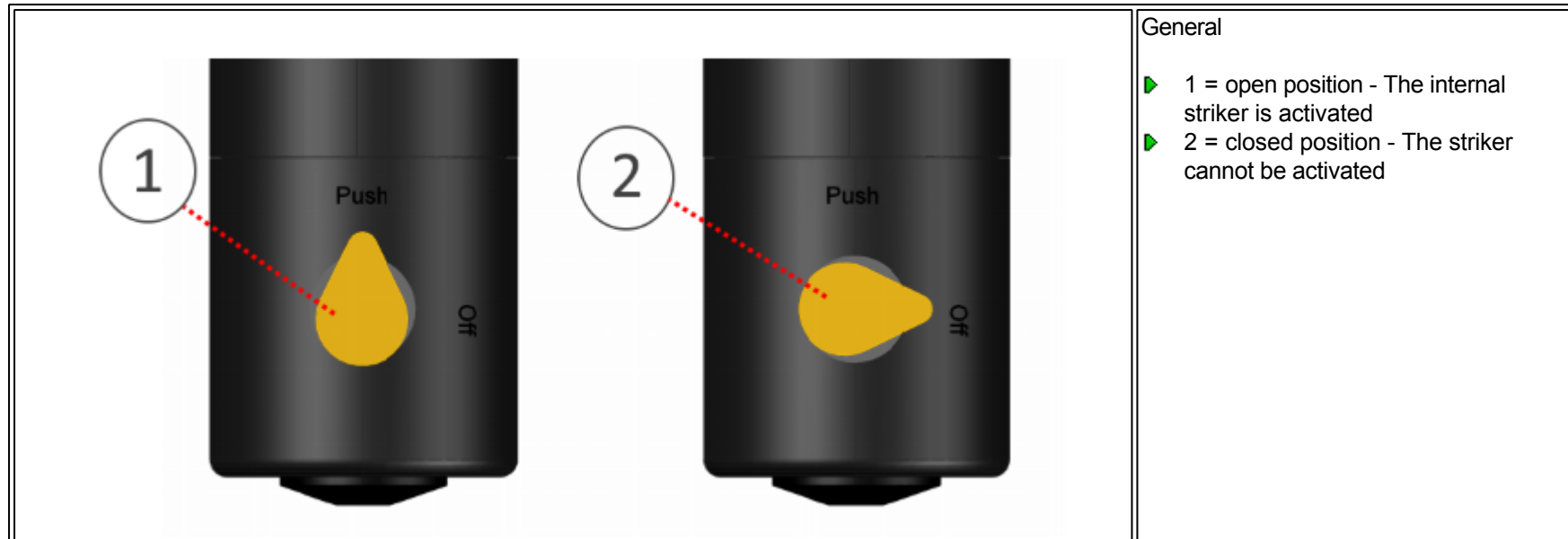
The **RSM_15** mechanical penetrometer is made up of a mechanical striker and a series of [components](#) including: a guide and measurement body, a mechanical hundredths of a millimetre comparator for measuring the needle penetration depth, herein referred to as a NEEDLE tip, a series of Needle caps and depth extensions, measurement accessories and a hard travel case.

Striker



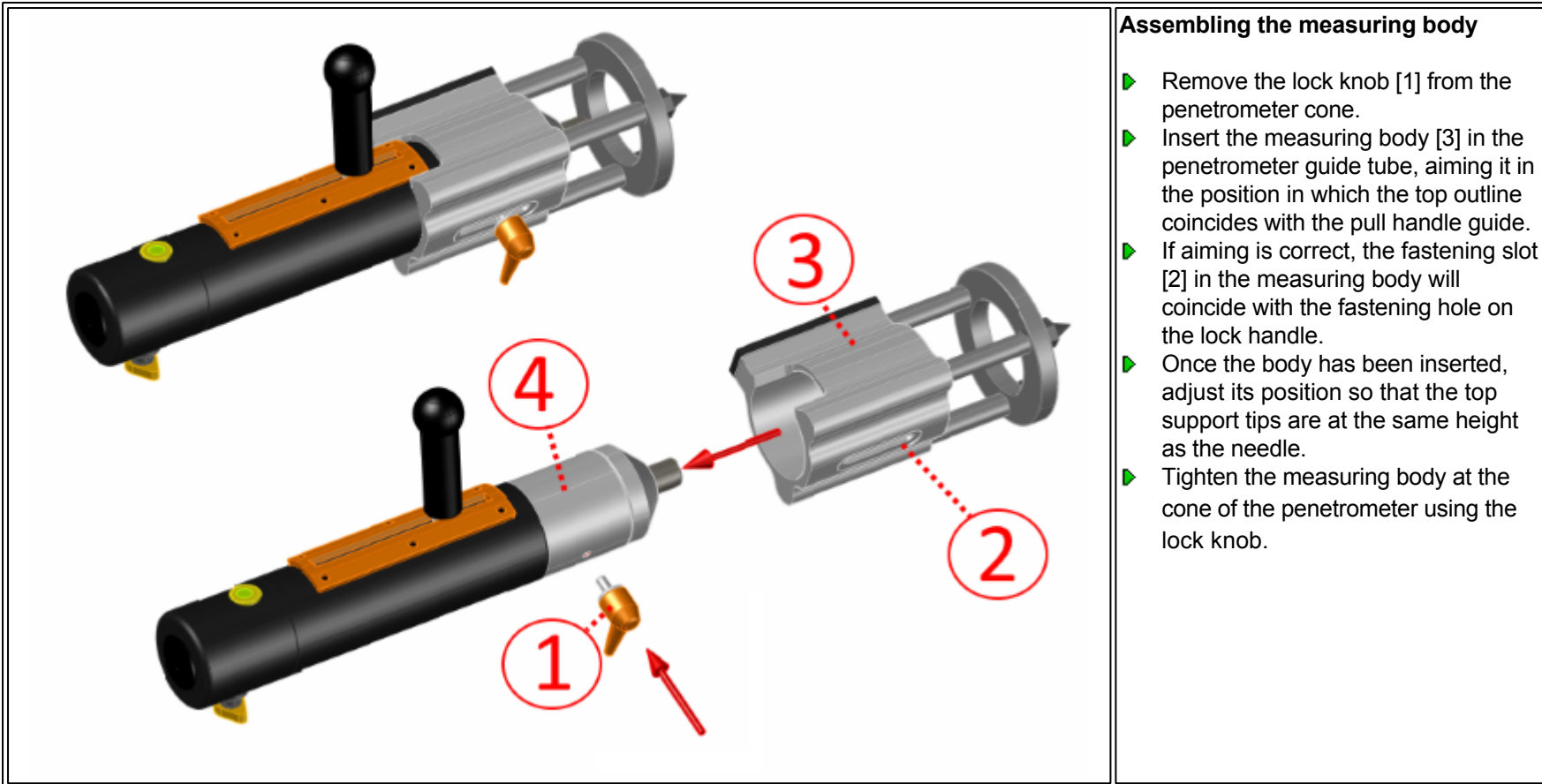
Rear cap

The RSM penetrometer is equipped with a striker activation button with a safety system. If the button is aimed horizontally with respect to the larger axis of the penetrometer, it remains blocked. Aim the button vertically and press to activate the impact mass as illustrated in the following images.

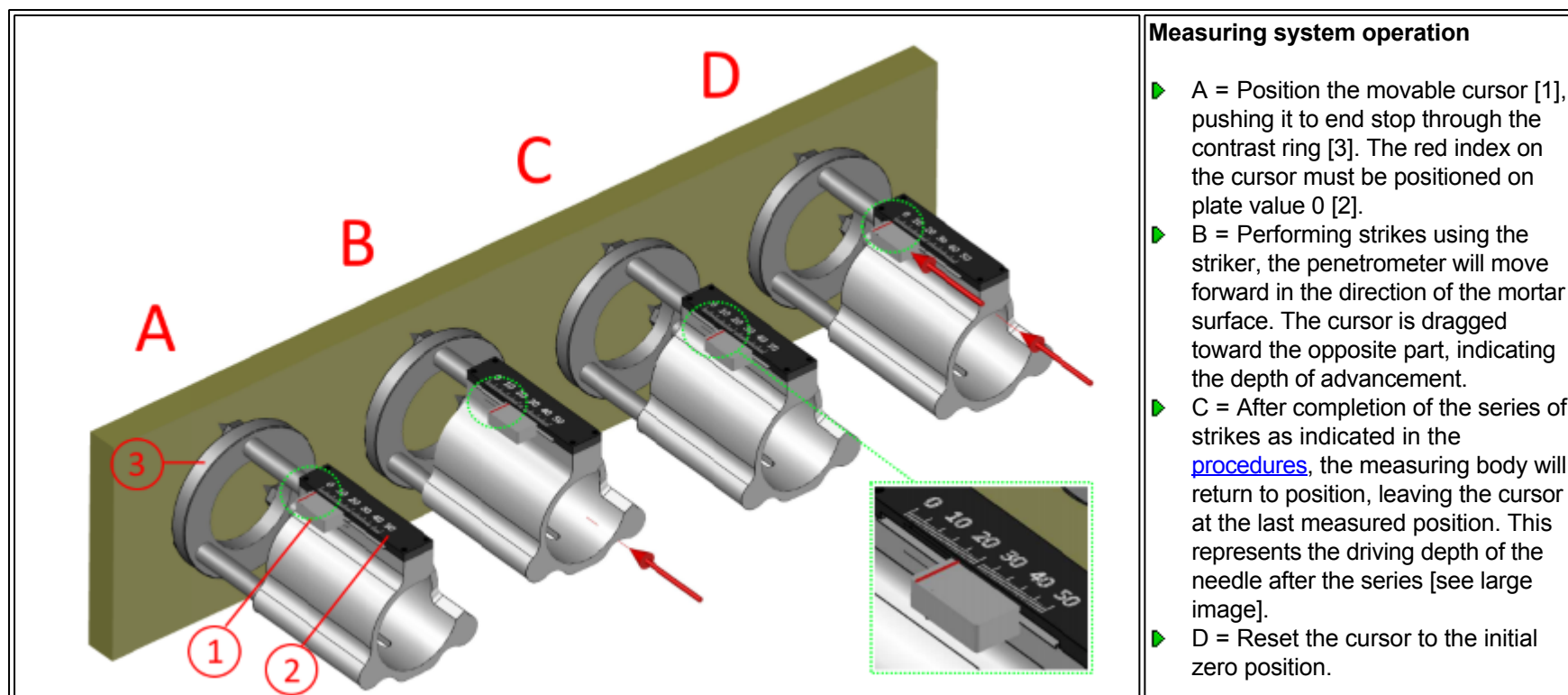


External measuring body

The above-described measuring body [n] is used for measuring needle driving depth. The system measures depth in real time, avoiding use of a comparator. The measurement scale engraved on the plate has millimetre resolution. Below is a description of operation.

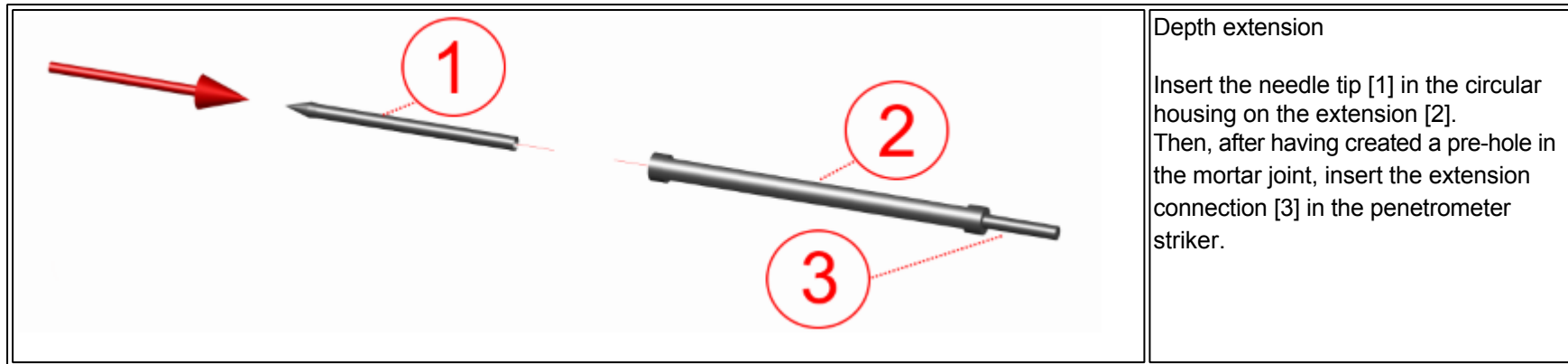


Below is a description of measuring body operation.



Needle and extension

The RSM_15 penetrometer is supplied with a series of tips and extensions for measuring driving resistance of internal mortar joint layers. Below is a description of how to use the extension.

