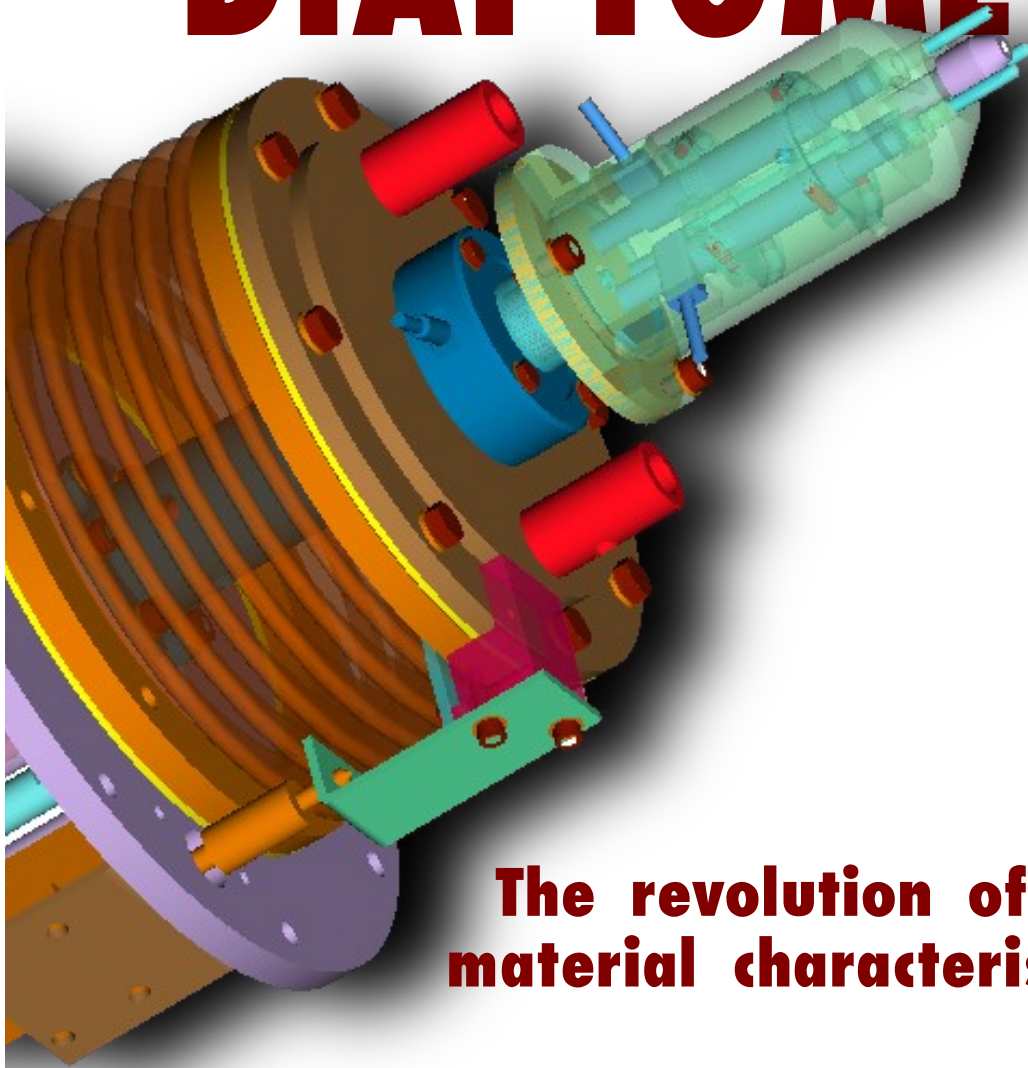


# DIAPTOMETRO



**The revolution of the  
material characterisation**



*Non-destructive Tests - Quality Assurance – Maintenance  
Technological Processes Control*



## DIAPTOMETRO

The DIAPTOMETRO is an instrument devoted to qualify metallic materials and designed for industrial purposes

By means of an indentation process, executed by an instrumented spherical head, the DIAPTOMETRO evaluates the yield stress  $\sigma_{SN}$ , the strain hardening coefficient  $n$  and the stress-strain curve of metallic materials ( $\sigma-\varepsilon$ )

The DIAPTOMETRO is a computer-based instrument: it takes measurements through a very simple, cheap, non-destructive testing indentation.

