

**NATIONAL INSTITUTE OF RESEARCH AND
DEVELOPMENT IN MECHATRONICS AND
MEASUREMENT TECHNIQUE
INCDMTM, BUCHAREST -ROMANIA**

Facilities for Advanced Micro and Nanotechnologies

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INCDMTM Bucharest

NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT IN MECHATRONICS AND MEASUREMENT TECHNIQUE, as national institute of CD and unique in their field of mechatronics in Romania, is working mostly to achieve the main objectives of National Strategy and the European Research, watching convergence to the micro-nanotechnology, in re-appropriate activity, new equipments and high-tech mechatronic technology systems, intelligent measurement and control and transforming it into a flagship technology with high internal and international visibility.

INCDMTM Bucharest participates in the Network ROMNET MINAFAB bringing an important contribution to national development of the **micro-nanotechnologies domain** providing advanced facilities with immediate application in industry.

- **Advanced micro-technologies for micro and nano-processing**

- (1) Advanced micro-technology and equipment for micro- and nano-processing by using sinterizing laser beam

- (2) Advanced micro-technology and equipment for laser micro-welding with high power laser beam

- **High-tech micro-technologies for vibration testing**

- (1) High-tech micro-technology for vibroacustical diagnosis in-situ, in order to ensure predictive maintenance

- **Intelligent micro- and nano-technologies control**

- (1) Micro- and nano-technologies control non-contact for the topography of surfaces – rugosity and contour

- (2) Micro- and nano-technologies control non-contact for the topography of surface s– 3D topography

- (3) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – lengths

- (4) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – profiles

- (5) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – 3D

- (6) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – interferometer

- (7) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – heights

- (8) Micro- and nano-technologies micro-nano-dimensional control of industrial benchmarks – linear and angular inspection

- **Advanced calibration micro- and nano-technologies**

- (1) Advanced micro- and nano-technologies for the calibration of inductive comparators and transducers

- **Advanced calibration micro- and nano-technologies for characterizing micro- and nano-structures**

- (1) Advanced micro-technology for the evaluation of superficial structures

- **Advanced micro-technologies for micro- and nano-processing**

(1) Advanced micro-technology and equipment for micro- and nano-processing with laser beam by the sintering method

Overview:

Advanced micro-technology and equipment for micro- and nano-processing with laser beam uses the selective sintering device **EOSINT M 270 TITAN VERSION** in order to produce: models and prototypes for implantable bio-medical products, functional prototypes for the auto vehicle and for the airspace industry, high quality casts, as well as for designing and dynamically testing of implants and of other mechanical pieces used in the industry. This micro-technology is used for creating complex geometries, impossible to carry out by other means of processing metal.



EOSINT M 270 TITAN VERSION

The technical and scientific description of the device is the following:

Exposed surface: max. 250 x 250 mm

Exposed height: max. 215 mm

Exposure speed: max. 7000 mm/s (any type of piece can be carried out within a few hours)

Laser beam diameter: 100 – 500 micro-meters

The positioning speed of the arm used in spreading powder layers: 40 – 500 mm/s

CAD designing software and dedicated software for rapid prototyping

- **Advanced micro-technologies for micro- and nano-processing**
(1) Advanced micro-technology and equipment for micro- and nano-processing with laser beam by the sintering method

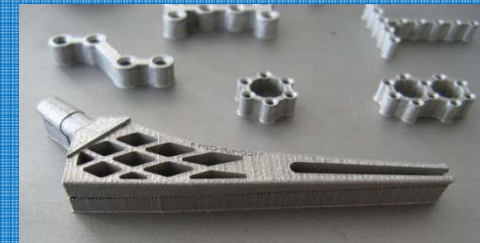
Applied in:

Functional prototypes used in the industry, casts, individual components:

1. DirectMetal20 – bronze-based
2. maraging steel (1.2709)
3. Stainless steel 17-4 (1.4542)
4. Stainless steel PH1

Bio-medical implantable devices and functional prototyping for the automobile industry and the airspace industry:

1. CobaltCrom MP1 Super-alloy
2. Titan Ti64
3. Titan Ti64ELI
4. Genuine Titan



Implants and bone synthesis elements



General use micro-mechatronic products by INCDMTM

- **Advanced micro-technologies for micro- and nano-processing**
(1)Advanced micro-technology and equipment for micro- and nano-processing with laser beam by the sintering method

Applications:

Industry prototypes, molds, individual components

- DirectMetal20 – from bronze aged
- Martensitic steel(1.2709)
- Stainless steel 17-4 (1.4542)
- Stainless steel PH1

Implantable biomedical and functional prototyping for the automotive and aerospace industry:

- CobaltCrom MP1 Superalloys Titanium Ti64
- Titan Ti64ELI
- Pure Titanium

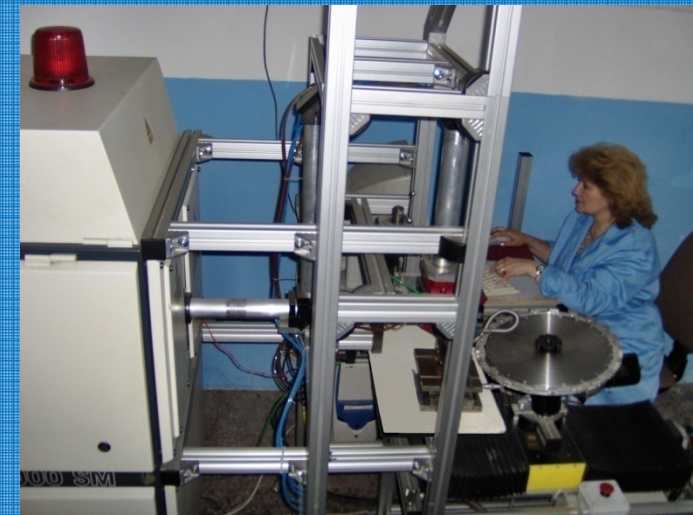
(2) Advanced micro-technology and equipment for high-power laser beam micro-welding

Overview:

The advanced equipment for high-power laser beam micro-welding that is roomed in the MACROLASER Center uses a high-power ROFIN SINAR LASER GmbH /Germany - 2200W laser and can carry out various welding, cutting, and thermal treatment operations. The application of the laser in production processes uses important advantages such as: flexibility applied to the processed material, geometrics and the processing operation.

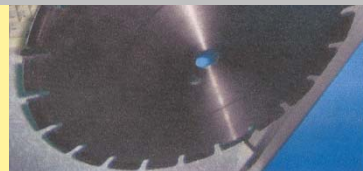
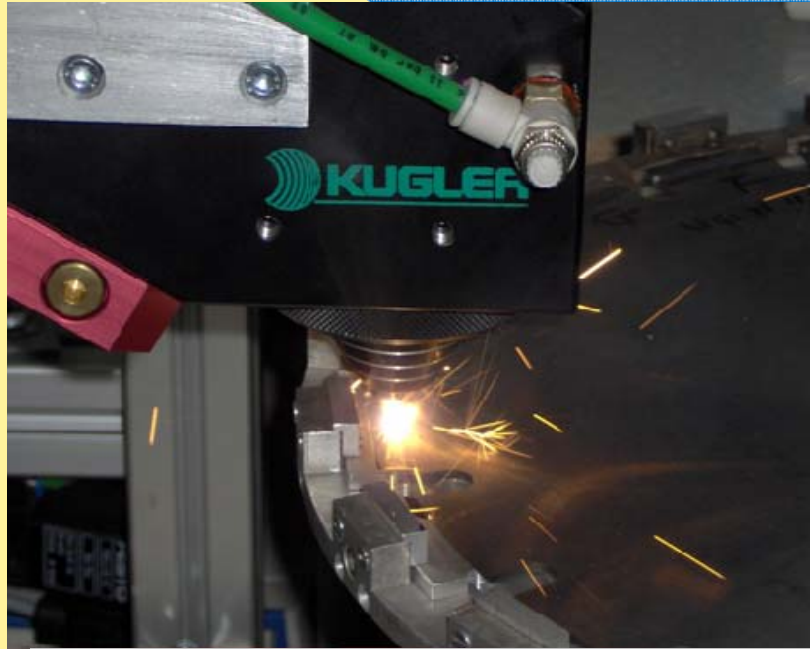
Technical and scientific description of the device:

1. The laser beam generation system:
Laser source (> 2000w; 10,6 μ m); cooling unit; command and control unit; process gas storing place;
2. The system for transporting the laser beam: components for laser beam deflection, transportation pipes, sustaining support.
3. Active processing system: beam focusing head, beam arranging module; protection gas module.
4. Positioning and fixing system:
Laser type..... RS 2000 SM
Wavelength..... 10,6 μ m
Take-up interval.... 200 -2200 W
Beam diameter.... cca 19 mm



RS 2000 SM

(2) Advanced micro-technology and equipment for high-power laser beam micro-welding



**Disc with diamond welded segments
(Products carried out by INCDMTM)**

Applications:

- laser welding of diamond-welded segments placed on the body of the discs used in processing industry and construction industry; thermal treatment for superficial durification, rough material settlement, etc.

- **High-tech micro-technologies for vibration testing**

(1) High-tech micro-technology for vibroacoustical diagnosis in-situ, in order to ensure predictive maintenance

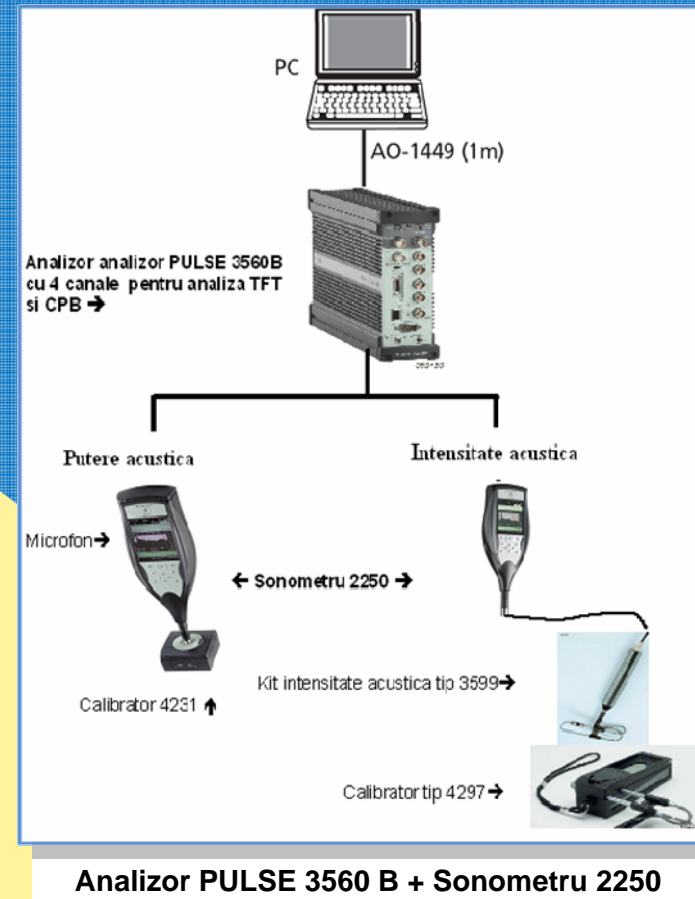
Overview

Vibro-acoustical in-situ diagnosis represents a modern micro-nano-technology, needed in the industrial environment given its predictive character that allows installations and devices to prologue their life and, consequently, to trigger an increase in the quality of the products.