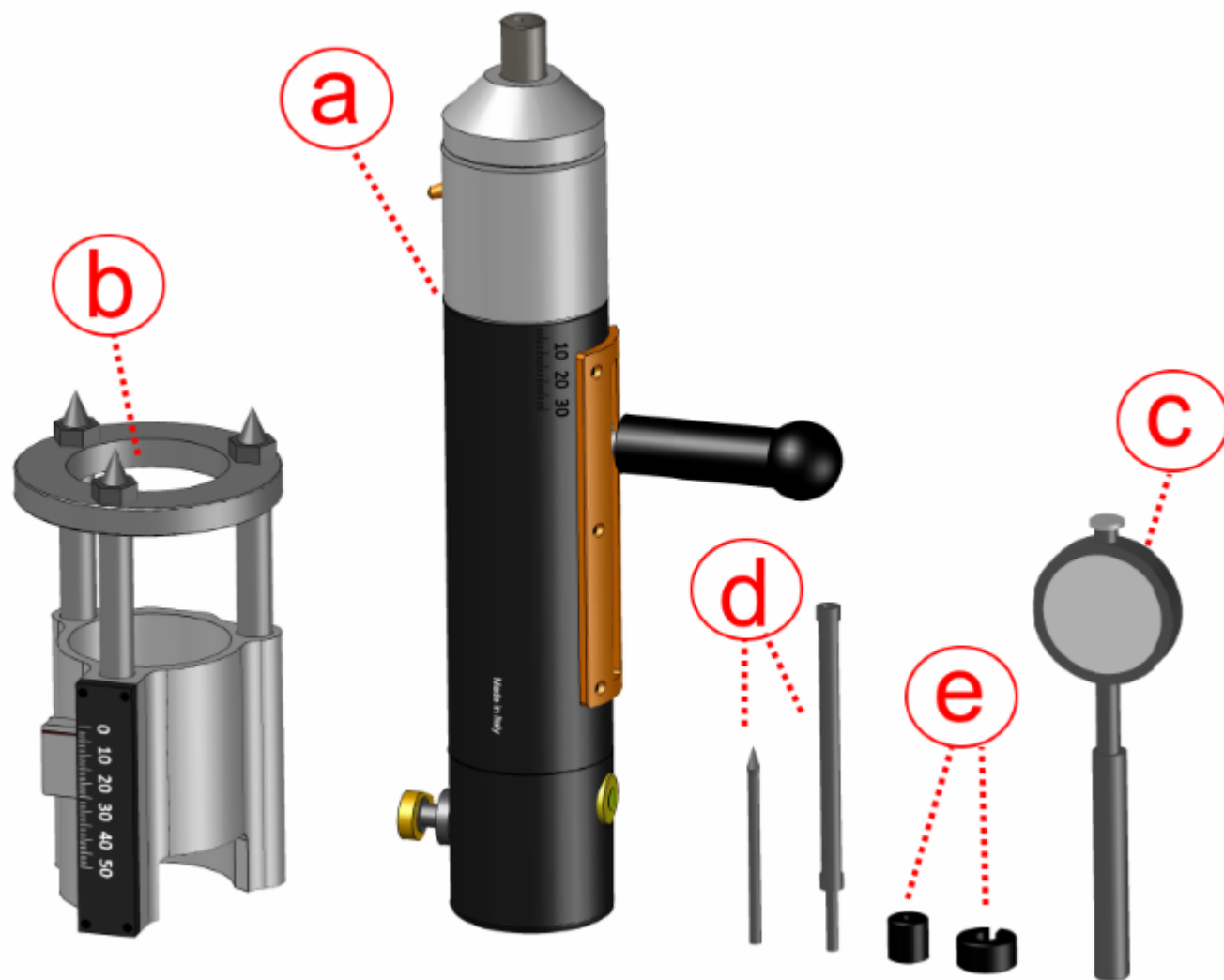


6.4 Components

Components

The RSM penetrometer is composed of the following components and accessories:

- ▶ RSM penetrometer striker
- ▶ External reading body
- ▶ Manual depth gauge
- ▶ Measurement needle and extension
- ▶ Measurement reference accessories

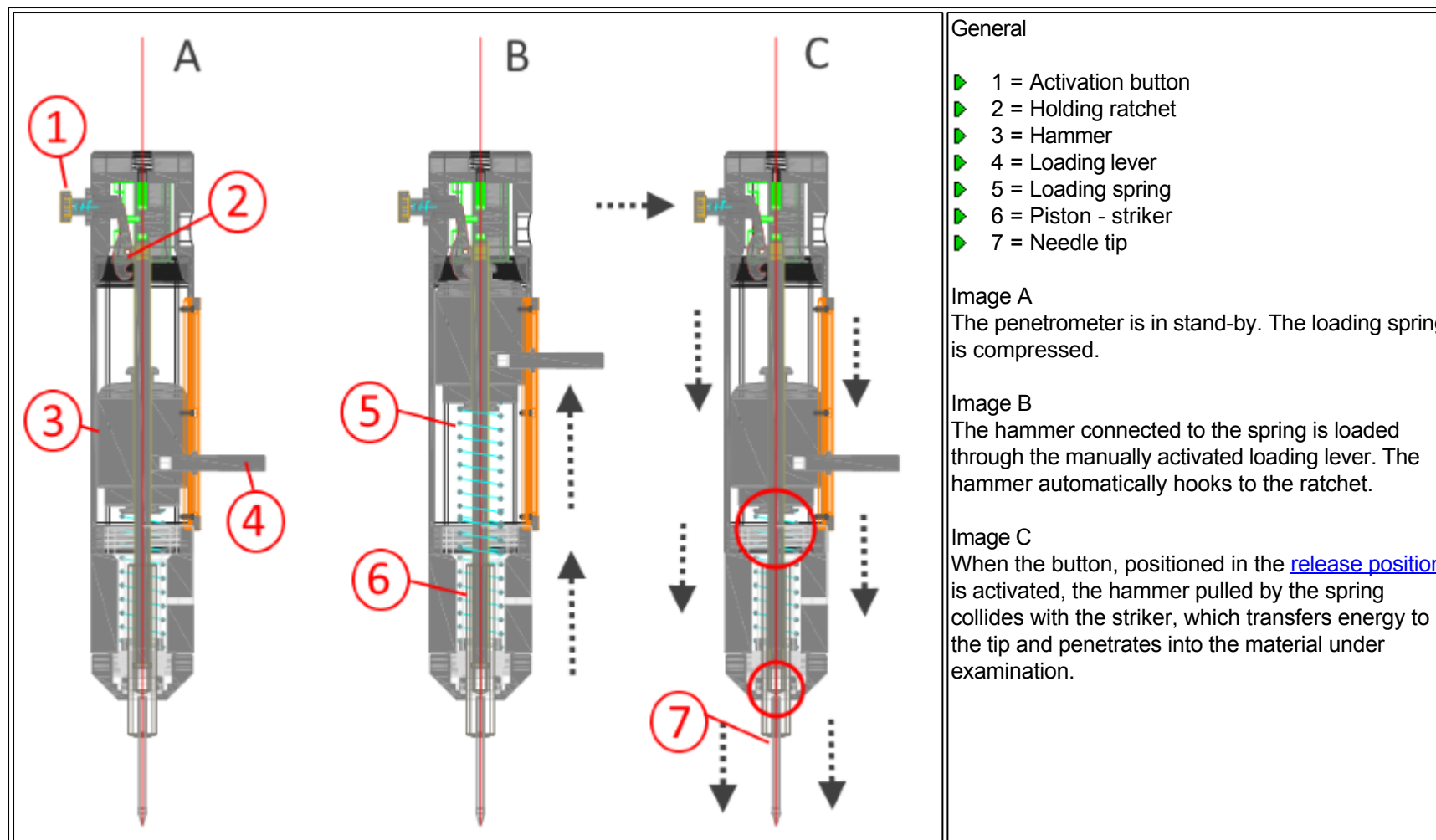


6.5 Operating principle

Operating principle

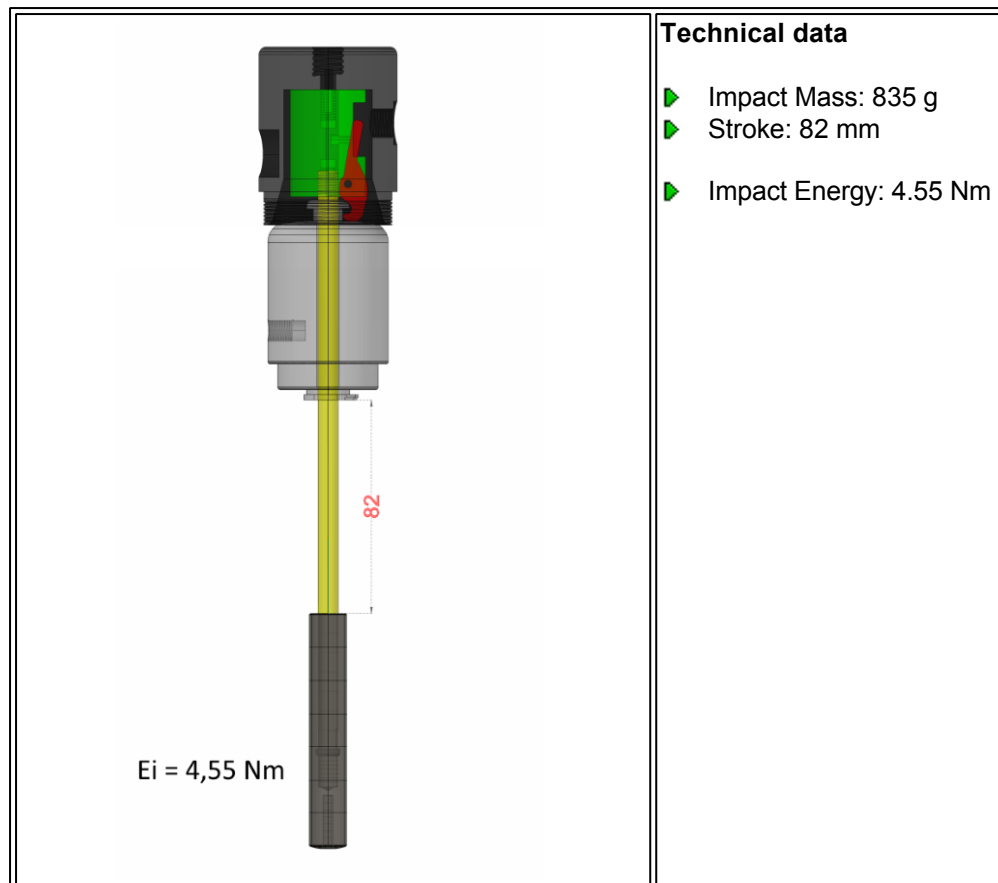
The RSM series mortar penetrometer is composed of a hammer [3] connected to a spring [5] which manually sets loading, hits the striker [6], into which a tip [needle 7] is inserted to drill into the mortar. The end of the alloyed steel needle tip is a cone with a 25° angle. The needle subjected to constant dynamic strikes moves forward inside the mortar joint, pushing and compressing the mortar along the side of its path.

The mortar resistance given to needle driving is proportional to the mechanical resistance of the material.



Impact energy

The RSM_15 mechanical penetrometer bases its operation on the impact of a known mass in the striker, which transfers this energy to the tip. Below are the technical specifications of the RSM_15 penetrometer.



6.6 Surface Measurement

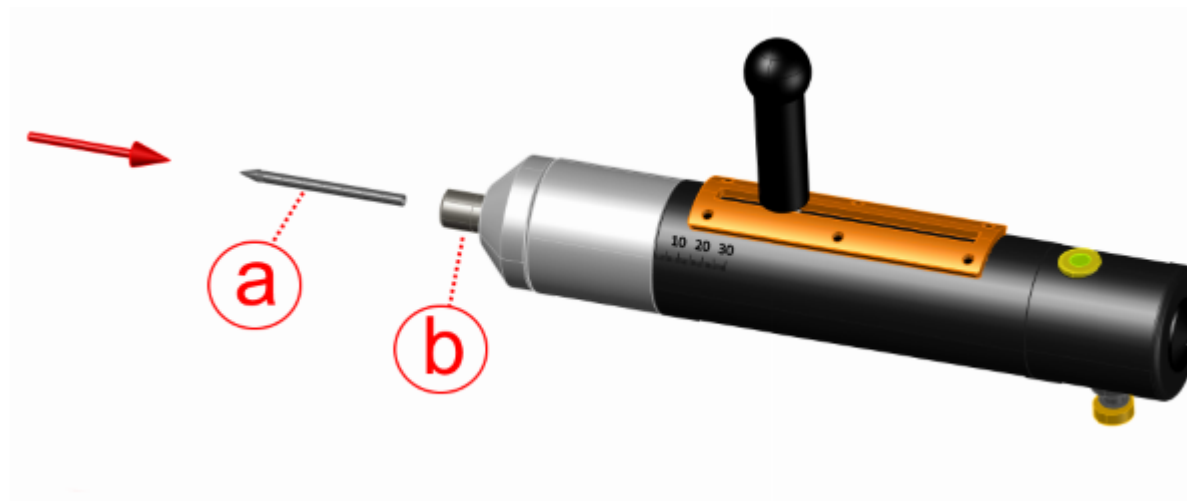
Surface Measurement

Below are RSM_15 penetrometer procedures for surface measurements.

Driving and measuring operations can be carried out with the use of the external measuring body and/or simply using the striker and the measuring comparator.