Thanks to its reduced dimensions, the DIAPTOMETRO can be successfully used whether on small material samples or on *in-situ* components.

## Key Features

<i>non-destructive and non-invasive</i>	Measures can be obtained just creating a small crater on the object under test
<i>Fast</i>	Quick preparation of the test area and immediate measure. It is not necessary to get material samples from the object under test and usually the object doesn't need to be removed from its natural collocation
<i>Easy</i>	The instrument is easy to use without any particular pre-knowledge or training
<i>Portable or Desktop</i>	The Diaptometro is realised in two versions, one for laboratory use and the other is portable in order to be used in operating field
<i>Accurate</i>	Measures are sensitive and repeatable



## Fields of use

<i>Quality Control</i>	Fast and accurate measures on raw or finished mechanical parts
<i>Supply Control</i>	Incoming raw materials and semi-finished products are controlled through a fast and non-destructive process
<i>Maintainance and parts life</i>	with the possibility to check parts without removing them, the life of plants and machinery critical elements can last longer
<i>Safety</i>	Safety tests on plant with <i>in situ</i> monitoring of critical elements
<i>Special Process Control</i>	<i>in situ</i> applications for topic measurements in critical areas (e.g. welded grooves, areas with thermal alterations, etc.)



# Versions



The DIAPTOMETRO is available in a desktop version and in a portable version, battery supplied.

