



SINT
Technology

DRMS Cordless

Device for the Drilling Resistance Measurement

The DRMS Cordless (Drilling Resistance Measurement System)

The **DRMS Cordless** (Drilling Resistance Measurement System) is a device designed to perform simple and precise drilling resistance measurements in stone materials and in mortars.

The position of the drill is referred to the surface of the stone (starting point) and it is always known because it is directly controlled by the software through its dedicated electronics.

The hole depth measured by the system is exactly referred to the surface of target material.

The system can measure continuously:

- Penetration force
- Actual drill position
- Rotational speed
- Penetration rate

Both rotational speed and feed rate are kept constant during operation, and can be continuously regulated between minimum and maximum values.



The system works with a dedicated software that allows both the control of the device and the evaluation of the results.

The outputs of the system are numeric values and x-y plots of Drilling Force.

The equipment has been developed both for laboratory tests or specially for outdoor applications with integrated power battery to the unit for a good autonomy.

Special diamond drill bits are suggested to avoid wear effects.

Drill Bit Rotational Speed and Penetration Rate

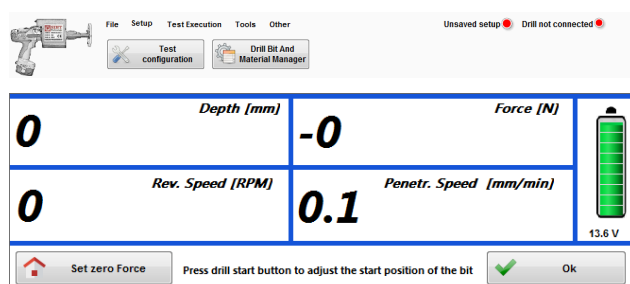
The rotational speed of the drill ranges from 20 to 1000 RPM, and the penetration rate from 1 to 80 mm/min.

Both rotational speed and penetration rate are controlled and maintained constant during the drilling process.

This is realized by an appropriate electronic system of actuation and control.



Drill Bit Position & Starting Point

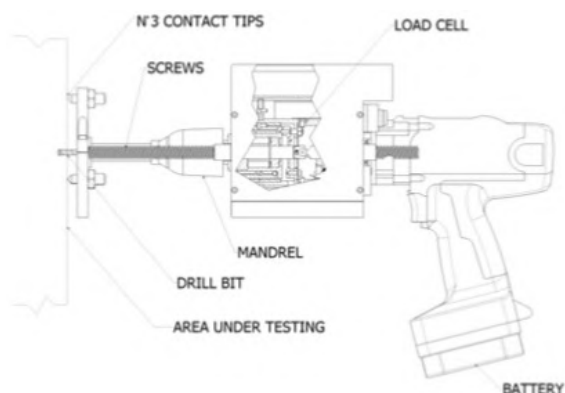


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The hole depth measured by the system is exactly referred to the surface of target material.

Force Measurement

The force applied to the target is measured continuously. The measurable force is comprised between 0 and 100 N.



Electronic Features

Data Acquisition Board:

- USB port connection
- 12 bit of resolution with PGA (Programmable Gain Amplifier).

Stepper and rotating motor control board:

- Constant speed PWM control
- High output current (Max 8 A)

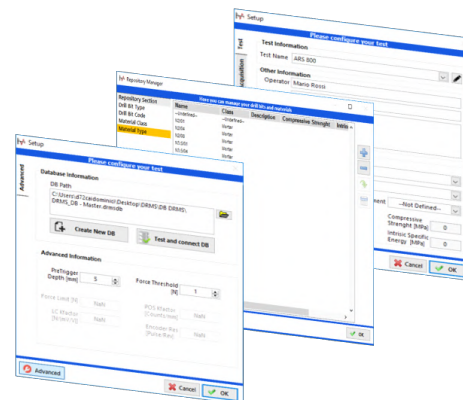
Software Features

The acquired data are transmitted, during the test, to a PC through the USB connection.

The software, developed with LabVIEW™ (National Instruments), has many features related to the graphic data representation, loading and saving data files from the archive.