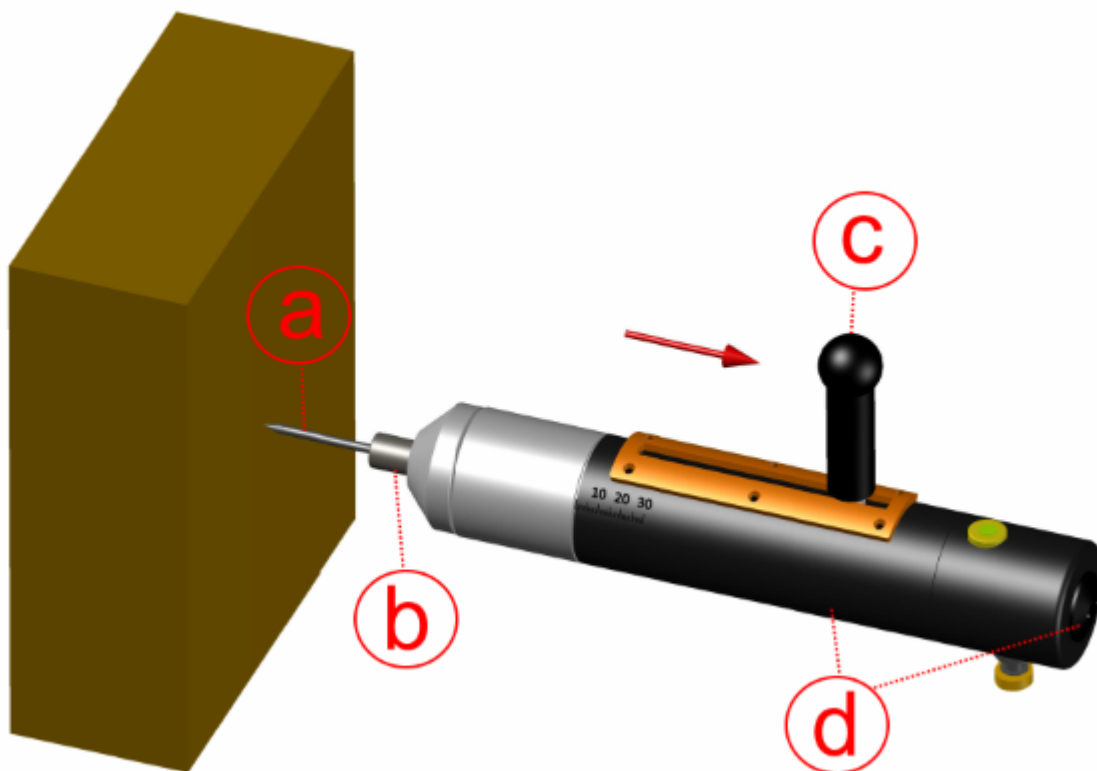
Surface measuring with the comparator

A. Tip Insertion



Insert the tip [a] in the housing on the head of the striker [b], making sure that the needles goes through to end stop.

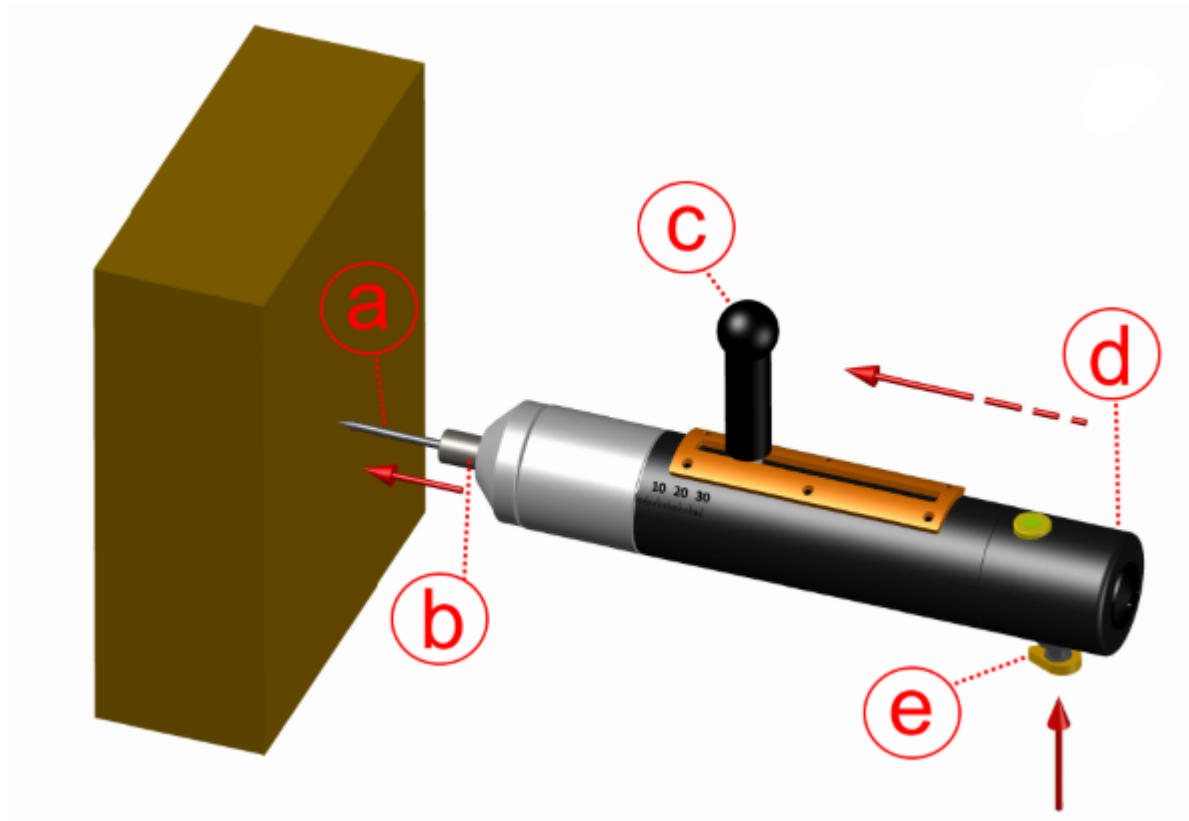
B. Position and loading



Position the tip [a] in the mortar stroke identified in the masonry. Keep the penetrometer in contrast with the wall, applying slight pressure. Make sure that the penetrometer is in horizontal position (using a level located in the rear cap).

Load the hammer, pulling the pull handle [c] in the direction indicated by the arrow and, however, in the opposite direction from the wall.

C. Driving

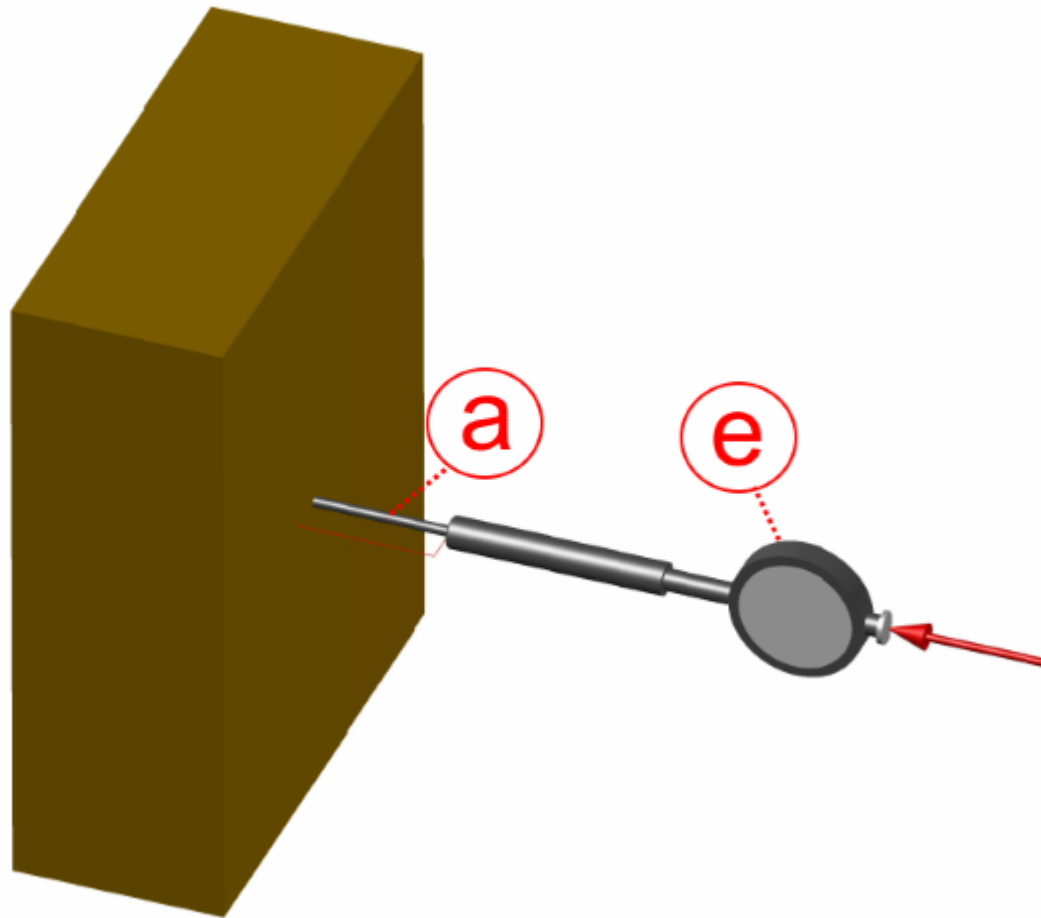


Keeping the penetrometer horizontal and in contrast with the wall, press the release button [e] ([make sure you have unlocked it](#)).

The hammer transfers its kinetic energy to the striker [b] and then to the tip [a] which will drive into the material.

Repeat this operation the number of times indicated in the [test procedures](#).

D. Reading



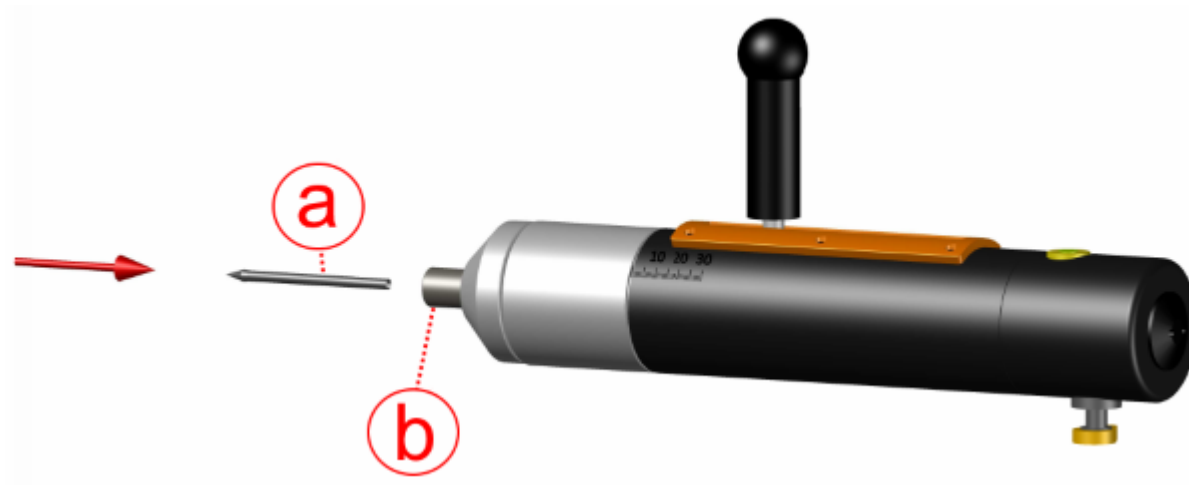
Remove the RSM penetrometer.
Measure the driving depth of the needle
[a] using the manual comparator supplied
with the instrument.

The driving depth will be calculated as the
difference between L0 and L1 ([see
procedure](#)).

Record the value in the [report table](#).

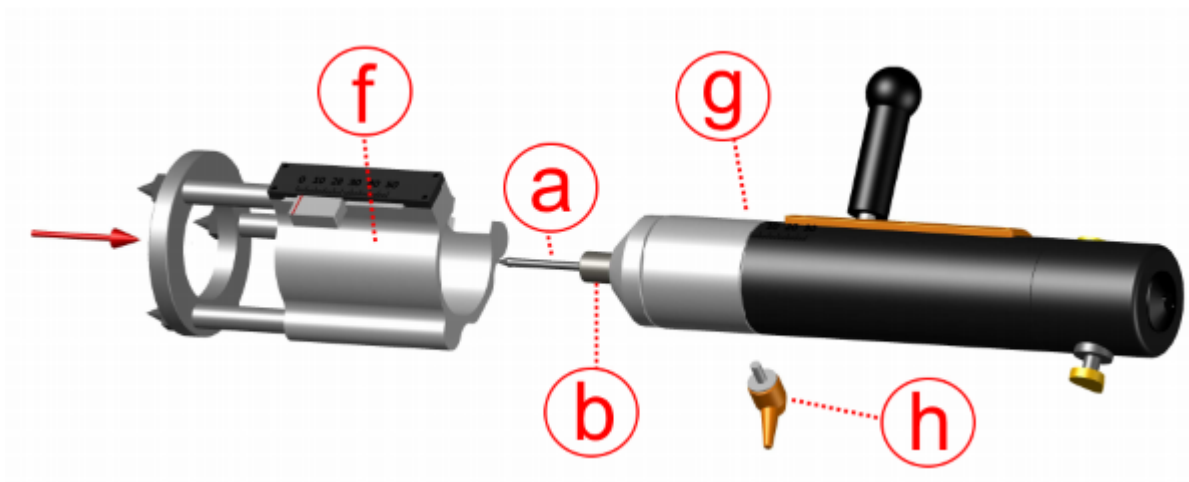
Measuring body Surface Measurement

A. Tip insertion



Insert the tip [a] in the housing on the head of the striker [b], making sure that the needles goes through to end stop.