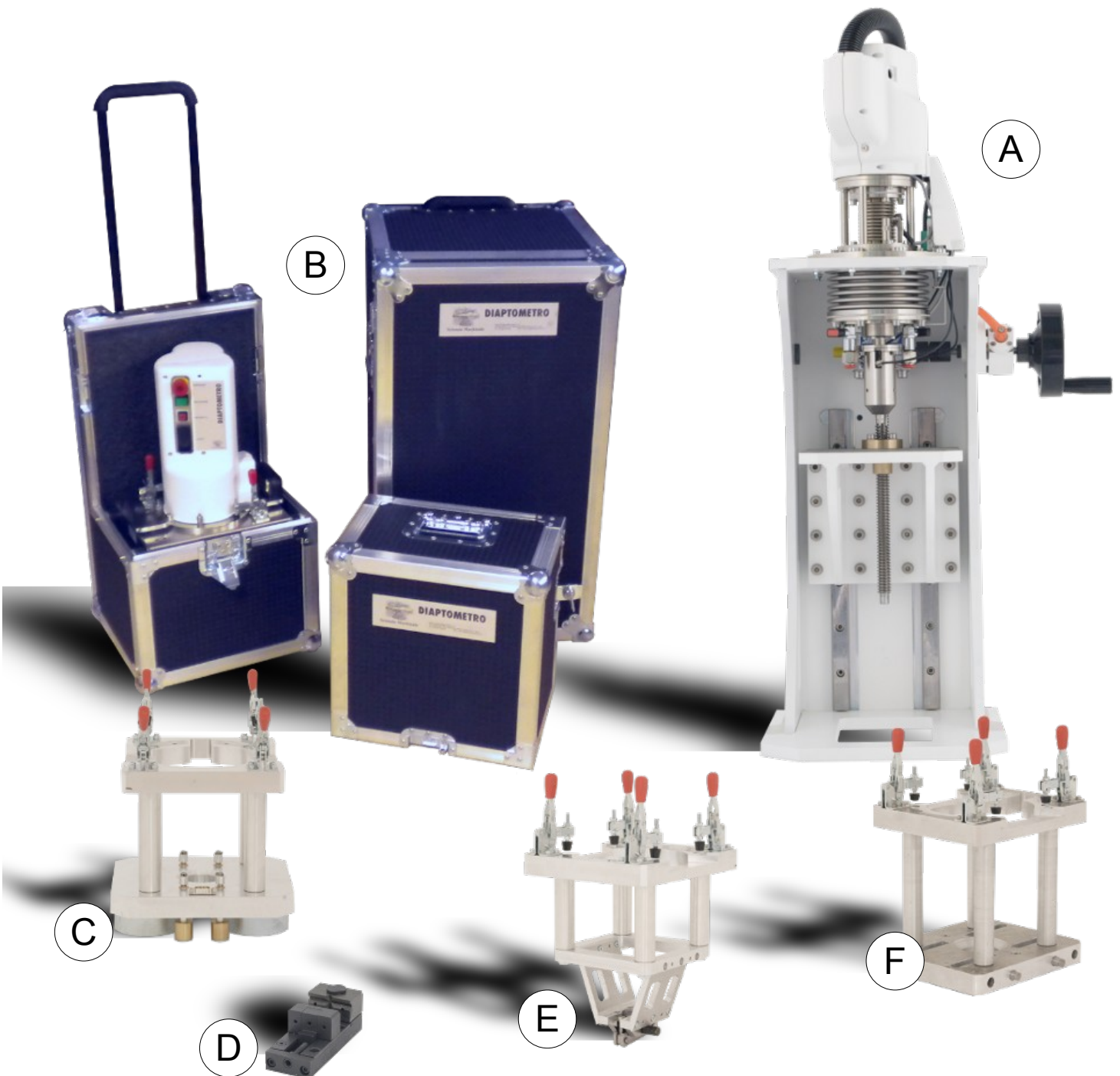
## Features

- The measurement is done by means of an indentation process, executed by an instrumented spherical head
- The instrument evaluates the yield stress  $\sigma_{SN}$ , the strain hardening coefficient  $n$  and the stress-strain curve of metallic materials ( $\sigma$ - $\epsilon$ )
- portable for field use
- topic analysis (crater diameter  $< 1$  mm)
- automatic use: you could run it also if your are not a specialist