Technical and scientific description of the device

➤ Analizor PULSE 3560 B

- Portable device;
- Alimentation: 2 batteries Nickel-Metal Hydride or a c.c. 10 - 32 V power source;
- Acquisition unit with 4 gateways;
- Frequency range: 0Hz÷25,6 kHz;
- Basic software: sound and vibration 7700 analyzer with FFT and CPB analysis; - Used power: max. : 26 W
- Output signals: (a) + 5V ± 0.5V; max. 0.4A ; (b) +12 V ± 1.0V; max. 0.4A



(1) High-tech micro-technology for vibroacoustical diagnosis in-situ, in order to ensure predictive maintenance

➤ 2250 Sonometer

- Monitoring and evaluation of the environmental sound
- Evaluation of the noise produced by autovehicels/machines
- Auditive protection setting; Noise reduction; Product quality control
- Class 1 sound measurements, according to the newest international standards
- Real time sound analysis in the 1/1 and 1/3 octave
- Data stocking on memory cards
- Linear frequency area: from 3 Hz ÷ 20 kHz
- Real-time analysis of sounds in 1/1 and 1/3 octave sorting
- Acquisition, measuring, processing and analysis programmes

Applications

- **in laboratory environments:** the measuring of acoustical pressure for domestic electric devices, fanners, measuring vibrations on the grip of the portable tools (boring, polishing, cutting tools);
- **in situ:** the measuring of the noise level in industry, of the acoustic pressure and of acoustic power emitted by adding-machines, dynamic balancing.

- **Intelligent control micro- and nano-technologies**

(1) Control micro- and nano-technologies of the topography of surfaces – rugosity and contour

Overview

In order to align to a high-tech measuring standard, micro- and nano-technologies are used; with that view, we use the rugosity and contour checking device: Form Talysurf 120 Taylor Hobson – Anglia. The Form Talysurf series represents the international standard for rugosity, linearity and shape measuring..

Key characteristics include a highly-precise linear reference bar, a high resolution inductive transducer with a 1 mm track and a market-leading software.

The product is used in workshops or laboratories, the user becoming easily acquainted with the device due to the instruction books and to some programming techniques that can be easily learnt.



Talysurf 120 Taylor Hobson

- **Intelligent control micro- and nano-technologies**

**(1) Control micro- and nano-technologies of the topography of surfaces –
rugosity and contour**

Technical and scientific description of the device

- transducer with a 1 mm track and 16 and a 16 nm resolution, with a cross bar unit of 120 mm.
- the Wide-Range option for contour measuring with a track up to 28 mm and an analysis software customized according to the contour: Ultra Contour.

The unique calibration Taylor Hobson ensures an ultra-precise linearity of the transducer, ensuring the precision of shape and surface, ensuring for the entire measuring gamma.

The Ultra Windows software can be programmed, and has included all international parameters.

Measuring area X, Z: 120/1 mm [rugosity]

Measuring area X, Z: 120 / 28 mm [contour]

Detector resolution: 8 nm / 0,5 mm

Z resolution: 17 nm

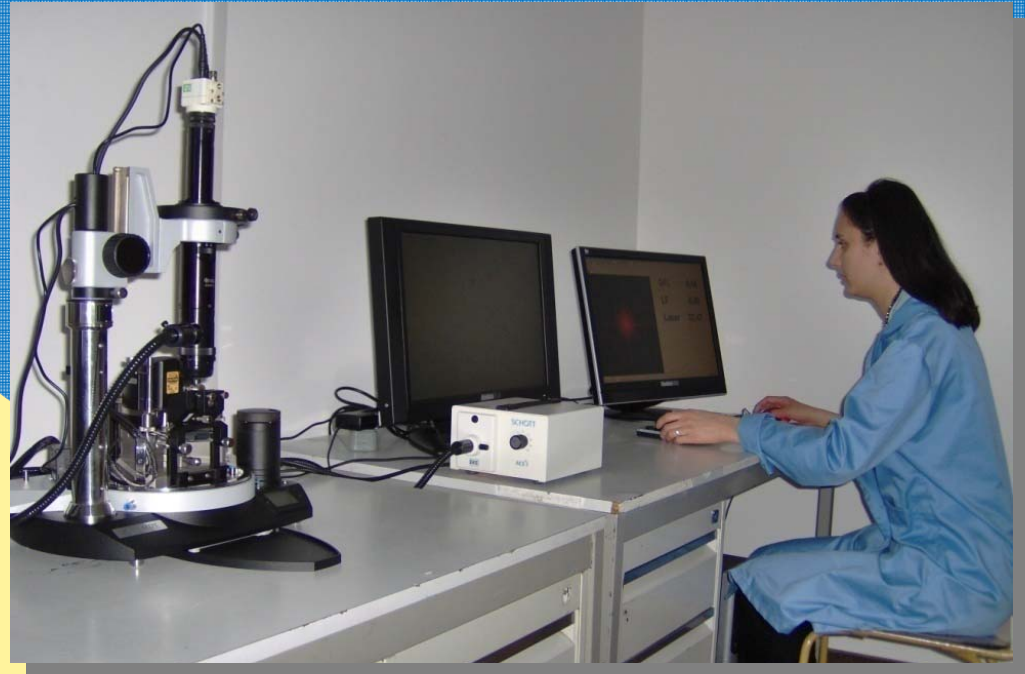
Applications:

- rugosity checking and contour for axes, guidances, bearing rings, cog wheels in the processing industry, the airspace and the automobile industry.

(2) Control micro- and nano-technologies of the topography of surfaces – 3D topography

Overview

Ultimate generation control micro-nano-technologies use the Atomic Force Microscope for a deep characterization of very thin film-like) surfaces or for the surfaces of existing devices, with the aid of a measuring tip attached to the cantilever.



Atomic Force Microscope

Technical and scientific description of the device

- Maximum scanning area X, Y: $50 \times 50 \mu\text{m}$
- Maximum scanning area on the Z axis: $12 \mu\text{m}$
- Resolution: $< 0,6 \text{ nm}$ (with a close loop), $< 0,01 \text{ nm}$ (without a close loop)
- Plane aberration: max. 2 nm over a horizontal interval of 50 microns , without software corrections

(2) Control micro- and nano-technologies of the topography of surfaces – 3D topography

Technical and scientific description of the device :

- AFM head with a super-luminescent diode (835 nm)
- Zoom: 780× (for a 19 inch monitor)
- Optical resolution: 1 μm
- Monitored focusing, software-controlled, for a 10 mm depth
- High precision digital zoom CCD camera
- Resolution 1032 \times 778 pixels
- Frame speed: 20Hz
- Controller processor speed: > 500 MHz

Applications:

3D topography, spectroscopic analysis, ropiness and elasticity determination for materials that form the surface, structural chemical analyses, microscope probes with magnetically modeling, nano-lithography, microscopic scanning, in the chemical industry, the processing industry, in the aerospace industry, etc.

(3) Control micro- and nano-technologies of the topography of surfaces – lengths



DMS 680

Overview

With the aid of micro-nano-techniques for measuring lengths that use the DMS 680 Joint Instruments device – Italy, the periodical checking of try gauge instruments and calibers is carried out.

(3) Control micro- and nano-technologies of the topography of surfaces – lengths

Technical and scientific description of the device

- Measuring uncertainty U_{95} : max 500 nm
- Measuring range: -absolute measuring: 100 mm
-differentiated measuring: 680 mm
- Resolution : 100 nm

Applications

- the determining of the dimensional aberrations for cylindrical neat calibers, filleted calibers, horseshoe calibers, leers parallel plan stalls, metrological calibers.

(4) Control micro- and nano-technologies of the topography of surfaces – profiles

Overview

Micro-technologies destined for checking micro- and nano-dimensional features of high precision marks uses high-tech equipments such as profile projectors. The PV-5100 (Mitutoyo) projector is a medium-sized device, with a 508 mm (diameter) display. The protection of the contour and the state of the surface of a work piece can be transmitted to a display with a 5x, 10x, 20x, 50x, 100x amplification factor and measuring and observation can also be performed.

