LABORATORY EQUIPMENT CATALOGUE

CUT biotech
CENTRE FOR HIGH - THROUGHPUT TECHNOLOGIES

CENTRE FOR ADVANCED COMPUTING AND MODELLING

CENTRE FOR MICRO - AND NANOSCIENCES AND TECHNOLOGIES

GF
FACULTY OF CIVIL ENGINEERING
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FACULTY OF CIVIL ENGINEERING
EDITORIAL

Within the framework of the Project entitled “Research Infrastructure for Campus-based Laboratories at the University of Rijeka”, whose realisation was funded through non-refundable grants of the European Regional Development Fund, the University of Rijeka has, since 2014, ensured the essential infrastructure necessary for improvement of scientific-research work and for the achievement of significant results through several new research centres. In particular, the Centre for Micro and Nano Technologies, the Centre for High-Throughput Technologies, the Centre for Advanced Computing and Modelling, as well as the Faculty of Civil Engineering laboratories.

By ensuring new, top-notch equipment, these centres have obtained a strong incentive to start with their research work and develop new ideas.

This capital research infrastructure currently acts as the sine qua non within the scope of momentous and globally competitive work in the field of science development. For the University of Rijeka, even the fact that this advanced equipment is certainly set to facilitate scientific productivity, significant effects are likewise expected on the commercial level, which is a key point.

A case in point is the recently realised collaboration between the University of Rijeka and the Company Rimac Automobili (Rimac Automobiles) that will be utilizing the UNIRI Bura SuperComputer in its future technological solutions and innovations.

This brochure succinctly presents the basic characteristics - “an Identification Card” - of the scientific equipment that the University of Rijeka has procured for its newly founded research centres through non-refundable grants of the EU Funding Programmes.

Our desire is to emphasise the different dimensions of these scientific resources, to further encourage their optimal utilization within the Campus, as well as the local and even national community, in order for this infrastructure equipment to actualise existing and future projects on the international scientific scene to boot.

Rijeka, February 2018

University of Rijeka Rector
Prof. Snježana Prijić-Samaržija, Ph.D.
HIGH-THROUGHPUT ANALYTICS
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Mass Spectrometer MALDI-TOF/RTOF MS (BrukerUltrafleXtreme)</th>
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</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for High-Throughput Analyses O-275</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring Machine</td>
</tr>
</tbody>
</table>

**Short description**
A high resolution machine that allows a fast and highly accurate analysis of the molecular mass, records the molecular mass spectra with the support of the chemical fingerprint method, and allows a precise structural characterisation of the molecule.

**Main purpose**
- MALDI MS and/or MS/MS scanning of pure analyte, tryptic protein digestion, glycan spectra.
- MALDI TOF MS fingerprint scanning (fingerprinting) of the complex composite-analyte (without prior separation)
- Definition of the molecular mass of pure analyte, post-translational protein modifications, precise structural analysis of the intact molecules and protein identification.
- Sample purity analysis – detection/confirmation of impurities in the sample

**Technical specifications**
- 2 kHz speed in TOF mode and 1 kHz in TOF/TOF mode
- Smartbeam-II™ laser of the newest generation
- Reflectron and linear mode measurement
- PAN™ technology which allows a resolving power up to 40000
- FlashDetector™ combined with 4 GHz digitizer
- Newest TOF/TOF technology based on the LID-LIFT process

**Source of founding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Mass Spectrometer UPLC-QQQ (Waters Xevo TQD)</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for High-Throughput Analyses, O-275</td>
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<td>Equipment category</td>
<td>Measuring Machine</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Image of Mass Spectrometer UPLC-QQQ" /></td>
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</tbody>
</table>

**Short description**
A high resolution machine that allows a fast and highly accurate analysis and quantification of small molecules.

**Main purpose**
- MS and/or MS/MS spectra screening
- Definition of analyte molecular mass
- Analysis of serum metabolites
- Analysis of serum drugs
- Neonatal screening

**Technical specifications**
- LC ionisation interface
- Analyzers: two quadrupoles mass analyzers, a collision cell
- Mass range: 2 to 2048 m/z
- Detector: photomultiplier
- MRM sensitivity ESI+: 1 pg reserpine injected on column, on a throughput of 0.8 mL/min, must provide a signal-to-noise ratio (S/N) bigger than 10000:1 for the transition from m/z 609 to 195
- MRM sensitivity ESI-: 5 pg chloramphenicol injected on column, on a throughput of 0.8 mL/min, must provide a signal-to-noise ratio (S/N) bigger than 200:1 for the transition from m/z 321 to 152
- A software specifically intended for neonatal screening, in accordance with the ISO 13485 and compatible with the machine.