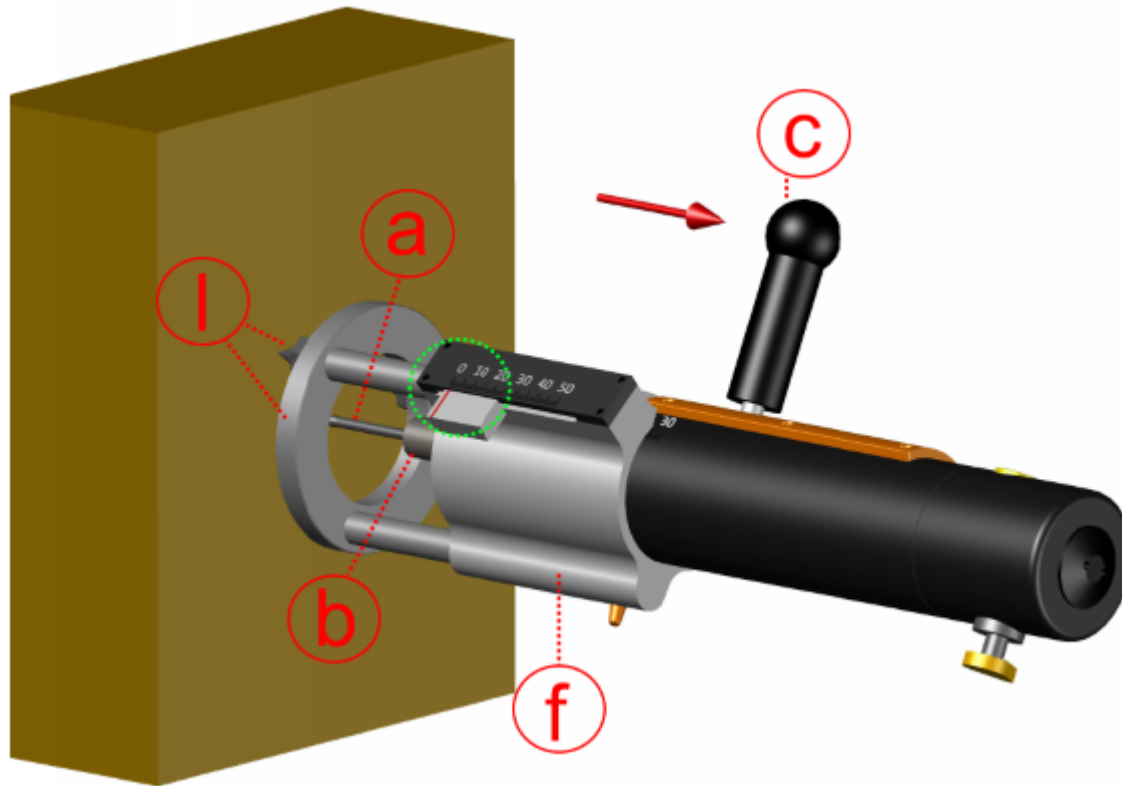
B. Measuring body insertion on the striker



Insert the measuring body [f] in the striker [g]. Solidly secure the two components using the rear lock knob.

[See measuring body assembly section](#)

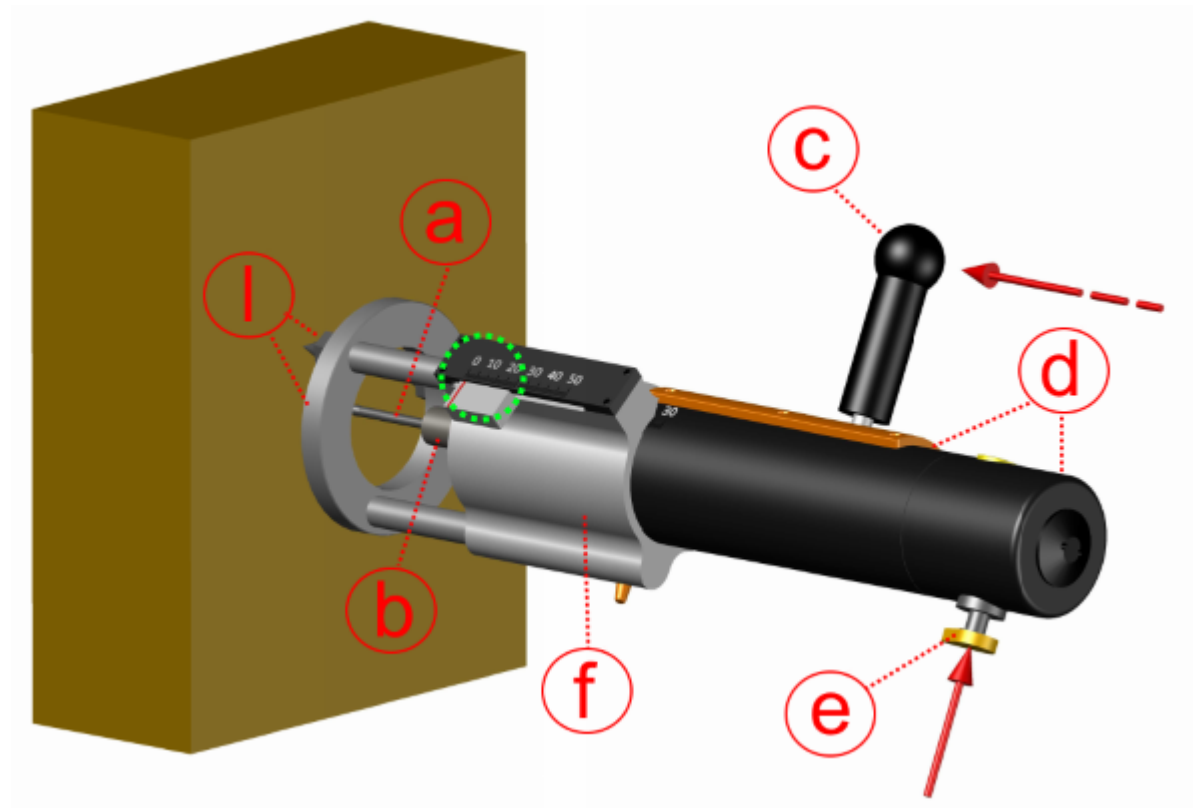
C. Position and load the striker



Position the RSM penetrometer in contact with the mortar joint under examination.

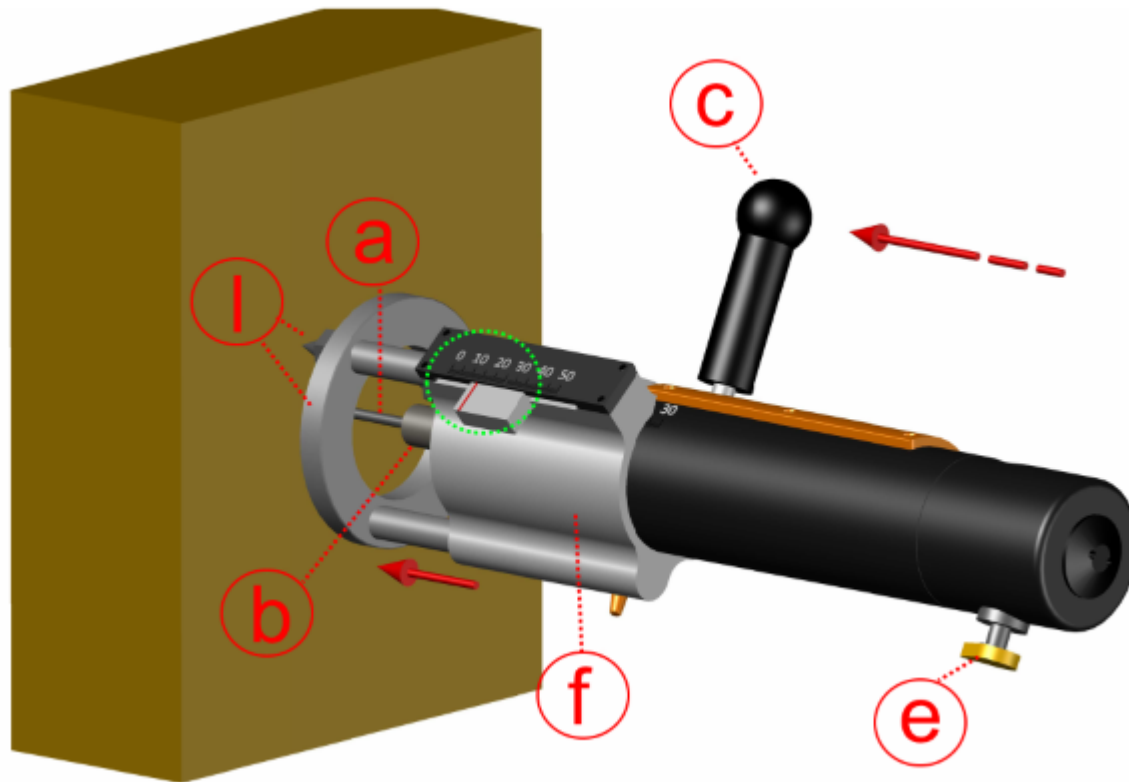
Keep the penetrometer in a horizontal position, contrasting it with its own body. Load the hammer using the loading pin. Make sure that the measuring cursor is [reset](#).

D. Tip driving



Press the release button [e]. The hammer will collide with the striker [b], transferring its kinetic energy to the tip [a], which will be driven into the material.

E. Depth reading



After having performed the number of strikes as indicated in [test procedures](#), proceed with reading the [depth value](#) by looking at the red cursor indicator with respect to the measurement plate.

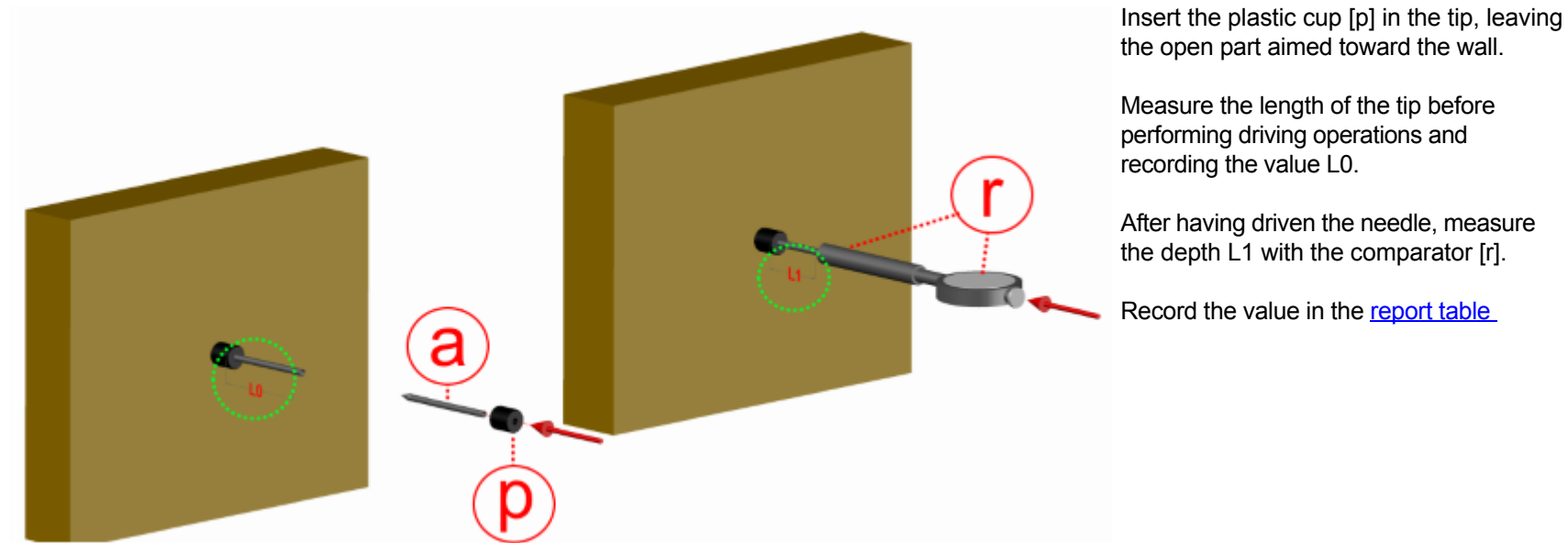
Record the value in the [report table](#).

Measurement accessories

You can use the plastic cup to facilitate tip driving value measuring operations.

Use of the cup is at the discretion of the operator.

Use of the plastic is advisable when the external surfaces of the mortar are particularly degraded in order to give the comparator a larger supporting surface.

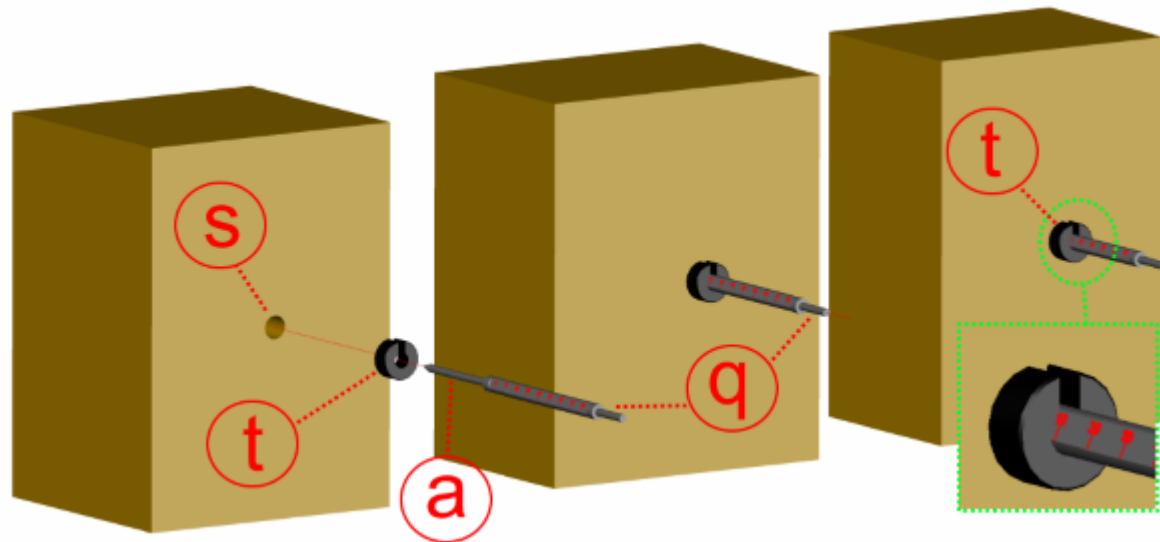


6.7 Depth measurement

Depth measurement

To measure the depth, as indicated in the [test procedures](#), you must use the [extensions](#) supplied together with the instrument.

