



WELCOME TO PRO ENGINEERS

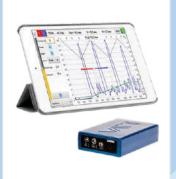
Pro Engineers is a young organisation and the front runner in introduction of advanced technological products and new innovations in its category and expanding enormously by collaborating with various business establishments across the world who are developing and manufacturing innovative products. We are constantly searching for new ideas and creative innovations for making a positive impact in shaping the future of Indian Industries. At RiM LaS we aim at providing our customers with superior quality products that completely satisfies their need. RiM LaS, offers an array of value added products & solutions, aiming at simplifying customer needs, improving efficiency & optimizing the value proposition offered. Exclusive representation of world-wide established manufacturers gives us the opportunity to find an integral solution .That is what distinguishes us from others.

Our strength lies in consolidation. Our broad product line and wide networks enable us to meet customer requirements in totality. **Pro Engineers** offer a wide range of products and solutions in the field of Quality Testing and Field Inspection. We offer a range of high quality innovative brands that represent the best in each of our product categories. These brands have a strong legacy of innovation; these brands are leaders in their respective product category and help our customers tirelessly get the job done.

PRODUCTS

We are committed to be the leading solution provider in the Indian region to provide the most reliable yet cost effective NDT inspection, quality assurance and control related equipments and solutions to our highly value customers.









PRINCIPAL PARTNERS

Pro Engineers has been chosen as exclusive National Sales Partner for India from the world's best global technology leaders, to compliment their offerings, to the Customers. We are partnering with technology innovators for Indian Territory who repose their confidence in **Pro Engineers** by working solely through us.











PORTABLE HARDNESS TESTER

Hardness is the mechanical resistance offered by a material. The definition of hardness differs from that of strength, which is the resistance of a material to deformation and separation.

Which method of material hardness testing is most appropriate for your application depends on the material you want to measure. We have Leeb and UCI both portable hardness testers.

DYNAMIC/LEEB HARDNESS TESTER TKM359 CE

High precision hardness tester **TKM-359CE** intended for quick measuring of metal items in laboratorial, manufacturing and field conditions. It is designed to measure metal hardness, including thermo treatment quality check, HFC (high-frequency current) tempering, and mechanical strength estimation.

MEASUREMENT:

- > Measurements on steel, cast iron, tool steel, stainless steel, gray and ductile iron, brass, bronze, aluminum and wrought copper alloys
- > Measurements on large and small molds, bearings heavy work pieces, and permanently assembled parts Failure analysis of pressure vessels, steam generators, etc.
- > Material identification

- > Wide range of controlled metals and alloys
- > Low sensitivity to the curvative and roughness of surface
- > Monitoring of hardness change along the surface
- $\verb|>Stable| measurements| independent| from force| and time| of pressing the probe to the surface|$
- > Possibility of material identification in blank production
- > Signalization of exceeding of prescribed readings threshold
- > Highly interactive colour display with Max, Min, Avg, and standard deviation
- > User Programmable additional scales
- > Manufactured according to DIN Standard.
- > High accuracy: $\pm 0.5\%$ (based on L = 800 ± 4 HL)
- > Measurements in any direction, no need to select angle
- > Special & Unique probe design Enables fast and accurate measurements in small spaces
- > Shockproof, dustproof and waterproof case allows to operate the device in the most demanding conditions
- > Bright color graphic OLED display ensures operation at low temperatures under field conditions and poor visibility
- > Unique test indenter increases resource sensor operation to minimum 250,000 measurements
- > Supports probe type "D", type "G", type "E" and special head "Z-359"
- > The memory storage capacity of 12400 in measurement results
- > USB interface and PC Software for Data transfer and analysis





TECHNICAL SPECIFICATION:

| Characteristic | Values |
|--|--------------------|
| Accuracy | 3% |
| Calibration error with the first rate test blocks: | |
| Rockwell | 1.5 HRC |
| Brinell | 10 HB |
| Vickers | 12 HV |
| Spot diameter on the item surface for probe positioning | From 7 mm |
| Quantity of possible additional calibrations of scales | 5 for every scale |
| Quantity of additional scales | 3 |
| Duration of one measurement | 2 seconds |
| Quantity of measurements for average reading calculation | 10 1-99 |
| Memory capacity, readings | 12 400 HB |
| Maximum quantity of name units of readings generated in memory | 100 |
| Quantity of algorithms for known to be false readings during average value calculation | 3 |
| PC Connection | USB |
| Power Supply | Ll-ion accumulator |
| Dimensions of hardness tester electronic unit | 121x69x41 mm |
| Weight of electronic unit | 0.3 kg |
| Weight of D-probe | 0.15 kg |
| Operating temperature range | -15+50 0C |





UCI HARDNESS TESTER TKM459 CE

High precision hardness tester TKM-459CE intended for quick measuring of metal items hardness in laboratorial, manufacturing and field conditions.