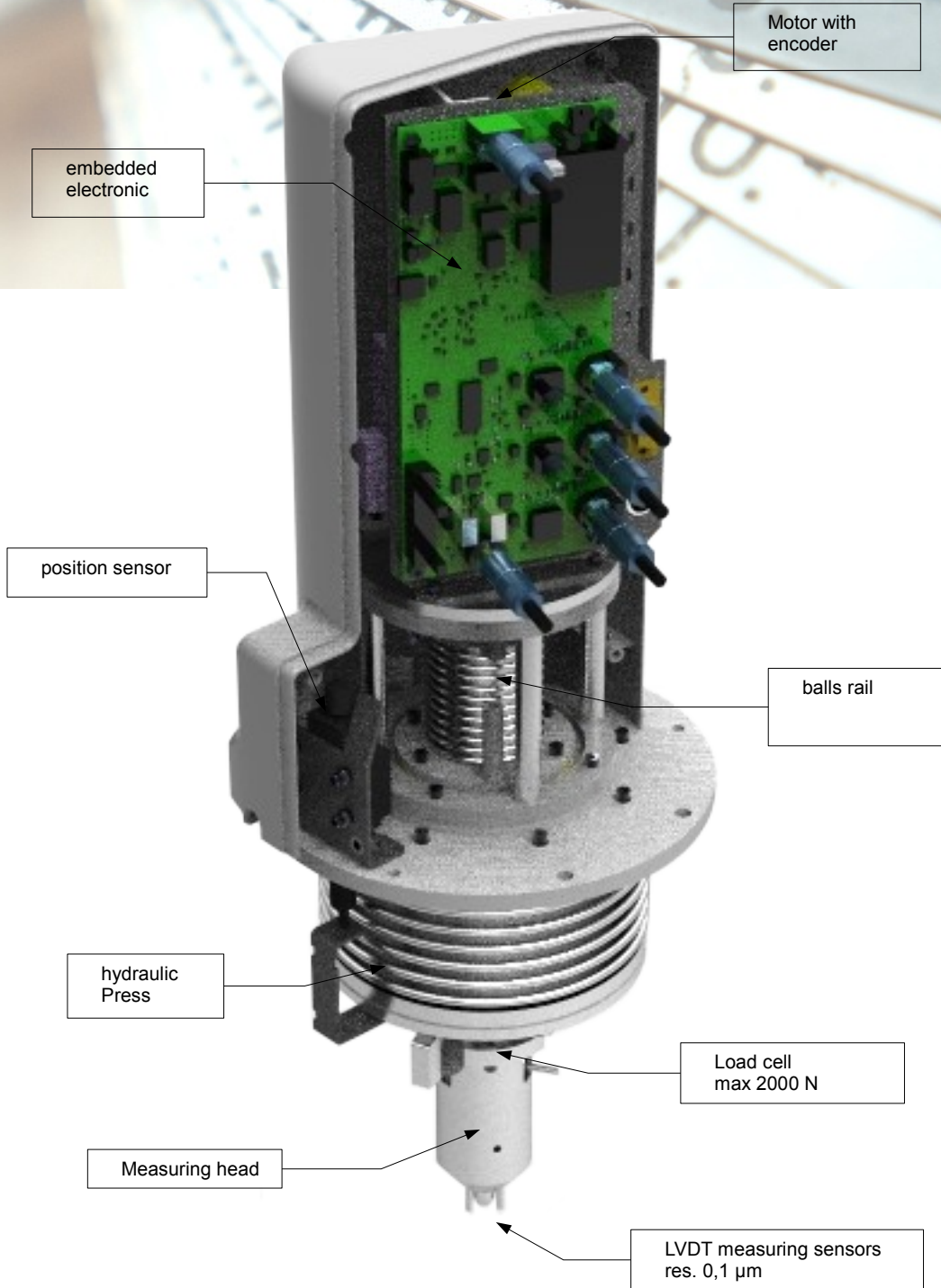
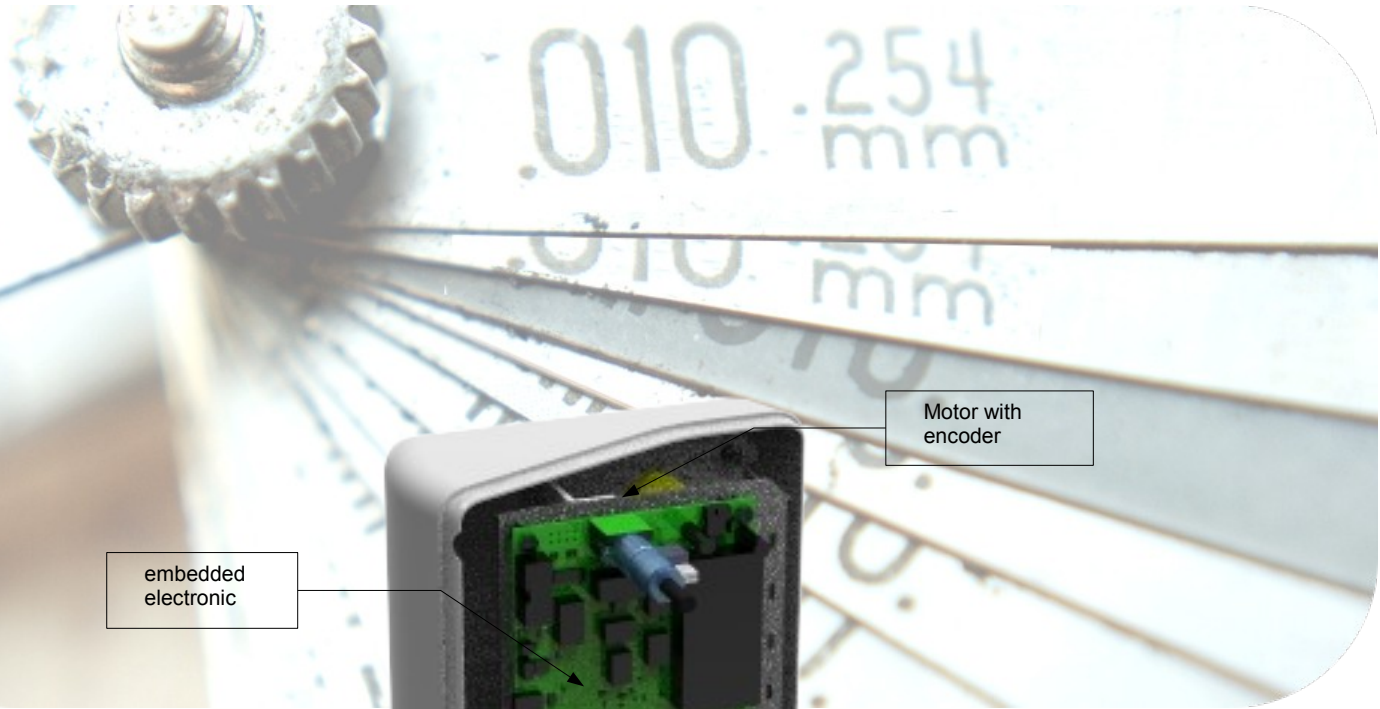