Using the extension and the measuring ring



After having created the 12 mm diameter pre-hole [s] and after having inserted the tip [a] in the extension [q], insert the measuring ring [t] in the extension.

Position the driving system inside the pre-hole and record the value L0, reading the free end of the reading ring.

Perform strikes as described in the [test procedures](#). The Needle and extension system will enter into the material, sliding into the reading ring. Once the series of strikes has been completed, read the driving depth value, again using the reading ring [t].

7. Test Procedure

Test Procedure

The test procedures described below have been utilised during experimentation when creating the SRM_15 instrument. These procedures can be modified according to operator need for specific applications. On the other hand, following the instructions below allows the operator to compare data with the supplied [reference curves](#) (indicative and for estimation) and to compare results acquired in different sites and by different operators.

Developed test procedures include:

- w Procedure TYPE A - Fast
- w Procedure TYPE B - Complete

Procedure A

- a) Select the masonry to be examined and clean it, removing plaster.
- b) Brush the horizontal mortar joint to be examined.
- c) Verify the initial length of the needle L0_Sup [80 mm or consider 70 mm if using the measuring cylinder]. Note down the measurement in the report table.
- d) Test by means of application of 10 strikes with the striker [\[striker operation\]](#).
- e) Remove the striker and read the penetration depth L10 sup, recording the value [\[see acquisition table\]](#). The absolute penetration value will be calculated using the formula (Surface Mortar Penetration Resistance) $RPMs = L0Sup - L10sup$
- f) Create a pre-hole on the mortar stroke being examined using a 12 mm diameter tip and 100 - 120 mm variable depth.
- g) Insert the extension and the needle in the hole and acquire outside of the site.
- h) Test by means of application of 10 strikes with the striker.
- i) Remove the striker and read the penetration depth L10 Int, recording the value [\[see acquisition table\]](#). The absolute penetration value will be calculated using the formula $RPMi: L0Int - L10Int$

Repeat measurement minimum 3 times on the same test area (mortar stroke), distancing the measurement by about 100 mm.

Procedure B

- a) Select the masonry to be examined and clean it, removing plaster.

- b) Brush the horizontal mortar joint to be examined.
- c) Verify the initial length of the needle $L0_Sup$ [80 mm or consider 70 mm if using the measuring cylinder]. Note down the measurement in the report table.
- d) Test by means of application of a series of 5 - 10 - 15 - 20 strikes using the striker and note down the depth of each series $L5Sup$ - $L10Sup$ - $L15Sup$ - $L20Sup$.
- e) Record the values in the report table, calculating the absolute values using the relation (Surface Mortar Penetration Advancement Resistance) $RAPMs = L0(x)sup - L(5)Int$ and represent the results in the advancement - depth diagram. From the graph, information can be obtained regarding the consistency of the material layer (constant slope) or the presence of different materials (outlier).
- f) Create a pre-hole using a 12 mm diameter tip of a depth between 100 - 120 mm.
- g) Perform the test as indicated in point d) using the measuring extension.
- h) Record the values in the report table, calculating the absolute values using the relation (Surface Mortar Penetration Advancement Resistance) $RAPMs = L0(x)sup - L(5)Int$ and represent the results in the advancement - depth diagram. From the graph, information can be obtained regarding the consistency of the material layer (constant slope) or the presence of different materials (outlier).

Repeat measurement minimum 3 times on the same test area (mortar stroke), distancing the measurement by about 100 mm.

8. Graphs and Tables

Graphs and Tables

Needle penetration value records can be entered into the table described below.
The choice of survey form depends on the [test procedure](#) used.

The graphs shown represent a general indication of how to record data. Variations and modifications are at the discretion and choice of the operator.

Survey Form - TYPE A - pdf document

Scheda Rilievo SRM_15

Scheda TIPO A

www.drcitalia.it

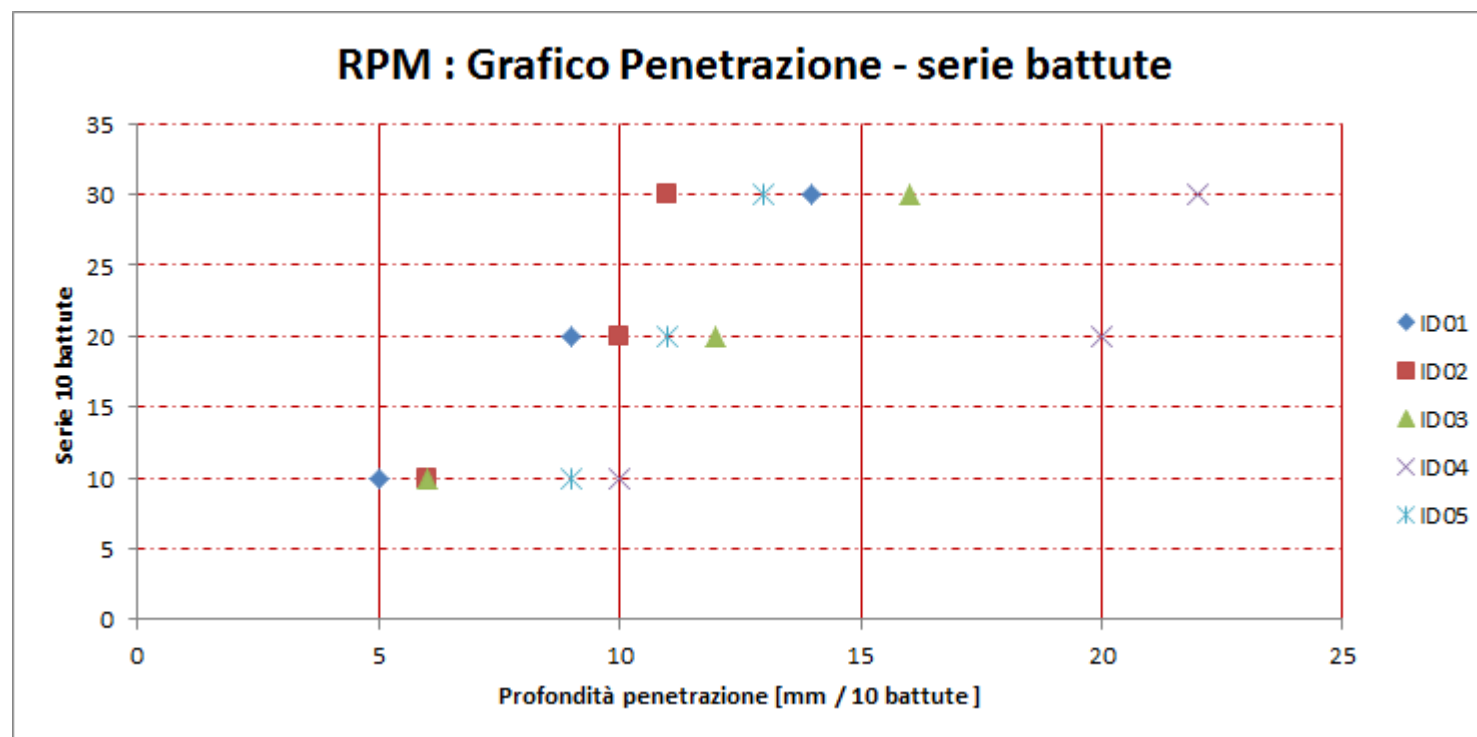
Tabella Rilievo Misure superficiali

Data
Operatore

Sito
Riferimenti pianta

ID prova	Prova n.	L0	Tipo SUP / INT	Profondità Misurata [mm / 10_B]			p_10	RPMS		Note
				L10	L20	L30		p_20	p_30	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

RPM Graph - Mortar Penetration Resistance



Survey Form - TYPE B - pdf document

Scheda Rilievo SRM_15

TIPO B

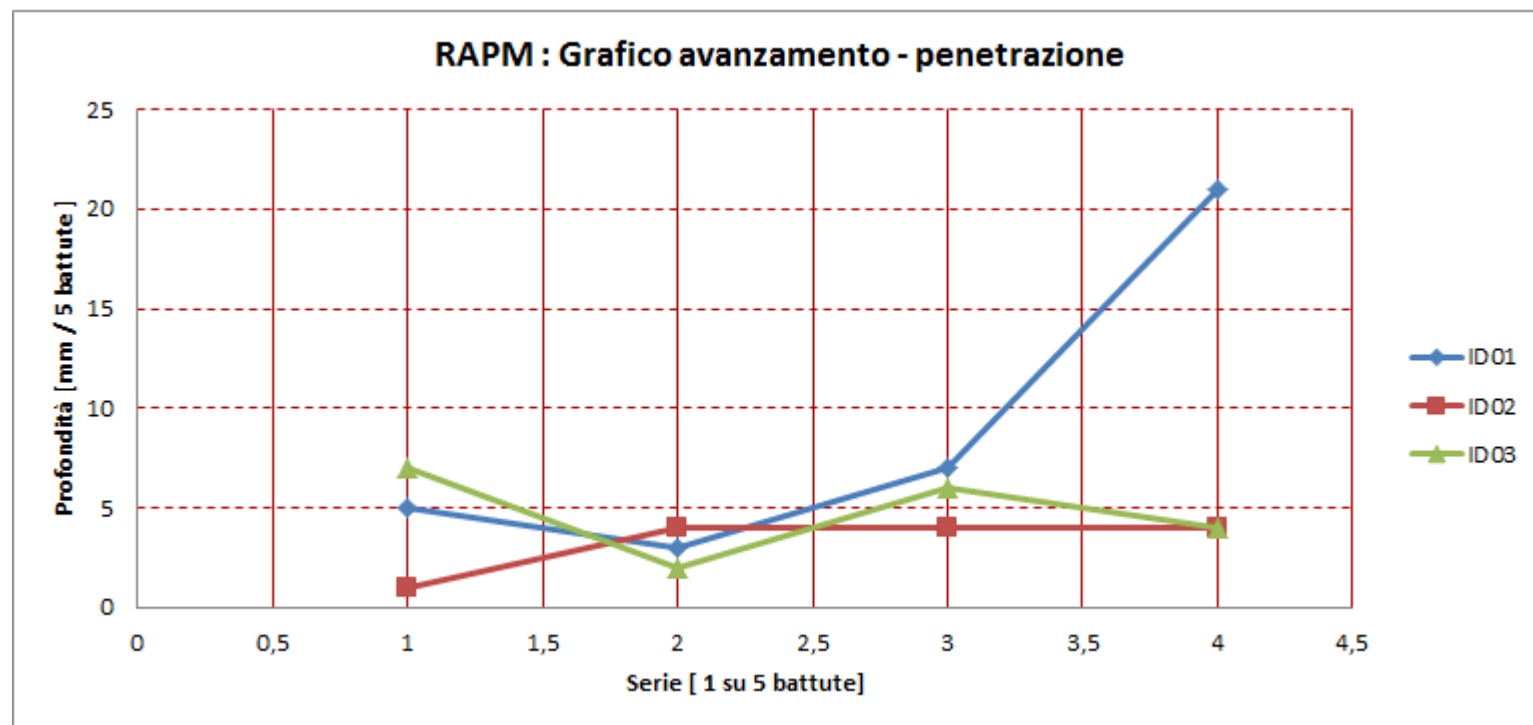
www.drcitalia.it

Tabella Rilievo Misure superficiali

Data	
Operatore	

ID prova	Prova n.	Tipo		Profondità Misurata [mm / 5_B]				RAPMS				Note
		L0_int	SUP/INT	L5_int	L10_int	L15_int	L20_int	p_05	p_10	p_15	p_20	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

RAPM Graph - Mortar Penetration Advancement Resistance

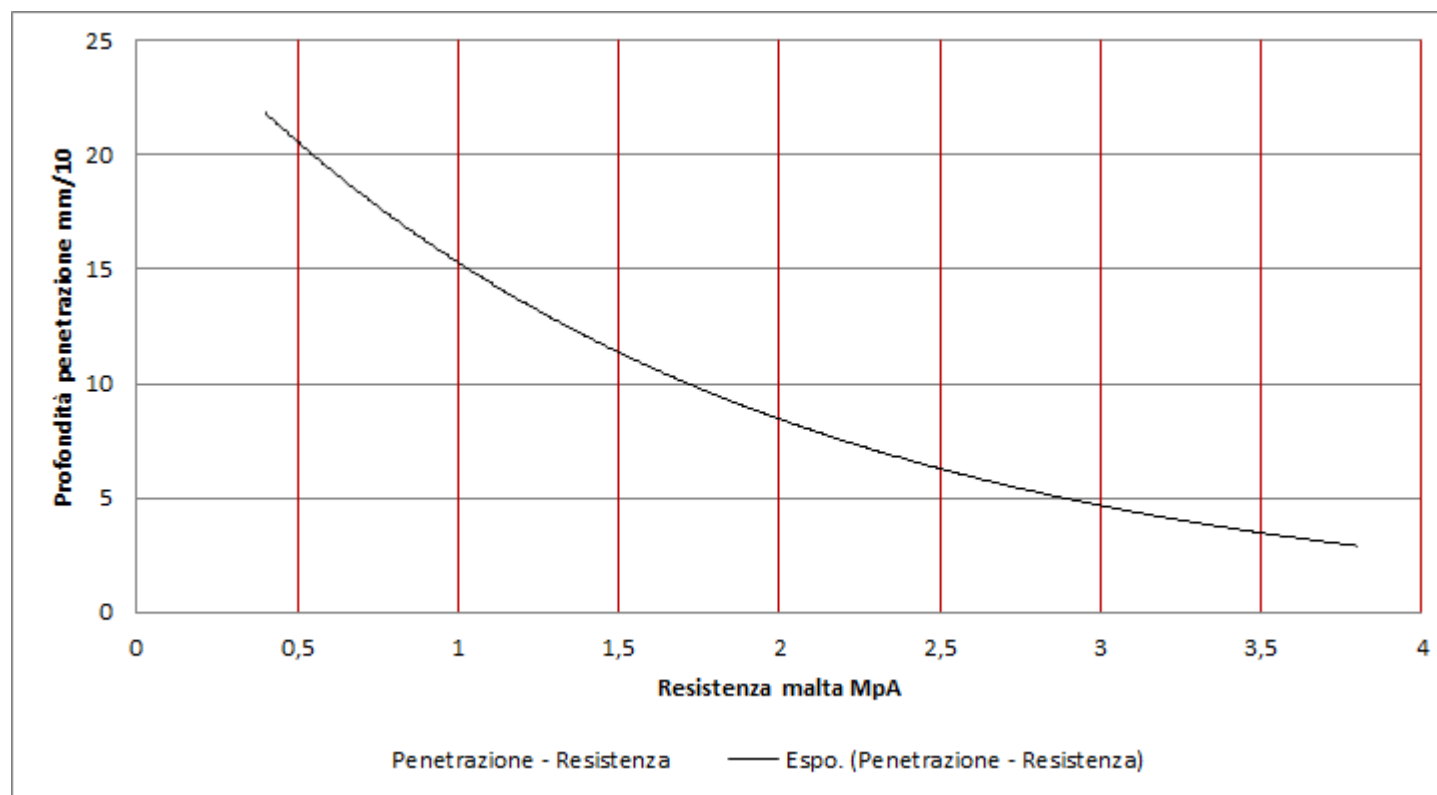


9. Curves

Correlation curves

The correlation curve shown below represents an indication of the ratio between the penetration value and the mechanical resistance of the mortar. These curves are not to be considered as absolute references.