The TKM-459CE works on the principle of "Ultrasonic Contact Impedance": The piezoelectric crystal causes the rod in the probe to vibrate longitudinally. The Vickers diamond at the lower end of the rod is pressed by a spring into the work piece surface. Depending on probe choice, this is done with the thrust of 10, 50 or 100 Newton





MEASUREMENT:

- > Hardness testing on fine-grained, weld joints thin-walled materials and alloys, carbonaceous and structural steels
- > Items with surface-hardened layers such as cementation, nitride hardening, high frequency current hardening
- > Heat-proof, corrosion-proof, non-corrosive steels, Plated coating (chrome), overlaying,
- > Items of complicated configuration.
- > Device is intended for non-destructive testing of production quality in metallurgy, Automotive, Tubes & Pipes, Gear, Bearing, mechanical engineering, aircraft, shipbuilding, atomic industry, oil and gas industry

- > Stable readings independent from force and time of pressing the probe to the surface
- > Hardness measurement in hard-to reach areas (position of probe does not influence the result of measurement).
- > Ultra-small control area (from 1 mm).
- > Control in slots and blind holes from 5 mm (not provided by rival devices).
- > Invisible print (Spot/Dent) on mirror-surface.
- > Low sensitivity to the curvative of surface, thickness and weight of product.
- > Manufactured according to DIN
- > Shockproof, dustproof and waterproof case allows to operate the device in the most demanding conditions
- > Bright color graphic OLED display ensures operation at low temperatures under field conditions and poor visibility
- > Signalization of exceeding of prescribed readings threshold.
- > Highly interactive colour display with Max, Min, Avg, and standard deviation
- > User Programmable additional scales
- > Supports probe type 10N, 50N and 100N. Unique probes for special application
- > Automatic test sequence Measurements of the hardness of layers starting at 30 microns!
- > Suitable for mass testing of work pieces
- > Low requirements for the mass and thickness of the work piece; for example, with thin-walled tubes starting at 2 mm wall thickness (1mm also possible by help of coupling paste)
- > The memory storage capacity of 12400 in measurement results.
- > Data transfer to PC with USB cable and software



TECHNICAL SPECIFICATION:

| Characteristic | Values |
|--|---|
| Relative average error at regular calibration test with second rate test blocks | 3% |
| Calibration error with the first rate test blocks: | |
| Rockwell | 1.5 HRC |
| Brinell | 10 HB |
| Vickers | 12 HV |
| Spot diameter on the item surface for probe positioning | From 1 mm on fl at surface From 5 mm in a slot |
| Quantity of possible additional calibrations of scales | 50 |
| Quantity of additional scales | 3 |
| Duration of one measurement | 2 seconds |
| Quantity of measurements for average reading calculation | 1-99 |
| Memory capacity, readings | 12 400 HB |
| Maximum quantity of name units of readings generated in memory | 100 |
| Quantity of algorithms for known to be false readings during average value calculation | 3 |
| Signalization about threshold exceeding | Provided |
| PC Connection | USB |
| Power Supply | Ll-ion accumulator |
| Dimensions of hardness tester electronic unit | 121x69x41 mm |
| Weight of electronic unit | 0.3 kg |
| Weight of D-probe | 0.3 kg |
| Operating temperature range | -15+50 0C |





HARDNESS CASE DEPTH TESTER P3123

In cooperation with the Fraunhofer Institute for Non-Destructive Testing (IZFP), Q NET Engineering GmbH has developed an ultrasonic test instrument for fast and easy SHD control.

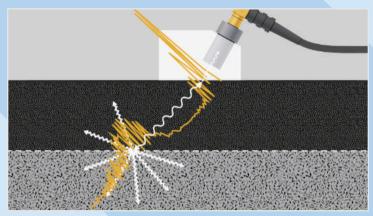
Reduced efforts and costs for testing facilitate rapid production control for a consistently high level of quality. The test instrument is used to optimize manufacturing parameters, reduce downtimes after inductor changes, for production monitoring and quality control.