Technical and scientific description of the device

- When 5x lenses are used, a field of de 100mm diameter can be projected;
- High performances protection lenses and the halogen-based of a telecentrical lighting system offers a real and high-accuracy description;
- The lighting inclined system of the surface ensures the obtaining of a clear protection image;
- A digital counter for angles is incorporated, thus, increasing the facility of use;
- Since its track is 200x100mm, it can also be used for measuring inspecting and observing large dimension pieces;
- The mechanism for rapid dissemination shortens as much as possible the measuring time for large pieces;
- Measuring area: 0÷200 mm [X axis]; 0÷100 mm [Y axis]
- Resolution: 1 μ m

Applications

- the determining of the dimensional and angular aberrations for gauges, calibers, plate caliber, dants, fillets, etc., in the industrial and the metrological field



PV-5100 (Mitutoyo)

(5) Control micro- and nano-technologies of the topography of surfaces – 3D

Overview

Checking micro-nanotechniques for the 3D coordinates measuring machine Leitz Reference 600 – Germany ensures a high precision adequate for the inspection of standard geometries (cylindrical blocks, gear boxes) as well as for the measurement of any type of geometries such as cam shafts, screw compressors and many others. It is used as well for the checking of cog wheels.

Technical and scientific description of the device

- High resolution Heidenhain glass rulers with automated temperature marks.
- Leitz measuring tips, adequate for extensions and palpators.
- The main structure is made up of granite and steel, avoiding aluminum
- Measuring uncertainty: $U=(0,9+L/350) \mu\text{m}$ with L in mm
- Measuring area: X x Y x Z: 1000 x 700 x 560 mm
- Resolution: 50 nm

Applications

- the determination of dimension aberrations for terminal measures, calibers, control devices, gauges.
- the determination of shape aberrations and of position aberrations for gauges and ultra-precise control devices in the processing industry, mechatronics, air-space industry, automobile industry and metrology, etc.



Leitz Reference 600

(6) Micro- and nano-technology for micro-nano-dimensional control of industrial benchmarks –interferometer

Overview

The micro-nano-technology of micro-nano-measuring and of micro-nano-calibration with the laser interferometer leads to an increase in the functional precision of the mechatronic installations and equipments.

Technical and scientific description of the device

The precision of the system is $\pm 0,5\text{ppm}$, for the entire operation gamma, in various temperature, pressure and humidity contexts. The intelligent sensors used are XC-80, that updates the information at every 7 seconds, by the means of a USB port that powers the XC-80 unit and its sensors. The important thing is that all measurements are based on a stabilized laser beam HeNe, reknown as an international length standard.

Measuring precision: $\pm 500 \text{ nm}$;

Frequency precision: $\pm 50 \text{ nm}$;

Resolution : 1nm

Aplication

- the calibration of measuring equipments: devices for coordinate measuring, devices for length measuring and
- direct measurements: stalls, calibers. Gauges, in the processing, airspace, mechatronic, automobile industry and metrology.



Laser
interferometer
XL - 80

(7) Control micro- and nano-technologies of industrial marks –heights

Overview:

Micro-Nanotechnology for checking which uses vertical micrometer MICRO-HITE 350 TESA – Switzerland is used to determine linear dimensional aberrations of height

Technical and scientific description of the device:

Measuring uncertainty:

$$U=(0,002+3L/1000) \text{ mm}$$

Measuring area: 350 mm

Resolution: $1\mu\text{m}$

Application

- checking of dimensional variation for final measures, gauges and calibres of height, length in Industrial and Metrology domain .



MICRO-HITE 350 TESA

(8) Control micro- and nano-technologies of industrial marks: liniar and angular inspection

Overview

Control micro- and nano-technologies of industrial marks uses the microscope with Vision Starrett Galileo System – USA which allows manual and automatic inspection of pieces, quickly, simple and precis. The system uses two monitors and a measuring software similar to Windows operating system.