Correlation curves must be created on the mortar of each building under examination in order to obtain an indicative estimation of the mechanical parameters. The penetrometric survey method aims to verify the homogeneity of mortar over the entire building and homogeneity along its own thickness along the area under examination.

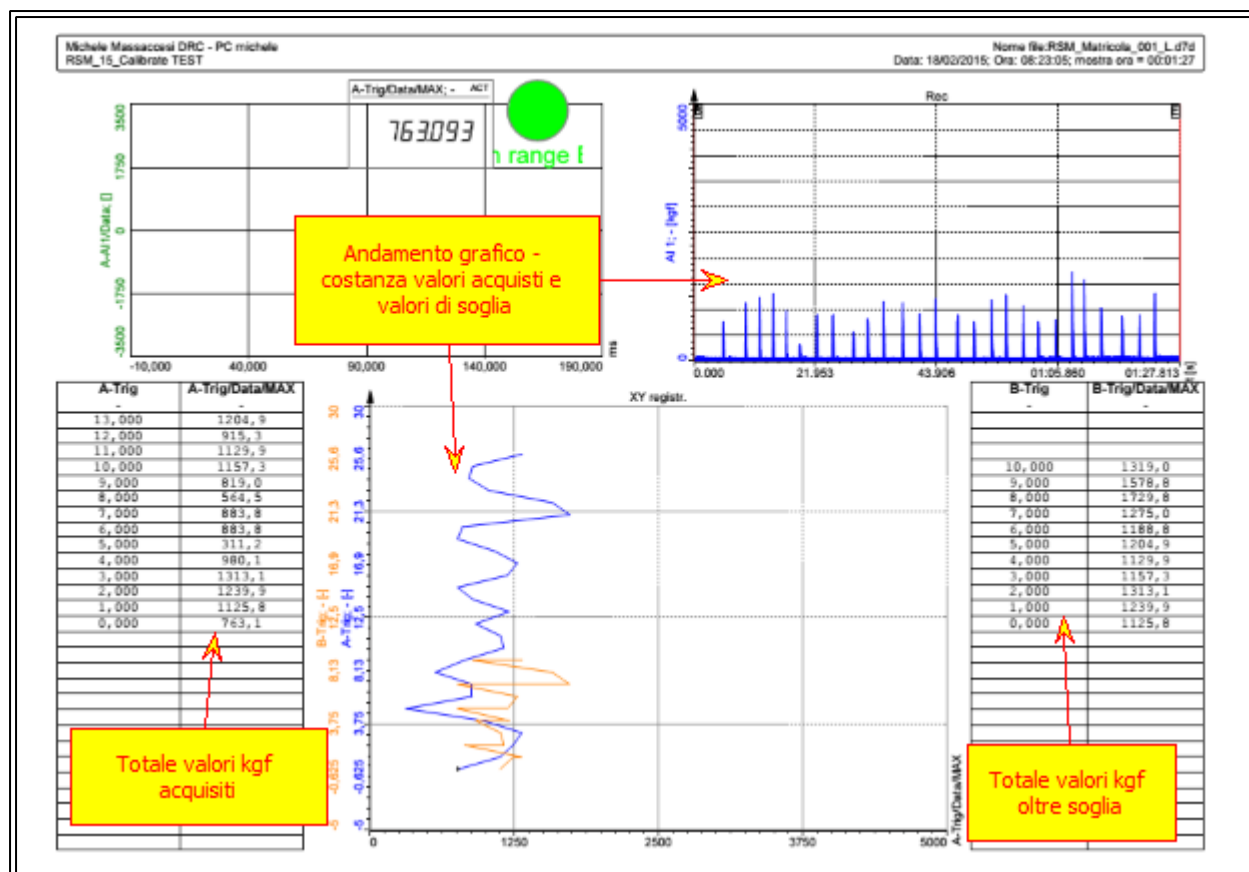


10. Calibration

Calibration

The RSM_15 penetrometer is calibrated with a new verification systems developed by DRC Srl for impact instruments. Calibration consists of the measurement and recording of 20 strikes carried out with the penetrometer aimed horizontally (calibration video).

The RSM_15 penetrometer is supplied complete with calibration report and measurement report.

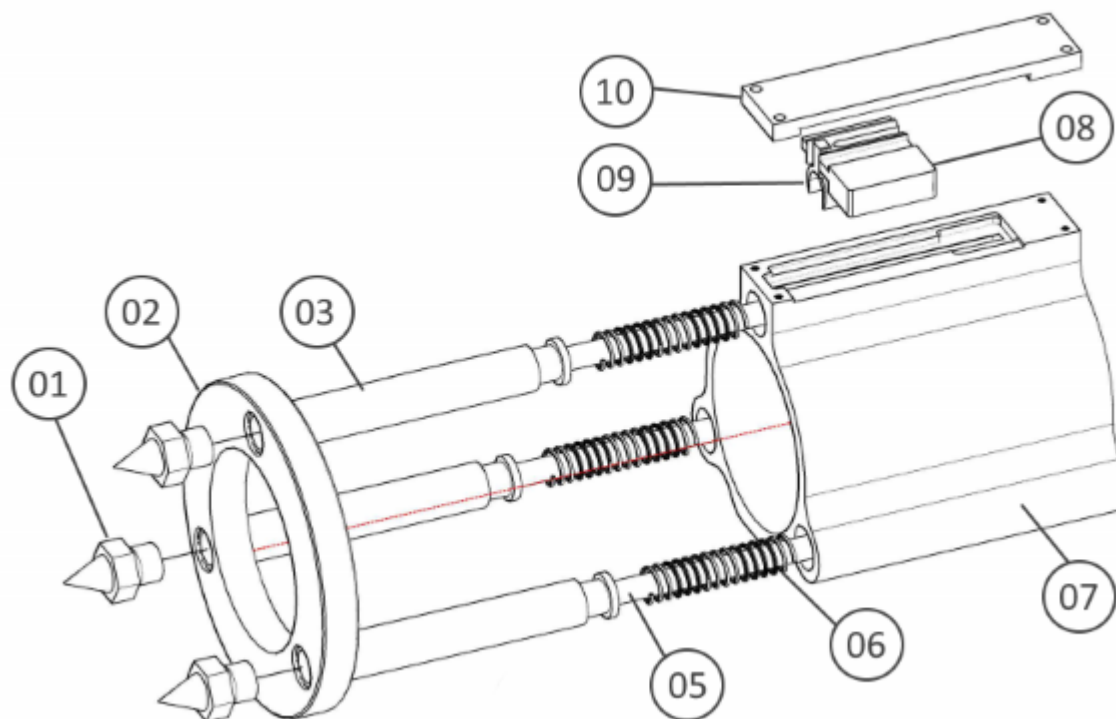


11. Exploded diagram

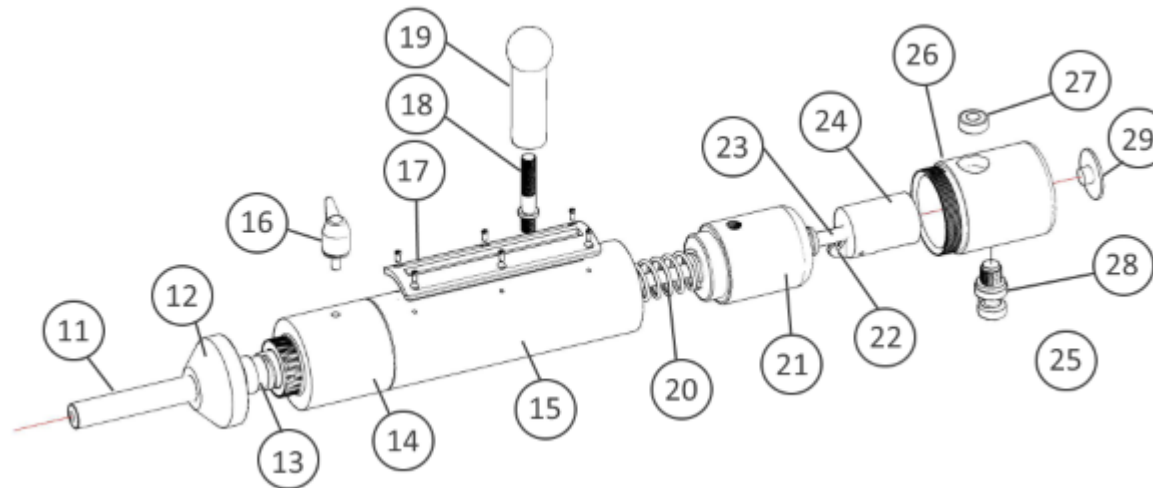
Exploded diagram

The RSM_15 mortar penetrometer components are shown below.

Exploded fit body



Exploded penetrometer



Exploded diagram of components

Code	Description	Pos	Code	Description	Pos
01.DRC.0339	Support feet	01	01.DRC.0337	Slot covering frame	17
01.DRC.0313	Support plate	02	01.DRC.0336	Pull pin	18
01.DRC.0302	Aluminium guide	03	01.DRC.0336A	Loading knob	19
01.DRC.0342	Plate screws	04	01.DRC.0103	Hammer spring	20
01.DRC.0303	Guide M6 shaft	05	01.DRC.0309	Strike hammer	21
01.DRC.0350	Aluminium guide spring	06	01.DRC.0315	Ratchet	22
01.DRC.0312	External measuring body	07	01.DRC.0311	Hammer guide rod	23
01.DRC.0301	Index Cursor	08	01.DRC.0306	Ratchet support	24
01.DRC.0317	Brass cursor	09	01.DRC.035	Top button knob	25
01.DRC.0300	Measurement plate	10	01.DRC.0305	Rear penetrometer cap	26
01.DRC.0307	Striker piston	11	01.DRC.0341	Circular level	27

01.DRC.0308	Tip ferrule	12	01.DRC.0335	Complete button	28
01.DRC.0333	Spring holder ferrule	13	01.DRC.0340	Support cap	29
01.DRC.0310	Penetrometer cone	14		Calibration report	30
01.DRC.0314	External tip guide tube	15	01.DRC.0304	Needle tip	31
01.DRC.0314	Locking lever	16	01.DRC:0331-32	Needle tip extension	32