## The Diaptometro and its accessories

- A – Diaptometro on desktop base
- B – Portable container; all the system is self contained
- C – magnetic fixture (optional)
- D – Plier for sample (optional)
- E – small tube accessory (optional)
- F – for tubes (optional)



# Internal structure





Nome progetto

- 50002-008-A-008-0003  
Indentation acquired at 15-ott-2010 12.35.36
- 0000 - Three Tips Configuration  
Configuration File
- cartella
- 50013-001-A-001-0001  
Indentation acqu...

Set Indentation Parameters

Steps

1. Setup
2. Set Indentation Parameters
3. Indentation
4. Peak

Name: [ ]

Title: [ ]

Date: 10-06-2010 11:25:54

Notes: [ ]

Set max force [N] = 0,76020

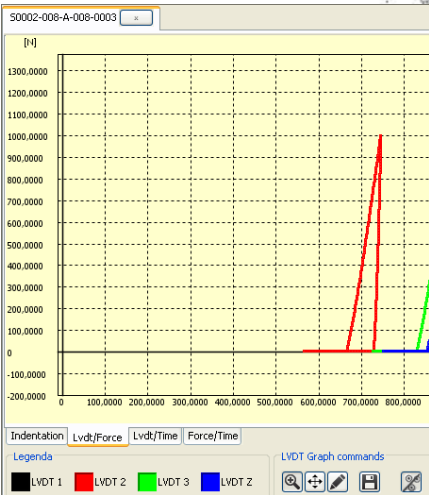
Result to Chart Position: [ ]

Around Temperature: [ ]

U, C: [ ]

System Time: [ ]

OK [ ] Cancel [ ]



\*Diaprometer Studio - New project

File Tools ?