METHOD

The test method is based on the effect that the hardened layer is almost transparent to ultrasonic waves while the non-hardened material scatters them back. The backscattered signal received by a probe, is processed by the UT hardware and automatically evaluated by the software. The Surface Hardening Depth (SHD) is calculated and displayed by the software.

In most cases the results comply with the results of destructive methods. SHD values > 1.2 mm are determined using standard equipment. Lower SHDs can be tested with special probe systems.



(Figure: Ultrasonic Backscatter Technique)

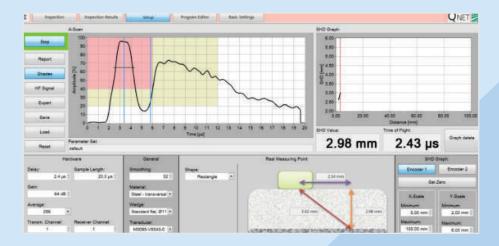
TECHNICAL DETAIL:

Instrument

- > 4 ultrasonic channels
- > Built for industrial use (IP65)
- > Portable for mobile use
- > inspection frequencies: 5 25 MHz
- > Measurement repeatability: ± 0.2 mm
- > Testing Software "SHD-Studio"
- > setup mode
- > Custom test programs
- > Import / export of test programs
- > Tools for visualization and analysis of test results
- > Individual test reports

Software

- > Setup mode
- > Custom test programs
- > Import / export of test programs
- > Tools for visualization and analysis of test results
- > Individual test reports



Features & Benefits:

- > Short setup times
- > Simple, uncomplicated calibration
- > Fast and easy scanning
- > High test sensitivity
- > Comfortable sensor handling
- > Sensor adaptable to complex geometries
- > Visualization of the current test point

- > Testing at small radii and undercuts possible
- > Individual report templates
- > Storage of results in data base
- > Analysis and revaluation of test results
- > line scans and circumferential scans
- > Automation possible

Application Examples

Our probe systems are individually designed and manufactured for the component to be tested. The contact surface of the coupling wedge is shaped in such a way that it adapts exactly to the part.



















CRACK DEPTH METER 281M

This is a High-precision instrument for measuring the depth of cracks exposed on various metals and alloys (incl. stainless steel, aluminum), previously detected by other methods.

The device is the most efficient in combination with other crack-revealing methods: magnetic particle, capillary or eddy-current.

TYPICAL CONTROL OBJECTS:

- > Shafts, rolls, rolling mills, details of constructions, machines and mechanisms;
- > Pipes, tubes, oil-and-gas pipelines;
- > Pressure vessels;
- > Energy industry devices.

OPERATION ADVANTAGES:

- > Control of ferromagnetic and non-ferromagnetic materials (stainless steel, aluminum alloys, etc.)
- > Wide measuring range from 0 to 100.0 mm.
- > Low impact of the material electromagnetic properties on the measurement result.
- > The device is equipped with various design sensors to control products of irregular shape.
- > Mobile spring-loaded contact electrodes of the sensor enable the user to perform measurements on curved surfaces.
- > Crack Depth Meter works successfully in field, workshop and laboratory conditions.

| Measuring range (crack depth) | 0 - 100 mm |
|--|-----------------------------------|
| Measuring accuracy | 10% ± 0.2 mm |
| Maximum crack width (depending on the sensor design) | up to 3,5 mm |
| Minimum crack length | 5 crack depths, no less than 3 mm |
| Power supply | accumulator |
| Display lighting | provided |
| Automatic switch off | provided |
| Electronic unit dimensions | 160x85x30 mm |
| Weight | 400 g |
| Operating temperature range | -5 +50 °C |
| Warranty | 1 year from the day of delivery |





ULTRASONIC FLAW DETECTOR

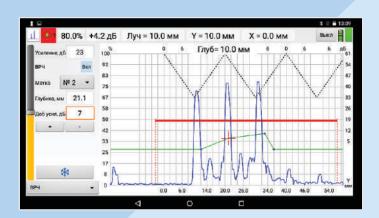
Velograph II

Always free hands - nothing extra!