12. Video Instruction

Video Instruction

KIT Penetrometro RSM

Funzionamento Penetrometro RSM

Montaggio corpo esterno di misura

Misura con comparatore

Misura con corpo esterno

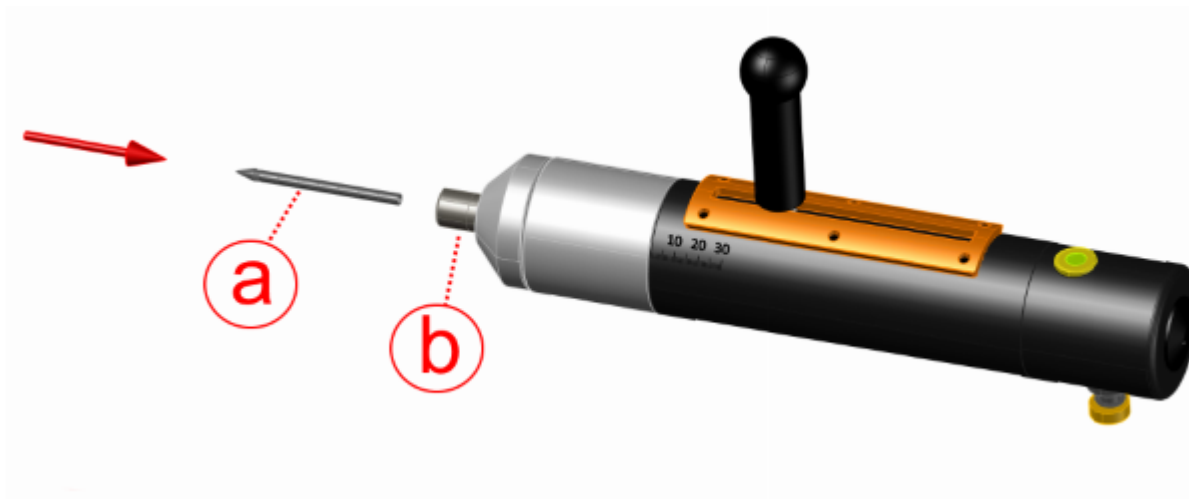
Montaggio prolunga

Misura con prolunga

Misura con prolunga e corpo esterno

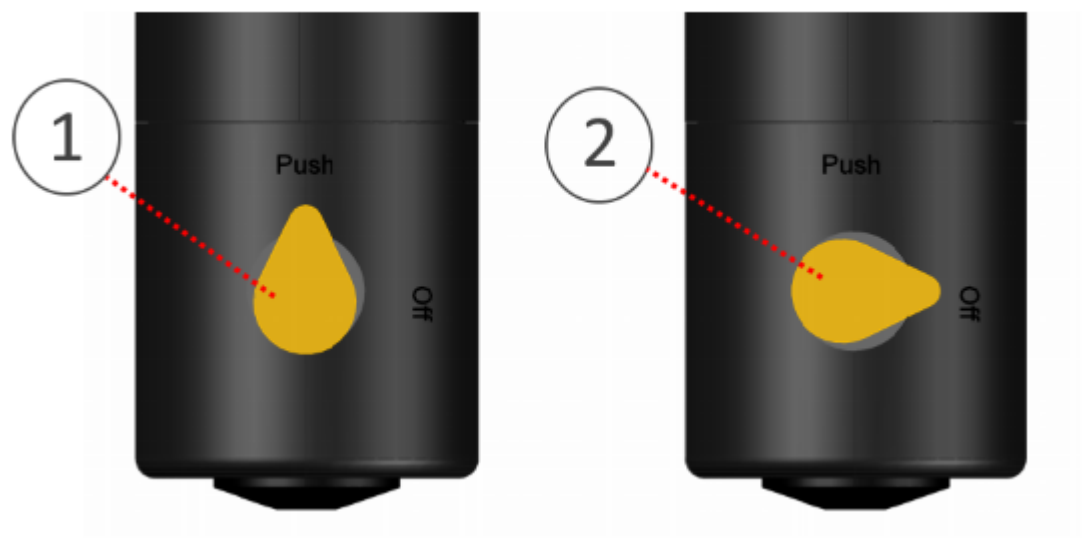
13. Quick start

1. Misura_01A



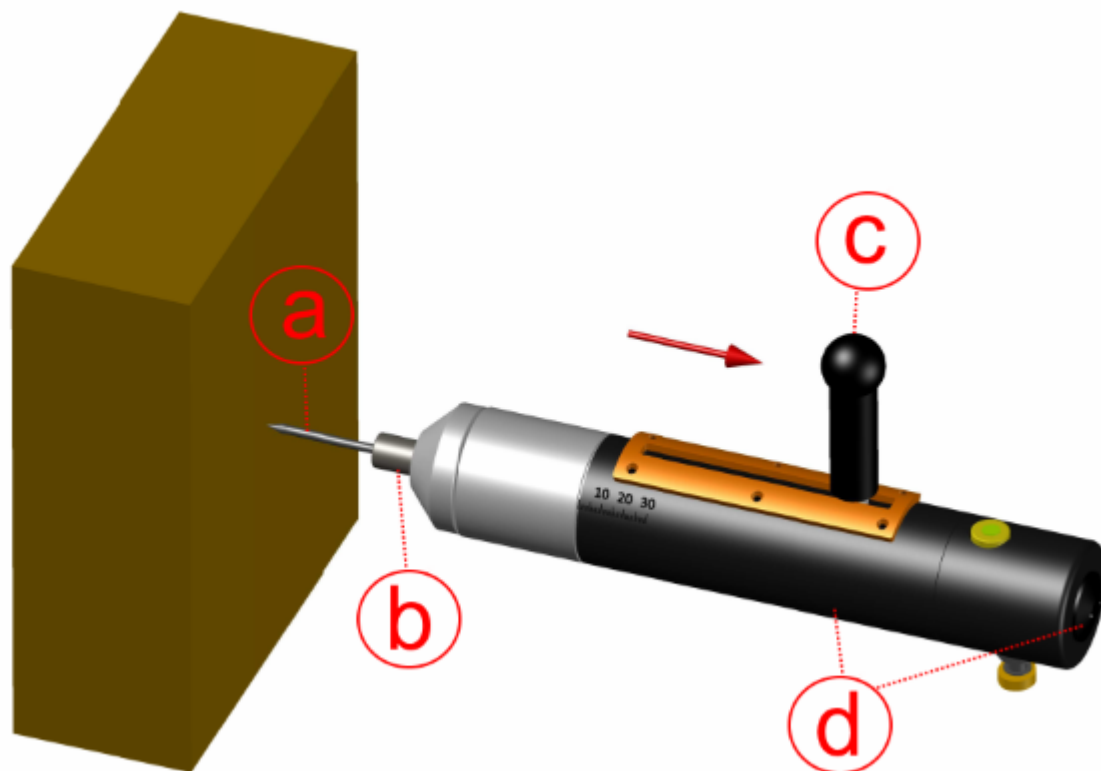
Inserire il puntale nel percussore

2. Tappo posteriore_01



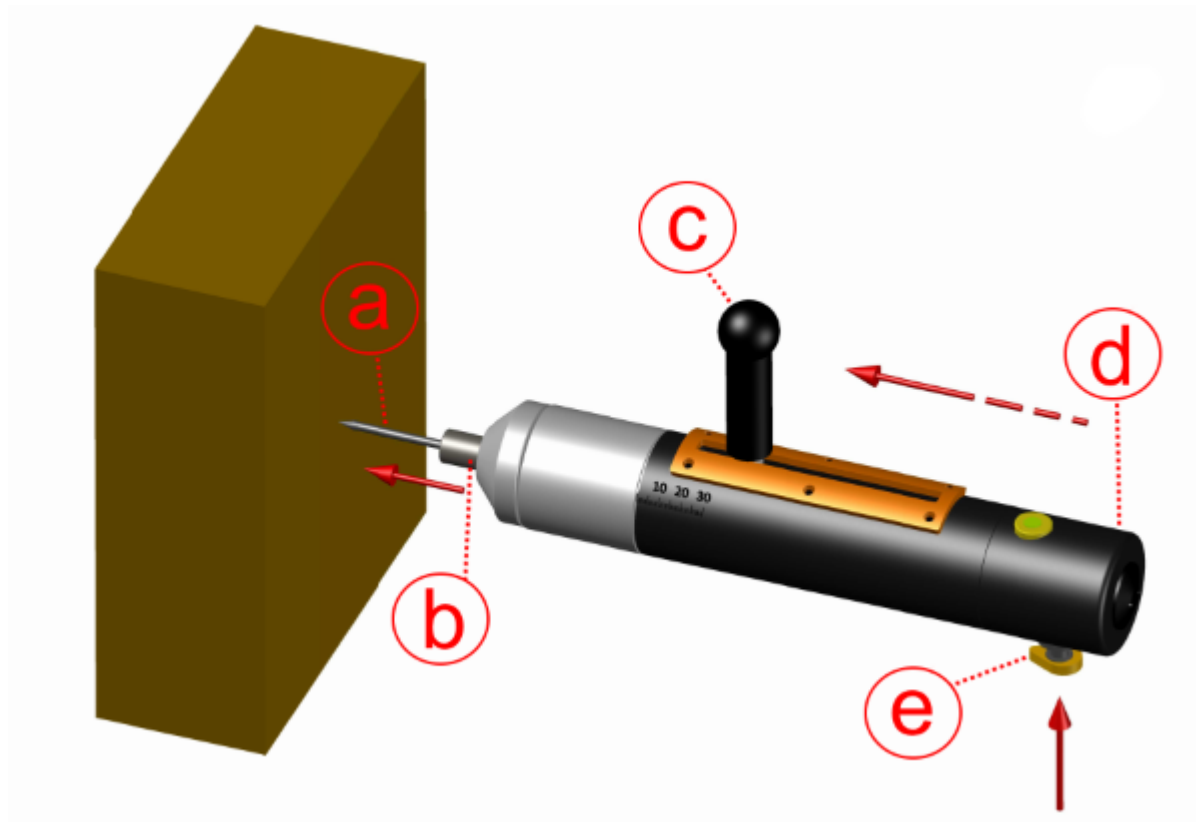
Sbloccare il pulsante posteriore di sicurezza ruotando la manopola nella posizione 1

3. Misura_02A



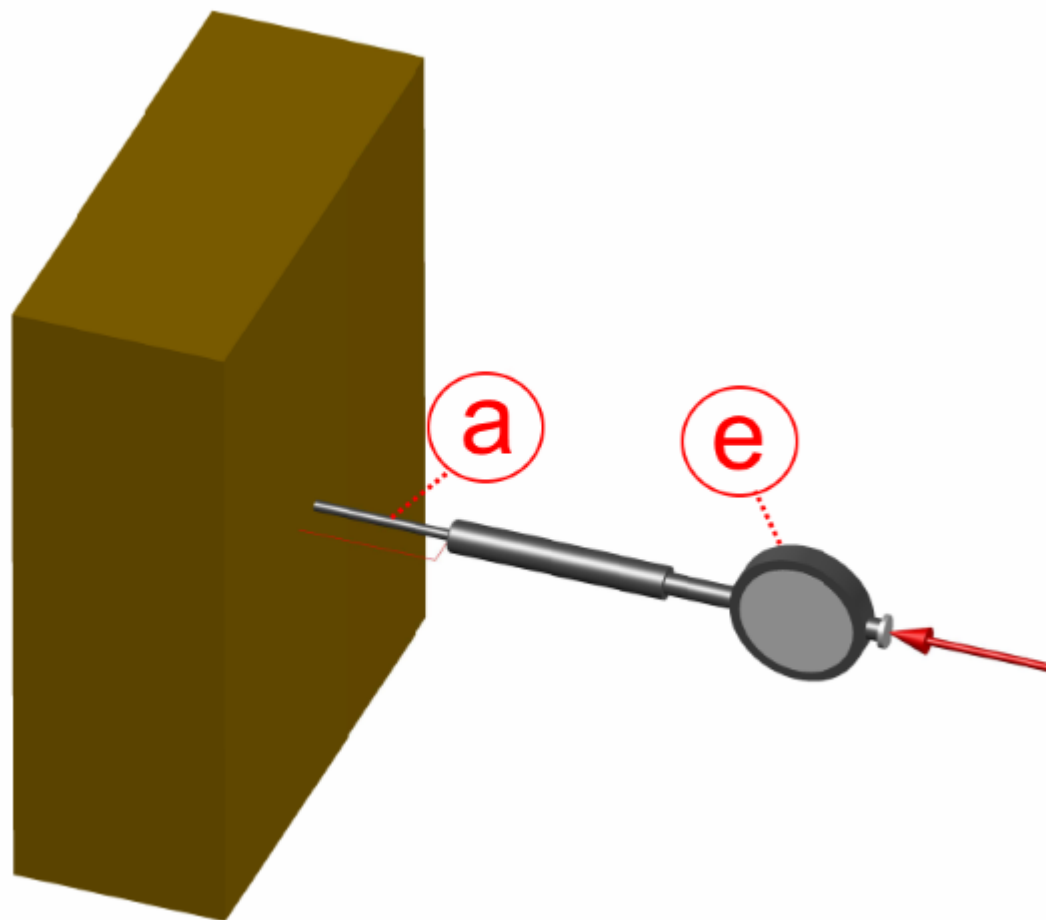
Caricare la manpola di carica posizionandosi a contrasto con il corpo di misura

4. Misura_03A



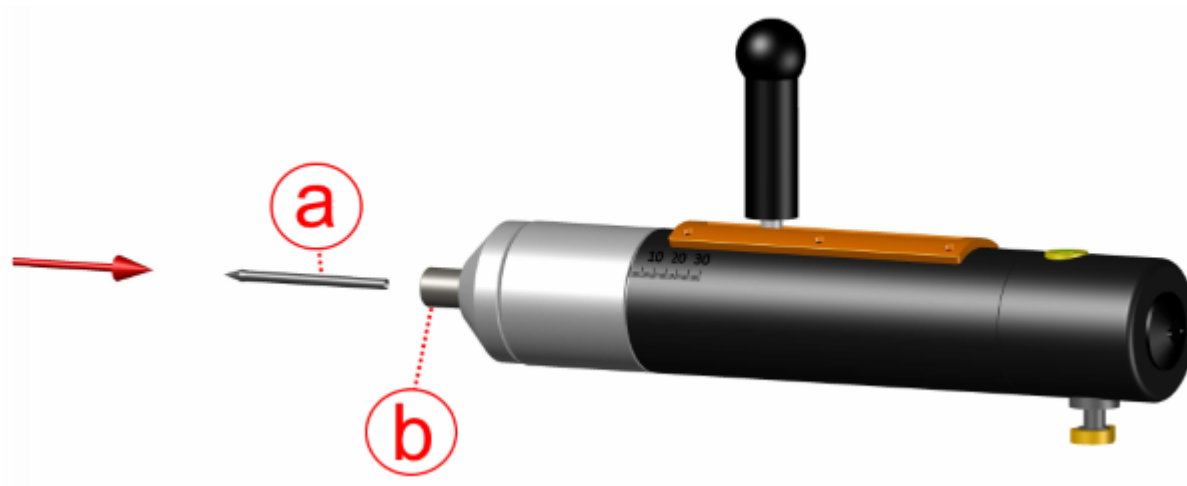
Azionare il pulsante E

5. Misura_04A



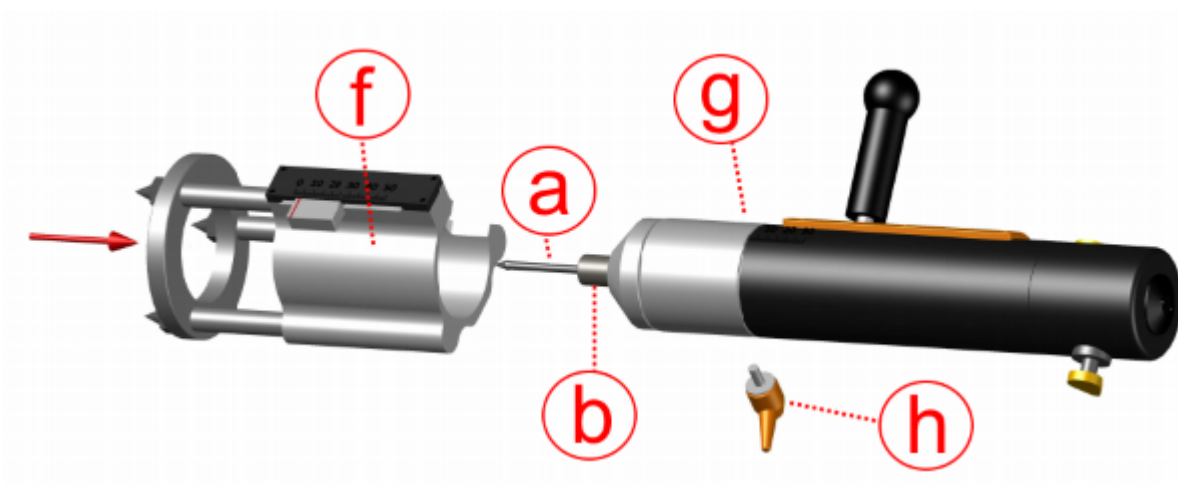
Eeguire la lettura della profondità di infissione con il comparatore