New project

- 50013-001-A-001-0001  
Indentation acquired at 15-ott-2010 12.35.36
- 0000 - Two Tips Configuration File
- Fitting 0
- Fitting with cut at 1
- New fitting 0
- Fitting with cut at 1
- 50013-001-A-002-0001  
Indentation acquired at 15-ott-2010 12.35.36
- 0000 - Two Tips Configuration File
- Fitting 2
- Fitting with cut at 1
- 50013-001-A-003-0001  
Indentation acquired at 15-ott-2010 12.35.36
- 0000 - Two Tips Configuration File
- Fitting 1
- Fitting with cut at 1

Fitting viewer

Name	Yield stress ( $\sigma$ )	Strain harden...	Sigma0 ( $\sigma_0$ )	M Young	Correlation	Error
[ ] [50013-001-A-001-0001] Fitting 0	1988	0,07	1960	210000,00	0,39	0,68
[ ] [50013-001-A-002-0001] Fitting 2	1929	0,04	1913	210000,00	0,68	0,21
[ ] [50013-001-A-003-0001] Fitting 1	1469	0,24	1356	210000,00	0,41	0,49
[ ] [50013-001-A-001-0001] New fitting 0	1988	0,07	1960	210000,00	0,39	0,68

( $\sigma$  (MPa))

Graph commands

Export PDF

Statistics

Yield stress ( $\sigma$ ) Average 1844 Yield stress ( $\sigma$ ) Std. Dev. 217,84 Yield stress ( $\sigma$ ) Std Dev On Avg (%) 11,82

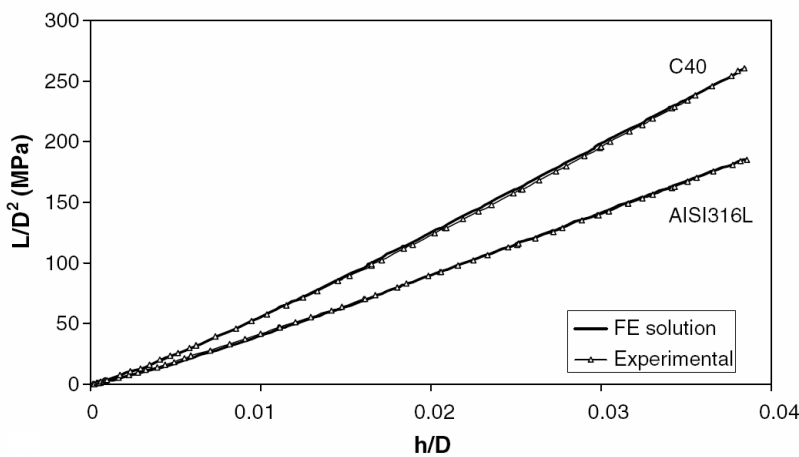
Not connected No connection No connection

## Theoretical measuring method

The DIAPTOMETRO (from greek: measure through contact) is able to evaluate the uniaxial stress-strain curve ( $\sigma$ - $\epsilon$ ) of material belonging to 3 main classes of metals: steels ( $E = 205$  GPa), copper alloys [Cu-alloys] ( $E = 120$  GPa), aluminium-alloys [Al-alloys] ( $E = 70$  GPa).

The only information the DIAPTOMETRO needs in order to execute its analysis is the class to which the metal under indentation belongs (it can be identified by Young's modulus  $E$ ). After that, the DIAPTOMETRO is able, through an indentation procedure, to measure the axial indentation load  $L$  (never greater than 1500 N) and the corresponding penetration displacement  $h$  (never greater than 0.1 mm).

Once  $L$ - $h$  curve is detected, the yield stress  $\sigma_{SN}$  and the strain hardening coefficient  $n$  can be evaluated; at the end, by means of Young modulus  $E$ ,  $\sigma_{SN}$  and  $n$  the DIAPTOMETRO can plot the uniaxial stress-strain curve



# Technical Features

Dimensions [mm]	480x200x200	
Weight of the head [kg]	8	
Maximum Load [N]	2000	
Load measure accuracy	0,1 %	
Travel [mm]	2	
Travel measure accuracy [ $\mu\text{m}$ ]	1,5	
Resolution [ $\mu\text{m}$ ]	0,1	
Indentation speed [ $\mu\text{m}/\text{sec}$ ]	10-50	
Sphere Diameter penetrator [mm]	2,5	5
Power Supply	AC 220 V 50-60 Hz	DC 24 V
PC link	RS232C	
Software	For Windows XP-Vista - W7 32bit	