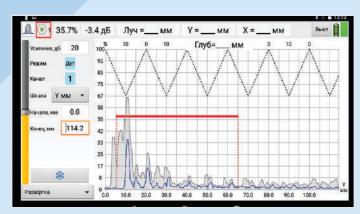
Velograph II is an ultrasonic flaw detector with a tablet or a smartphone used as a screen. Main workflows for testing and thickness measurement: metal and polyethylene pipelines, metal and polyethylene welded joints. A serious device that is as easy to use as a smartphone!

All settings with one hand - quickly and intuitively. There are no cables between you and the screen. Nothing prevents you from comfortably doing work, no matter where you are. At altitude, under difficult weather conditions, at low temperatures. It charges fast and holds charge twice as long. Think about your job, not your tools!

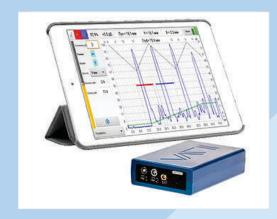
- > Easy to use as Smartphone
- > Screen Size user selectable, from Smartphone to Tablet
- > Most compact (100mm X 68mm X 26mm) and Light weight (165 gm) in Industry
- > Wireless connectivity between display and device.
- > Brightness adjustment depending on the lightning
- > Automatic report generation.
- > Unlimited DATA Storage.
- > Presence of envelop function, DVG, DAC, AWS D1.1 makes it powerful device.
- > Immediate software update by Google Play, No need to wait to developer for weeks.
- ${\color{blue} > } \ Supported by GPS \ and \ digital \ signature \ to \ increase \ efficiency \ and \ productivity.$



Dynamic DVG and DAC (ARC) curves, AWS D1.1



Envelope function for accurate maximum signal determination



TECHNICAL PARAMETERS:

| Parametr | Value |
|--|--|
| Channels | 2 |
| Operating frequency, MHZ | 1,5 15 МГц |
| Global gain adjustment range, dB | 0 84 dB |
| TVG dynamic range | 84 dB |
| Ultrasound velocity settings range | 1 11000 with step divisible by 1 |
| The measurement range of defect coordinates (the depth of the defect on steel) with an inclined transducer 5 MHZ | 3 240 mm |
| Depth range of defects (for steel) with a direct transducer | 3 180 mm |
| Maximum permissible basic error of measuring the depth of defects and thickness (for steel) with a direct transducer | ±(0,01t+0.2), where t - measured time interval value |
| Maximum permissible absolute error of measuring the coordinates of defects for steel with an inclined transducer | ±(0,03H+1), (range L and depth H) |
| Operating temperature range | -20° +45°C |
| Built-in rechargeable battery life | not less than 6 h |
| Mean time to failure, not less than | 18000 h |
| Dimensions | 100 mm x 68 mm x 26 mm |
| Weight | 165 g |
| Connectivity | Wi-fi, Bluetooth, USB |
| Functions | ACG, ARC, envelope |
| Automatic, semi-automatic calibration | Speed of sound, delay in prism, angle of entry |

APPLICATION AREA



Boiler Inspection Facilities, Heating Networks



Gas Supply And Distribution Systems



Lifting Equipment



Oil And Gas Industry Equipment



Building Metal Structures



Petrochemical Industry Equipment



Defense Enterprises Equipment



Space And Aviation Industry Equipment

COATING THICKNESS GAUGE

Coating thickness measurement is an irreplaceable assistant for quality assurance. NDT1 KRAFT LTD is specialist for coating thickness gauge manufacturing. Gauges are most accurate and cover all kind of coating application on Ferrous and Non Ferrous metals.

AREA OF APPLICATION:

- > Quality assurance
- > Research and Development
- > Good receipt inspection
- > Laboratory
- > Production

INDUSTRIES:

- > Tubes and Pipe, Screw Industries, Automotive, railway and steel industry, shipbuilding, aircraft construction and mechanical engineering
- > Tire manufacturers, vulcanization companies and many more
- > Anodizing, chromium plating, galvanizing
- > Maintenance and service companies, appraisers, technical testing organizations
- > Laboratories and research facilities

K6-C AND K5-C: Multifunction coating thickness gauge for all kind of coatings

PURPOSE:

Thickness measurement:

- > All kind of insulation, dielectric & Galvanic (zinc, chromium, nickel, cadmium, silver, tin and other) coatings on ferrous and Non Ferrous Metals.
- > Special dielectric & metallic thick coatings and plated coatings.
- > Coatings on the internal surfaces of Pipes and Cylindrical products.
- > Copper Foils n Printed Circuit Board.
- > Two Layer Coating.
- > Galvanic Coating on Screws and Threads.
- > Protective layer of concrete and determination of steel reinforcement position in concrete.
 Wall thickness of large products from fibreglass and carbon fibre reinforced plastics during manufacture and delivery with one side and two side's access.
- > Measurement of groove depth and evaluation of surface roughness after sand blasting or grit blasting.
- > Measurement of Air Temperature, Humidity, Metallic Temperature and Dew Point

- > TFT colour display with 2.4" diagonal and a built-in Li-lon battery
- > Shockproof ergonomic body with rubberized corners
- > Keyboard with functional keys that change their purpose depending on the mode of operation of the device and user-friendly and intuitive interface.
- > Additional modes and device settings, Scan Mode for fast measurement
- > Wide range of functions for work with statistics
- > Large number of new generation wear resistant transducers of wide purpose of application with algorithms that avoid influence of wear on measurement accuracy
- > Support for transducers with several calibration characteristics (up to 6 for PH3 series probes, up to 4 for NF-G probes, up to 2 F-G probes)
- > Large Memory
- > Absence of temperature and time drift of measurement results;



BASIC TECHNICAL SPECIFICATION (K6-C AND K5-C)

| Parameter | Model: K6-C | Model: K5-C |
|--|-----------------|-----------------|
| Measurement Range | 0.5 μ - 120 mm | 0.5 μ - 120 mm |
| Resolution | 0.1 μ | 1 μ |
| Removable Probe | YES | YES |
| Memory | 10000 | 10000 |
| Software for Report Generation | YES | YES |
| Probe Calibration (One Point and Two Point) | YES | YES |
| Possibility to save calibration parameters (3-9, depends on probe) | YES | YES |
| Measurement with Averaging | YES | YES |
| Measurement with Upper/Lower Limit | YES | YES |
| Display | Colour TFT 2.4" | Colour TFT 2.4" |

DIFFERENCE BETWEEN K6-C AND K5-C

| Parameter | Model: K6-C | Model: K5-C |
|---|----------------|-------------|
| Resolution | 0.1 μ | 1 μ |
| Probe calibration lock (blocking) | YES | NO |
| Data Statistics | Advanced | Simple |
| Scanning measurement mode | YES | NO |
| Audio Signal, Brightness and Shutdown time settings | YES | NO |
| Colour scheme | Light/Contrast | Contrast |

MK4-C COATING THICKNESS GAUGE

PURPOSE:

Small-sized device for operative coating thickness measurements of paint, lacquer, galvanic, powder, bitumen and other coatings on substrates from ferrous and non-ferrous materials with increased temperature range.

- > Colour OLED display with 1.7" diagonal, large digits on display;
- > Device can be delivered with integrated combined small-sized probe for measuring coating thickness on substrates from ferrous and non-ferrous materials;
- > Increased temperature range up to -30 °C;
- > Possibility of tolerance mode measurement, measuring with averaging;
- > Device can be delivered with integrated probe or with built-in probe on cable



| Parameter | Model: MK4-C |
|------------|--|
| Range | 0 μ - 30mm |
| Resolution | 1 μ |
| Accuracy | 0 to 500μ ± (2% + 1μ) 500μ to Tmax ± 2% |
| Memory | NO |





MAGNETIC-EDDY-CURRENT FLAW DETECTOR VID-345

The Device is intended for detecting cracks and measuring their depth, detecting stress- corrosive cracks in metal ferromagnetic constructions, even under layer of corrosion and/or protective coating.

Flaw detector enables to measure depth of corrosive damage as well as thickness of protective coating.

The device combines magnetic and eddy-current methods for flaws detection, which enables the user to control products with rough corroded surface and to measure through the layer of insulating coating of variable thickness without any additional readjustment.







OBJECTS OF CONTROL:

- pipes, pipelines, - oil and gas pipelines, vessels, pressure vessels, objects of energy production, details of structures, machines and mechanisms.

OPERATION ADVANTAGES:

- > Simultaneous identification and depth measurement of stress corrosion cracks, thickness of the insulating coating and/or corrosion.
- > Continuous monitoring of the thickness of insulating coating enables user to detect corrosion fissures.
- > Real-time adjustment of readings.
- > Adjustable threshold units for minimally detectable fracture depth and thickness of the insulating coating.
- > Intuitive interface.