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
**Instrument**
Mass Spectrometer UPLC-Q TOF with ion mobility option (Waters Synapt G2-Si)

**Laboratory affiliation**
Laboratory for High-Throughput Analyses, O-275

**Equipment category**
Measuring Machine

**Photograph**
![Image of Mass Spectrometer UPLC-Q TOF with ion mobility option (Waters Synapt G2-Si)](image)

**Short description**
A high resolution machine that allows an automated, highly accurate analysis of the molecular mass and a precise structural characterisation of a wide range of molecules, based on the ratio between mass and charge, as well as on the collision cross-section, (CCS).

**Main purpose**
- Dependent Analysis (DDA) and Independent Analysis, (DIA), MS and/or MS/MS screening of tryptic protein digestion spectra
- Qualitative and/or quantitative analysis of a wide dynamic range of proteomes
- Post-translational protein modification analysis

**Technical specifications**
- Analytes separation by nano-liquid chromatography, single-pump trap option, on throughputs of 0.3 µl/min
- Nano LC-ESI (electro-sprey) ionic source Z-spray Waters with additional ion throughput by StepWave module
- CID (Collision Induced Dissociation) and ETD (Electron Transfer Dissociation) fragmentation
- Possibility to separate ions based on their mobility during the gas phase
- Quadrupole analyzer with mass range up to 8.000 m/z
- TOF analyzer with mass range up to 32000 m/z
- Maximum mass measurement resolution in ESI positive and negative ionization method amounts to 50000
- Proteomic data analysis: PLGS, Mascot, PROGENESIS Qp, DriftScope

**Source of founding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contact**
cvt@uniri.hr
**Instrument**  Mass Spectrometer UPLC-QTOF

**Laboratory affiliation**  Laboratory for High-Throughput Analyses, O-275

**Equipment category**  Measuring Machine

**Short description** A high resolution machine that allows a fast and highly accurate analysis of the molecular mass of small molecules and a precise structural characterisation of molecules.

**Main purpose**  MS and/or MS/MS spectra sample screening, definition of the bond's molecular mass and sample purity analysis – detection/ confirmation of impurities in the sample.

**Technical specifications**
- Sensitivity at a femtogram level thanks to the iFunnel technology
- Screening resolution from 45k
- Uses the MassHunter program for sample quantification and identification
- Enables selective and non-selective sample analysis

**Source of funding**  The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**  cvt@uniri.hr
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<thead>
<tr>
<th>Instrument</th>
<th>Mass Spectrometer UPLC-QQQ</th>
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<td>Laboratory for High-Throughput Analyses, O-275</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring Machine</td>
</tr>
</tbody>
</table>

**Short description**
A high resolution machine that allows a fast analysis and quantification of small molecules.

**Main purpose**
MS and/or MS/MS spectra sample screening, confirmation and quantification of small molecules in a sample.

**Technical specifications**
- LC/MS Spectrometer - quadrupole mass filter, collision cell and high resolution and high accuracy analyzer
- Polarity switching: polarity switching from positive to negative in less than 1.5 s
- Ion source: Electrospray (ESI)
- Sensitivity in the MS working method: 1 pg reserpine or 1 pg buspirone injected on column provides S/N ≥ 500:1
- Sensitivity in the MS/MS working method: 1 pg reserpine or 1 pg buspirone injected on column provides S/N ≥ 1,000:1
- raspon masa: 50 – 10,000 m/z ili bolje

**Source of founding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Atomic Force Microscope (AFM) MultiMode 8</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>CVT - Area O-251</td>
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<tr>
<td>Equipment category</td>
<td>Measuring and Test Machine</td>
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<tr>
<td>Photograph</td>
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</table>

**Short description**
The Atomic Force Microscope allows to record images of the surface thanks to a detector, used to measure forces that cause deviations from the sample (any strong material or biological sample; dry or in solution) providing, in this way, a topography of nanometric dimensions.

**Main purpose**
- Topography test of materials’ surfaces and their physical properties, such as softness
- Biological materials test: topography, softness

**Technical specifications**
- SPM standard controller
- AS-130VLR scanner – 125µm x 125µm XY and 5µm Z range (vertical engage), improved resistance in liquids
- Laser Class 2M, 1mW maximum at 690nm (IEC and US CDRH)
- OMV, optical microscope with 10X objective for the visualisation of samples, lasers and types (video output through the NanoScope software)
- NanoScope 9.1 software

**Source of founding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Confocal Microscope LSM 880 Airyscan</th>
</tr>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>CVT - Area O-251</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test Machine</td>
</tr>
</tbody>
</table>

**Short description**
A contemporary confocal microscope that allows a fast and quality analysis of fluorescently marked biological samples, with a 4.8 times higher so called signal-to-noise ratio (SNR) and a 1.7 times higher resolution.

**Main purpose**
Screening fluorescently marked biological samples (immunocytochemistry) and analysis (colocalization, quantification, modelling).