Some important features are the following:

- Real time graphical indication of force vs. penetration depth with customizable filter (Butterworth and moving average filters)
- Raw data saving
- Embedded database to create a custom repository of materials, holes and drill bits
- Automatic correction of the drill bit wear
- Powerful post-processing tools



Technical specification of the DRMS device

Dimensions (height, width and length)	mm	270 x160x175
Weight	kg	5.5
Measurement Force Range	N	0 - 100
Rotational speed	RPM	20 - 1000
Penetration rate	mm/min	1 - 80
Total Stroke	mm	3 - 5 - 7
Drill bit diameter	mm	0.03 to 1
Drill bit type	/	Diamond
Monopod height	mm	800 - 1600
Battery power supply	VDC	14.4
Possibility to connect a external power supply for laboratory tests	/	Yes (Optional)

Data elaboration: traditional and statistical post-process

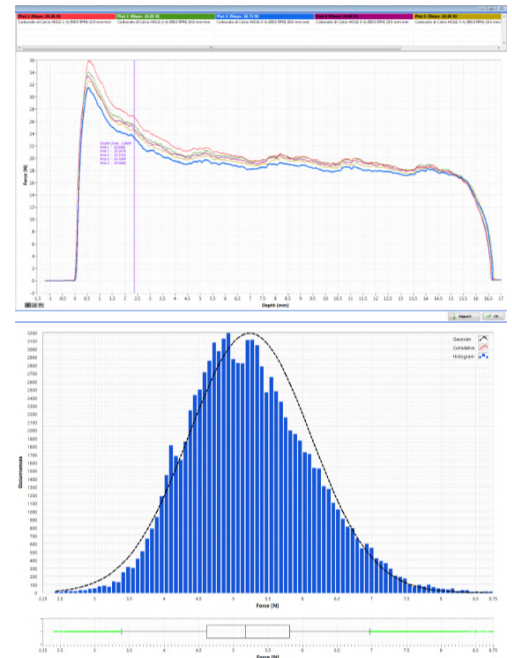
The DRILL 7 software allows to use two different post-processing techniques: the traditional and the statistical approach. The latter is suggested with materials characterized by high fluctuations of the drilling resistance around the mean value (e.g mortars).

Traditional post-processing:

- Multiple drilling force vs. depth visualization
- Customizable frequency filter
- Customizable data decimation
- Averaging functionality
- Drill bit wear correction algorithm

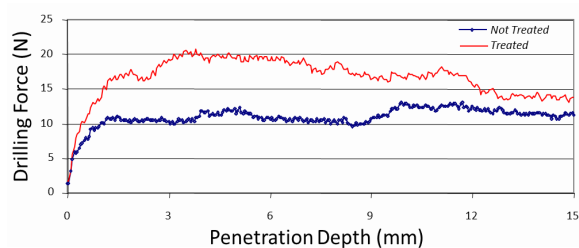
Statistical post-processing:

- Main statistical indices calculation
- Histogram visualization with normal distribution comparison
- Box-plot representation of data
- Q-Q plot calculation
- Cumulative force vs. depth graph
- Holes depth reduction



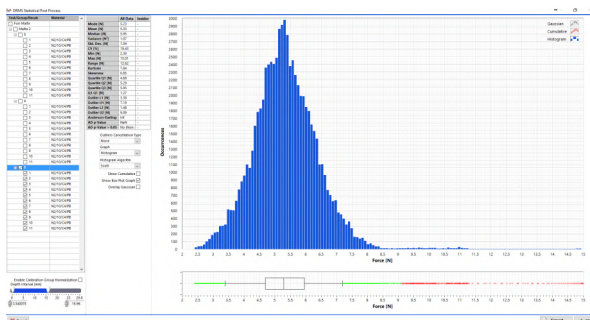
Typical test results

The following pictures show typical test results obtained on different kinds of materials using a 5mm diamond drill bit.



Drilling resistance measurement on a "Pietra di Lecce" limestone treated with Ethyl Silicate

- Drilling Force (N) versus Penetration Depth.
- This test compares the Drilling Resistance Profile in the Treated and Not-Treated conditions of the material.



Statistical analysis of a N2/10/C4/PB mortar

- Histogram and box-plot related to 10 holes drilled in the same material.
- The graph shows the dispersion of the drilling resistance force around the mean value.

Some of our works with the DRMS device:



Dome of Florence (Italy)



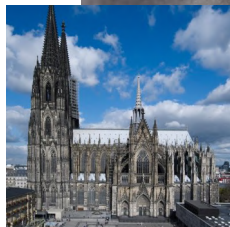
Parthenon, Athens (Greece)



Tower of Pisa (Italy)



**Santa Croce Cathedral,
Florence (Italy)**



Cologne Cathedral (Germany)



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Recognitions

SINT Technology's test laboratory is accredited to standard ISO/IEC 17025:2005 by the Italian accreditation body **ACCREDIA** with **certificate no. 0910**



LAB N° 0910

Certification of conformity to the requirements of standard

UNI EN ISO 9001