CONSTRUCTION ADVANTAGES:

- > Capability to use additional changeable sensors.
- > Metallic housing of electronic unit for use in severe field conditions.
- > The contact surface of the sensors is made of abrasion resistant zirconium ceramics.
- > Signalization of the defect detection: lighting, audio signaling through loudspeakers or headphones.

| Minimal fracture opening | 0.05 mm |
|--|------------------|
| Minimum detectable fracture length | 5 mm |
| Detectable fracture depth range | 0.3 - 5 mm |
| Fracture depth measurement inaccuracy | 10% ±0.2mm |
| Insulating coating thickness measurement range | 0 – 10 mm |
| Maximum insulating coating thickness allowing fracture detection | up to 10 mm |
| LBH of electronic module is | 150 x 80 x 35 mm |
| LBH of sensor is | 25 x 25 x 60 mm |
| Weight of electronic module and sensor | 0.5 kg |

Universal Portable Indention System (UPIS)

MUBATEC - HU-1





MUBATEC HU-1 + labor frame

With labor frame allows to make tests of samples and small-sized details and calibrate Portable Instrument Indentation HU-1.



MUBATEC HU-1 + magnetic frame

With magnetic shoes allows to control vessels and pipelines almost all sizes made from magnetic materials.



MUBATEC HU-1 + straps (chain) frame

With straps frame allows to control small and middle-sized vessels and pipelines from non-magnetic materials.



MUBATEC HU-1m + robotized frame

With robotized frame with automatic polishing of controlled place allows to make control in adverse environment including vessels of nuclear reactors.

Universal Portable Indention System (UPIS)

MUBATEC - HU-1





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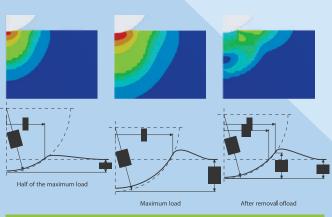


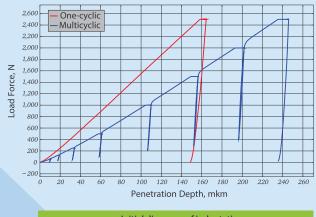
MUBATEC HU-1m + robotized frame

With robotized frame with automatic polishing of controlled place allows to make control in adverse environment including vessels of nuclear reactors.

PHENOMENOLOGICALMETHODOFCALCULATIONOFMECHANICALPROPERTIES

CALCULATION PROCEDURE MUBATEC



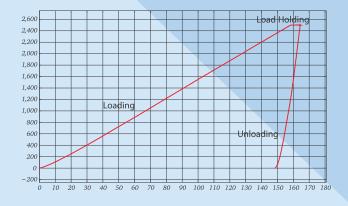


Calculation and experimental characteristics of indentation of ball indenter

Initial diagrams of indentation

Calculation of tensile and fracture toughness properties of metal are made according to Russian standard GOST R 56232-2014 Determination of stress-strain diagram in the course of ball instrumental indentation. General requirements. Calculation consists of several steps.

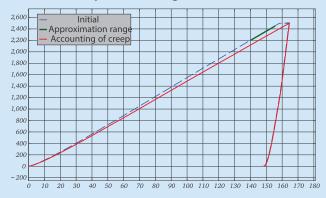
STEP 1. Selection diagrams for calculation



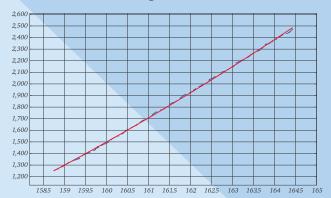
STEP 2. Determining of initial penetration depth



STEP 3. Grip determining

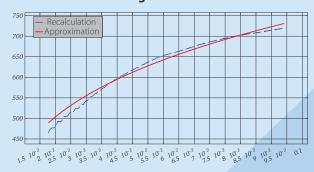


STEP 4. Determining of elastic modulus

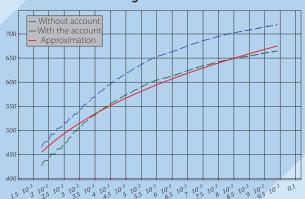


CALCULATION PROCEDURE MUBATEC

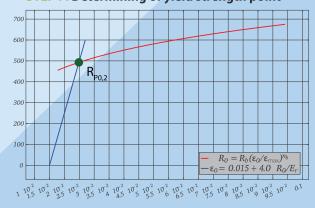
STEP 5. Determining of true stress-strain curve