This research has been carried out with the collaboration of:



Dipartimento Ingegneria Meccanica Nucleare e della Produzione, Pisa University, Italy



Dipartimento Ingegneria Materiali e Tecnologie Industriali, Trento University - Italy



Dipartimento di Ingegneria Meccanica e Industriale, Rome University III - Italy

#### Published Papers

M. Beghini, L. Bertini, V. Fontanari: "On the possibility to obtain the stress-strain curve for a strain-hardening material by spherical indentation". International Journal of Computer applications in Technology 2002, 15, (4/5), pp. 168-175

M. Beghini, L. Bertini, V. Fontanari: "Modellazione numerica della prova di indentazione sferica per materiali metallici" Associazione Italiana per l'Analisi delle Sollecitazioni (AIAS) XXXI Convegno Nazionale –18-21 Settembre 2002, Parma

Beghini, L. Bertini, V. Fontanari: "Evaluation of the stress-strain curve of metallic materials by spherical indentation". International Journal of Solids and Structures 43 (2006) 2441–2459

M. Beghini, L. Bertini, L. Bosio, V. Fontanari, R. Valleggi: "Progetto e realizzazione del 'diapometro', strumento per la caratterizzazione meccanica di materiali metallici mediante indentazione sferica strumentata". Associazione Italiana per l'Analisi delle Sollecitazioni (AIAS) XXXV Convegno Nazionale – 13-16 Settembre 2006, Università Politecnica delle Marche

B.D. Monelli, M. Beghini, L. Bertini, A. Di Gioia, V. Fontanari: "Analisi del processo di deformazione plastica nella prova di indentazione sferica" Associazione Italiana per l'Analisi delle Sollecitazioni XXXVI Convegno Nazionale – Ischia, Napoli, 4-8 Settembre 2007

B.D. Monelli, M. Beghini, L. Bertini, V. Fontanari: "Analisi del processo di deformazione plastica nella prova di indentazione sferica" AIAS – Associazione Italiana per l'Analisi delle Sollecitazioni XXXVII Convegno Nazionale 10-13 settembre 2008, Università di Roma "La Sapienza"

V. Fontanari, B.D. Monelli, M. Beghini, L. Bertini: "Numerical analysis of plastic deformation evolution into metallic materials during spherical indentation process" Journal of Materials Research, Vol. 24, No. 3, Mar 2009 pag. 1270

V. Fontanari, B.D. Monelli, M. Beghini, L. Bertini: "Mechanical Characterization of Metallic Material by Instrumented Spherical Indentation" SEM Annual Conference & Exposition on Experimental and Applied Mechanics. 1<sup>st</sup> -4<sup>th</sup> June, 2009, Albuquerque, New Mexico USA.

#### Patents

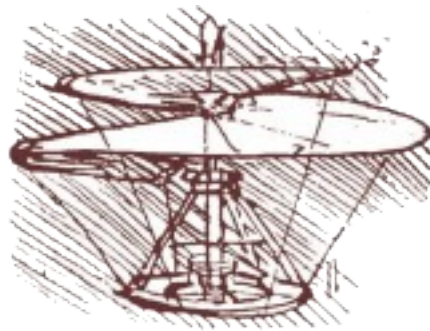
IT/TO2004000535 "Metodo per la rilevazione di caratteristiche meccaniche di materiali"

EP 05780178.9 "Metodo per la rilevazione di caratteristiche meccaniche di materiali"

Domanda USA N. 11/597,752 "Method for determining mechanical features of a material and apparatus that carries out this method"