6. Misura_10A



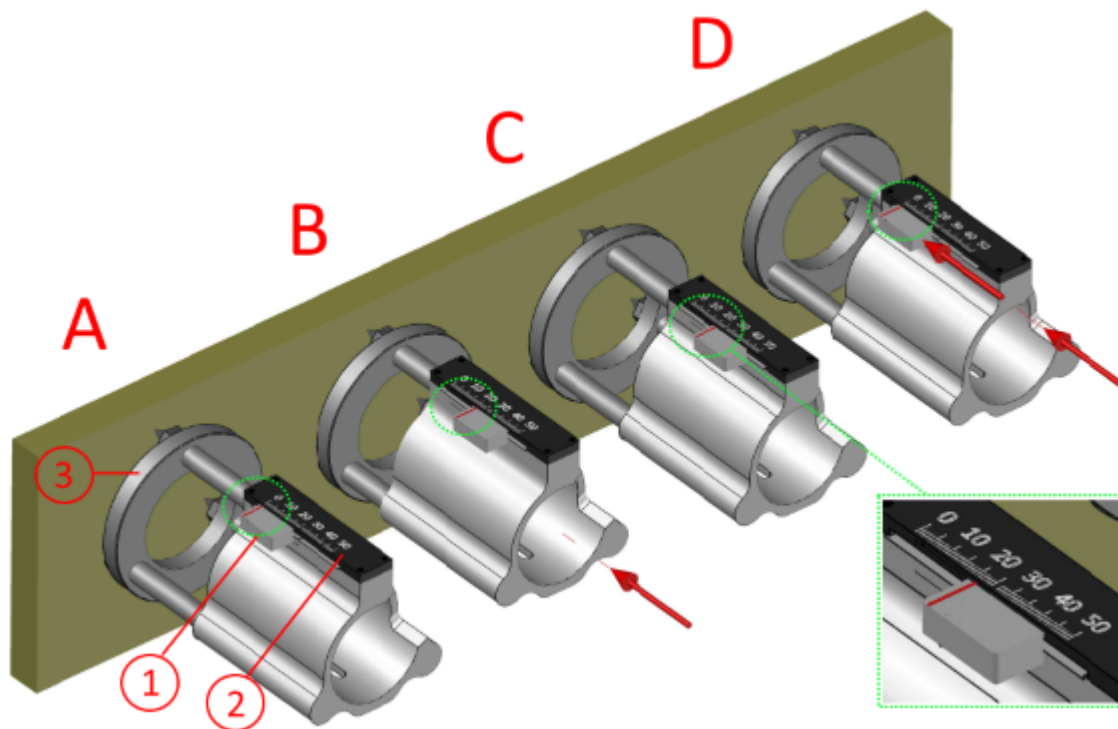
Inserire ago puntale nel percussore

7. Misura_11A



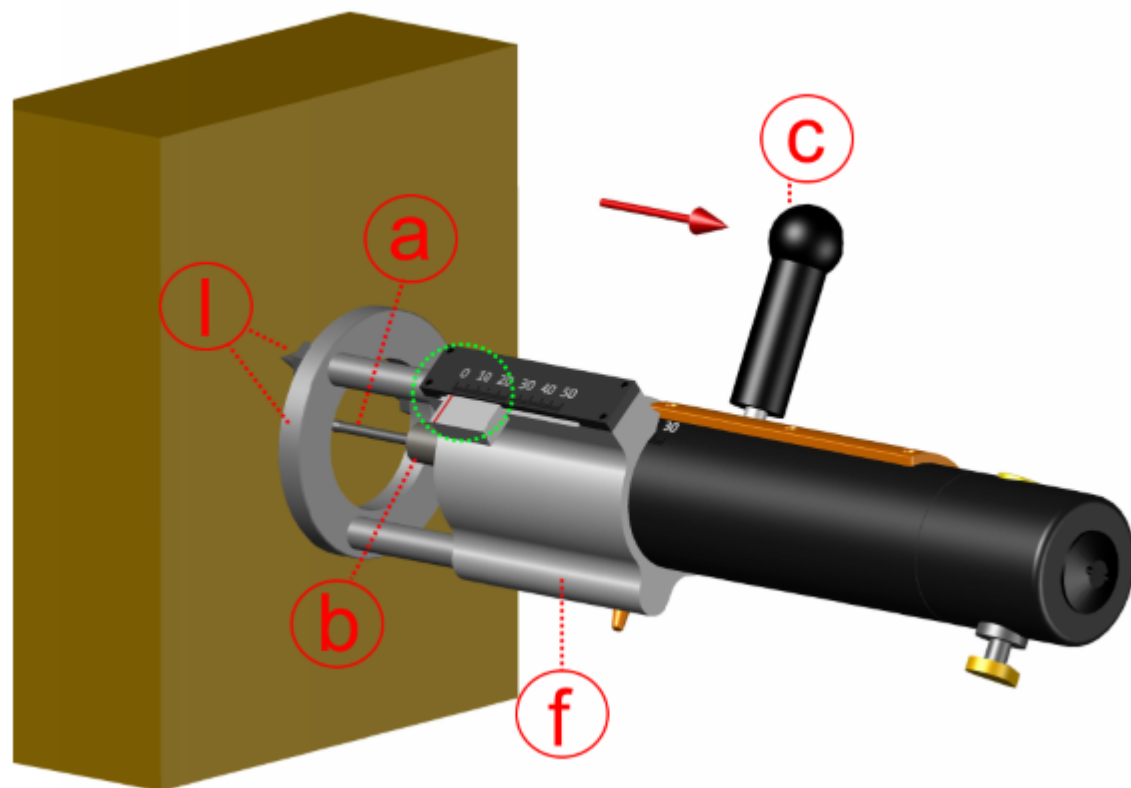
Inserire il corpo di misura esterno serrandolo al percussore con la manpola H

8. Corpo Estero_001AAA



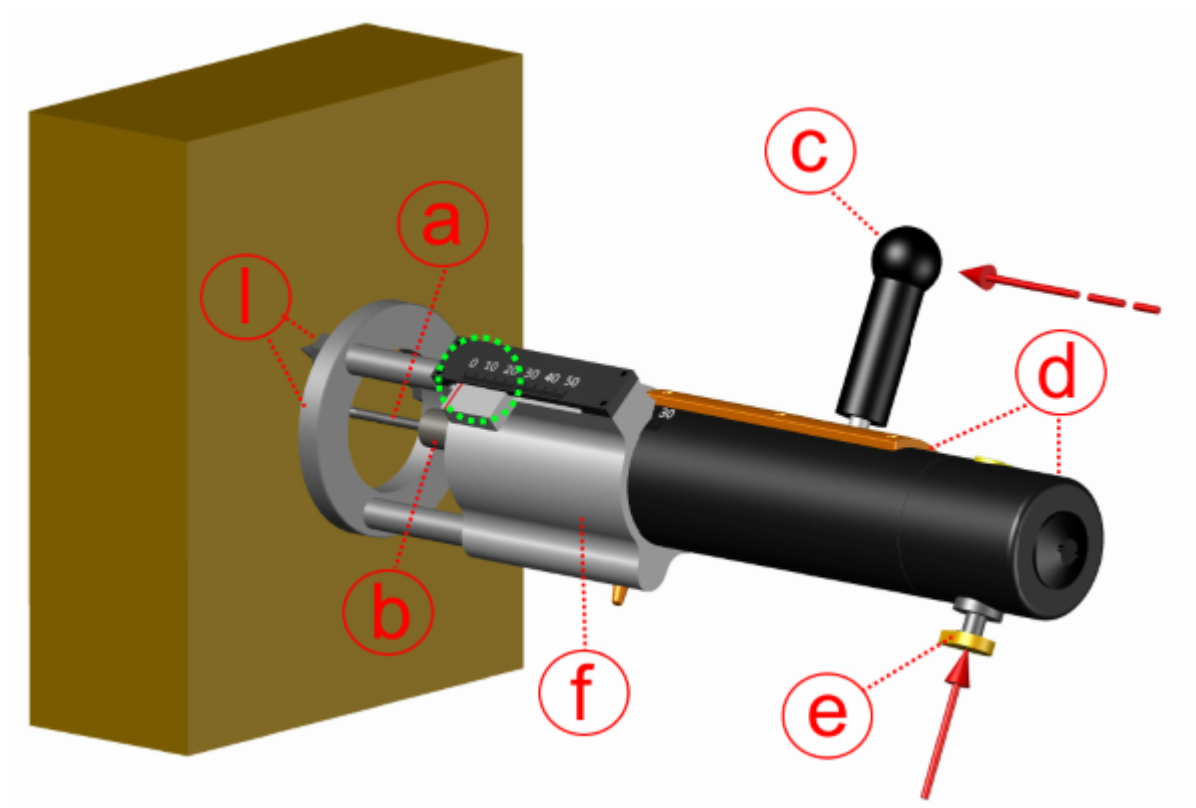
Azzerare il cursore

9. Misura_12A



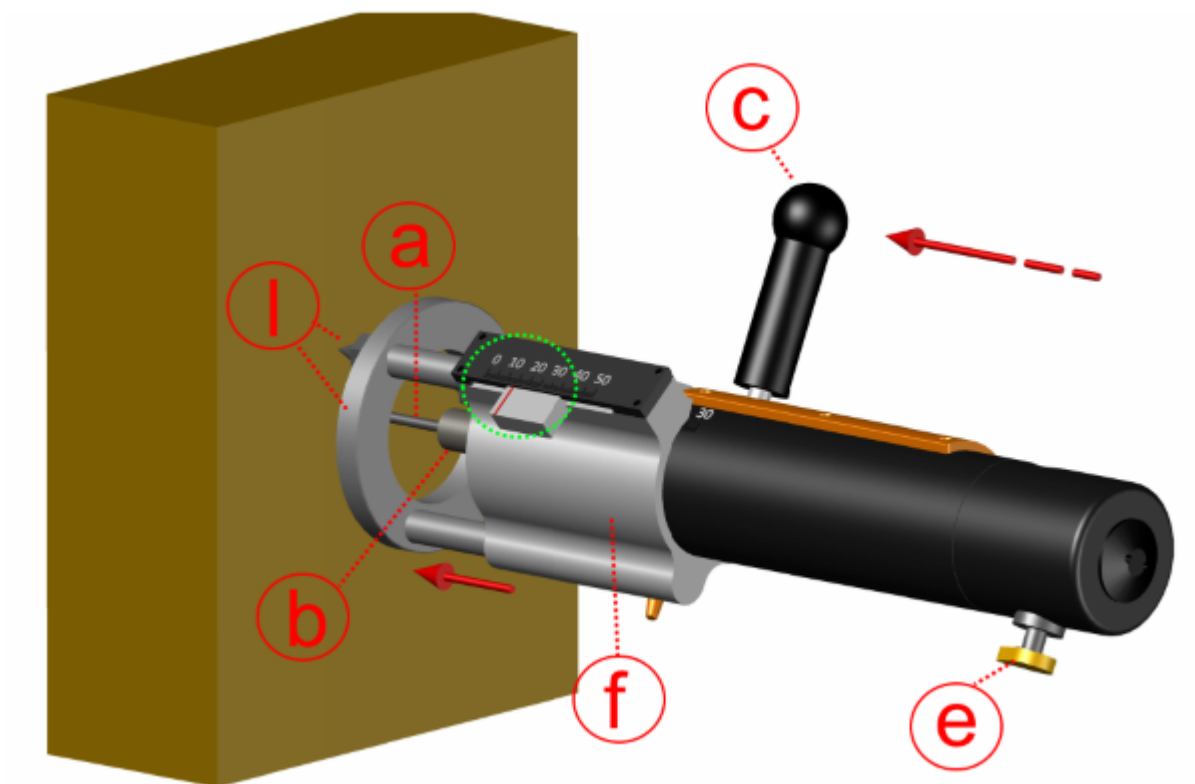
Caricare il percussore con la manopola C

10. Misura_13A



Sganciare il percussore con il pulsante E

11. Misura_14A



Leggere il valore di profondità del puntale utilizzando la posizione del cursore mobile