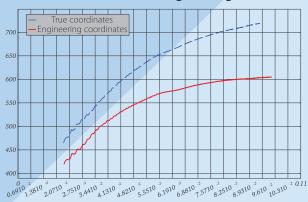
STEP 6. Determining of inflow



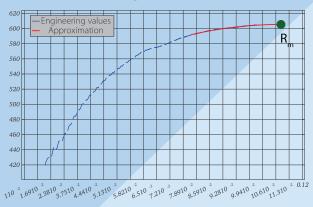
STEP 7. Determining of yield strength point



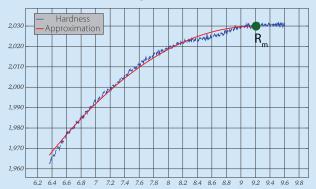
STEP 8. Recalculation of engineering curves



STEP 9. Determining of ultimate tensile stress (APPROACH 1)



STEP 10. Determining of ultimate tensile stress (APPROACH 2)

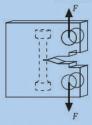


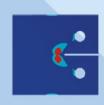
DETERMINATION OF FRACTURE TOUGHNESS BY INSTRUMENTAL INDENTATION METHOD

Prerequisites for Development of Methodology

Calculation algorithm for determining the fracture toughness by the ball indentation method is based on the energy approach to the assessment of the material condition under the indenter and near the crack top with respect of committed elastic-plastic works.

Tests for the static fracture toughness

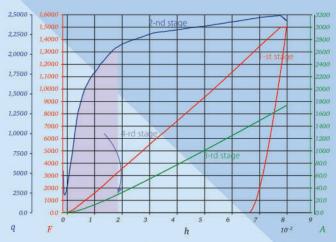




During static toughness tests the work of elastic-plastic deformations appears which can be expressed through unit fracture energy G_c .

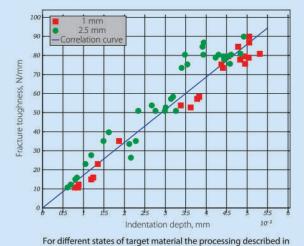
$$G_C = \frac{(1 - v^2)K_C^2}{E}$$

STEP 1. Indentation diagram processing



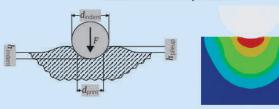
Critical depth of indentation at which unit work of indentation and unit fracture energy become equal can be found as follows. 1st stage. Obtaining of indentation diagram. 2nd stage. Calculation of dependency of contact pressure q and depth h. 3rd stage. Calculation of unit work of indentation as integral of contact pressure. 4th stage. Estimation of critical depth based on equality of value of unit fracture energy and value of unit work of indentation.

STEP 3. Correlation curve finding



For different states of target material the processing described in step 1 for indentation diagrams is performed. For every material state the pair of points h_c^i and G_c is evaluated, which are later used to produce a correlation curve.

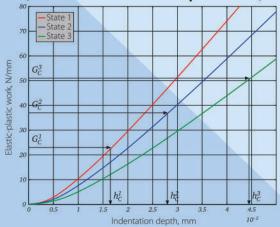
Tests for ball indentor penetration



During kinematic indentation tests the work of elastic-plastic deformations appears which can be expressed through unit work of indentation A:

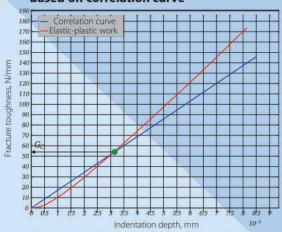
$$A = \int_0^h \frac{4F}{\pi d^2} dx$$

STEP 2. Processing of indentation diagram for different material states (consider function of elastic-plastic work)



For different states of target material the processing described in step 1 for indentation diagrams is performed. For every material state the pair of points h_c and G_c is evaluated, which are later used to produce a correlation curve.

STEP 4. Fracture toughness determination based on correlation curve



After indentation the diagram of elastic-plastic work is obtained. The crossing of this function and correlation line is evaluated. The value of ordinate of crossing point is the target value of fracture toughness $G_{\mathbb{C}}$.





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