Technical and scientific description of the device

Measuring uncertainty

X,Y: $U = \max.(1,9 + 5L/1000) \mu\text{m}$

Z: $U = \max.(2,5 + 5L/1000) \mu\text{m}$, cu L in mm

Measuring area: X 300 mm, Y 150 mm, Z 140 mm

Measuring system resolution: 100 nm

The software allows:

automatic recognition of characteristics;

a report generation;

capturing video image in “jpg” or “bmp” format with the ability of graphical reporting;

data import (“dxf” or “iges” files) for programming and exporting them

Aplications

- the determination of dimensional liniar and angular deviation for final measures, calibres and gauges and
- the determination of paralelism and perpendicularity abberations, in the processing, mechatronic, air-space, electronic and electrotechnical indusrty as wel as in metrology, etc.



Vision Sistem Starrett Galileo

- **Advanced Calibration micro- and nano-technologies**

(1) Advanced micro- and nano-technology for the calibration of intelligent instrumentation

Overview

OPTIMAR 100 Mahr is used for the calibration of compressors and inductive transducers. It is used within micro- and nano-calibration for beneficiaries in the high-tech industry.

Technical and scientific description of the device

Measuring uncertainty: $U_{95}=(0,2+L/100)$

μm , L in mm

Measuring area: 100 mm

Resolution: 20 nm



OPTIMAR 100 Mahr

Application

- digital and analogical comparators calibration and
- inductive, piezoelectrical, magnetical, etc. in the processing, aerospace, mechatronic and metrological industry.

- **Advanced micro- and nano-technologies for characterizing of surface micro-nano-structures**

- (1) Advanced micro-technology for evaluating superficial structures**

Overview

The 251 VRSA AFFRI – Italy durimeter is used as part of advanced microtechnology for evaluating superficial structures in the measuring of the toughness of the pieces with great endurance used within the industrial environment.

Technical and scientific description of the device

Resolution: 0,1 HV-HB-HR

Digital display

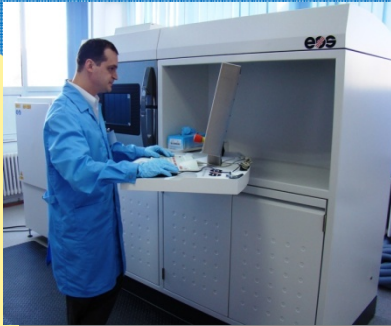
Authomatic conversion in other toughness measuring scales, including HRC

Aplication

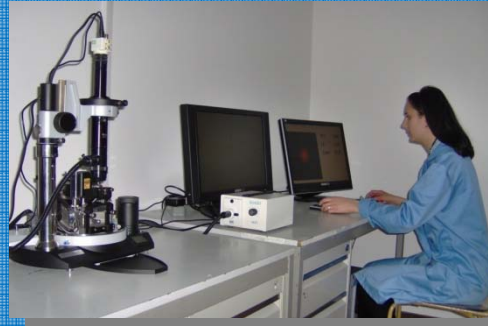
- density measuring within the Brinell, Vickers, Rockwell scales



251 VRSA AFFRI



EOSINT M 270 Titan Version



Atomic Force microscope



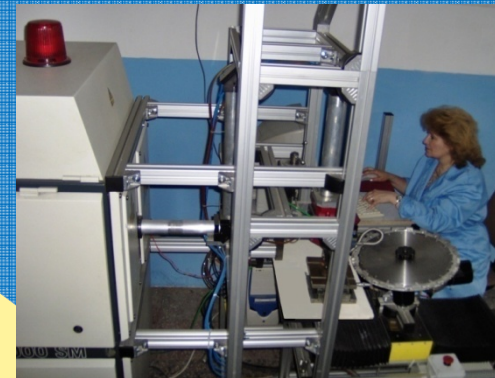
Leitz Reference 600



PV-5100 (Mitutoyo)



SISTEM VISION Starrett Galileo



RS 2000 SM



TALYSURF 120 Taylor Hobson



OPTIMAR 100 Mahr



MICRO-HITE 350 TESA



DMS 680



251 VRSA AFFRI

THANK YOU FOR YOUR ATTENTION!



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