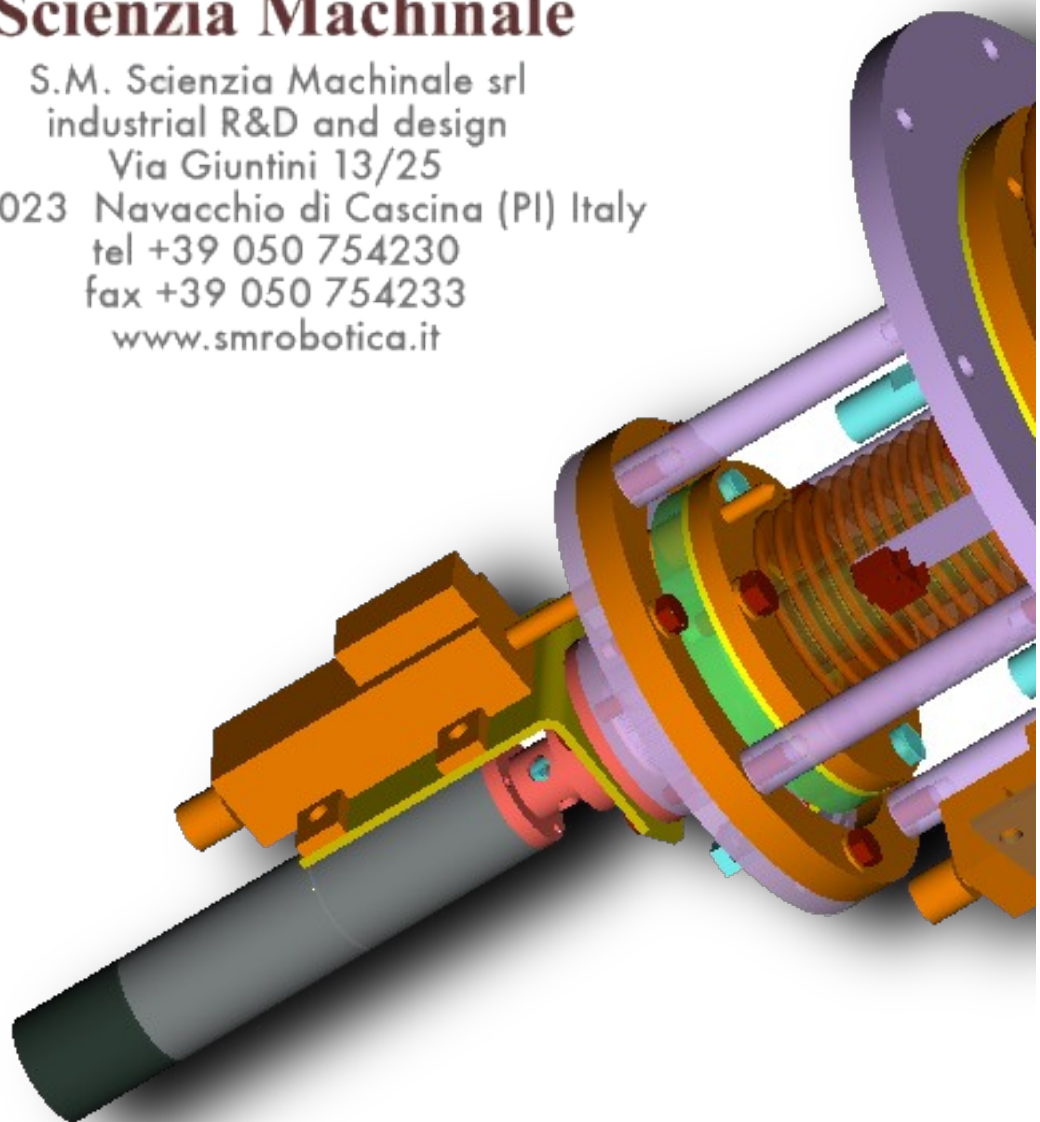
#### R&D Founded Projects

Bando Regione Toscana 2006 "Aiuti allo sviluppo precompetitivo" Diapometro Progetto N.2432



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