**Technical specifications**
- 2 multi-alkali 1 GaAsPspectral R/FL detector
- 5 lasers: 458, 488, 514, 543 and 633nm
- Real time control electronika
- Zensoftware for sample acquisition, analysis and quantification
- Epifluorescent filters: 38 HE, 43 HE and 49 for sample visualisation

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
**Short description**
A completely motorized fluorescent inverted microscope, that allows a fast and highly accurate screening of fluorescently marked biological samples, as well as the acquisition of video recordings to follow the dynamics of cell processes (growth, differentiation, migration).

**Main purpose**
- Taking images of fluorescently marked biological samples
- Video recording (the so called live cell imaging)
- Analysis and elaboration of fluorescent recordings

**Technical specifications**
- Inverted optical microscope with fluorescent and light microscopy (bright-field and Differential Interference Contrast)
- Epifluorescent filters: U-FUNA, U-FBW, U-FGW
- Z-drift compensator
- Hamamatsu Orca R2 CCD camera
- Fluorescent illuminator: Xenon lamp
- CellSens Olympus software

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Fluorescent Inverted Microscope IX73</th>
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<tr>
<td>Laboratory affiliation</td>
<td>Room with Olympus Microscopes, O-239</td>
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<td>Test Machine</td>
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<tr>
<td>Photograph</td>
<td><img src="image" alt="Fluorescent Inverted Microscope IX73" /></td>
</tr>
</tbody>
</table>

**Short description**  
A standard fluorescent inverted microscope, that allows fluorescently marked biological sample testing.

**Main purpose**  
Visualisation of fluorescently marked biological samples.

**Technical specifications**  
- Inverted optical microscope with fluorescent and light microscopy (brightfield and Differential Interference Contrast)
- Epifluorescent filters: U-FUNA, U-FBW, U-FGW
- Fluorescent illuminator: Xenon lamp

**Source of funding**  
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**  
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Wide Diameter Fluorescent Stereomicroscope MVX10</th>
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<tr>
<td>Laboratory affiliation</td>
<td>Room with Olympus Microscopes, O-239</td>
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<tr>
<td>Equipment category</td>
<td>Test Machine</td>
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</tbody>
</table>

**Photograph**

Wide diameter fluorescent stereomicroscope that allows a compromise between a micro and a macro fluorescent visualisation of tissue cells or living organisms.

**Main purpose**
To test fluorescent protein expressions such as GFP in tissues, organs and living organisms (in vivo research).

**Technical specifications**
- Stereomicroscope for the visualisation and dissection of transgenic laboratory animals
- Visualisation of fluorescent molecules: GFP, CY3 and YFP
- Fluorescent illuminator: Xenon lamp

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Phase Contrast/Inverted Microscope with Fluorescence - RISK</th>
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<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for systemic BioMedicine and Genomics, O-274</td>
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<tr>
<td>Equipment category</td>
<td>Test Machine</td>
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</table>

**Short description**
The machine is composed of 3 parts; a manual, a semi-manual and a completely automatic part. It is composed of a table, a control screen, a connector, a light source (UV lamp, visible spectrum), lenses, an ocular, a joystick, a device for controlled energy supply, a computer and softwareZen.

**Main purpose**
The machine is used to test cell cultures, tissue preparations and human biological materials, to test intercellular processes in living cells, to test cell interactions, mobility and cell growth, etc.

**Technical specifications**
- Microscope dimensions: 295x805x707 mm
- Weight: 36 kg
- Filters: 20 Rhod, 38 HE GFP, 43 HE DsRed, 09 AF 488, 49 DAPI
- Lenses: EC PlnN 5X/0.16 DICO, EC PlnN 10X/0.3 DICI, EC PlnN 40X/0.75 Ph 2 DICII, Pln Apo 63X/1,4 Oil DICIII
- Cameras: Axiocam 105 color, Axiocam 506 mono

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>System for Karyotypization</th>
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<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Human Genetics and Reproduction, O-134</td>
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<td>Equipment category</td>
<td>Test machine</td>
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<tr>
<td>Photograph</td>
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</table>

**Short description**
An interactive imaging system, composed by the microscope Zeiss Axio Imager M2, connected to the high resolution camera MetaSystems and to the software solutions for karyotypization (Ikaros) and fluorescence imaging (Iris).

**Main purpose**
- Karyotypization of eukaryotic cells
- Screening and elaboration of fluorescent images
- Sample analysis after the mFISH and mBAND marking
- Sample analysis after the comparative genomic hybridization (CGH)
- Telomere analysis (signal quantification)
- Saving, organisation and elaboration of collected data

**Technical specifications**
- Zeiss Axio Imager microscope, M2 motorized model - Lenses: Plan-Apochromat 63x/1.4 immersion lens, Plan-Apochromat 10x/0.45, EC Plan-Neofilter 5x/0.16; Ocular: Pl 10x/23 insures the uniformity of the obtained image along the entire visual field; Light source: halogen lamp 12V/100W; Filters: DAPI, FITC/Spectrum Green, TRITC/Spectrum Orange/Cy3, MetaSystems Triple band filter set Aqua/Green/Orange; Photo Fluor LM-75
- Camera: MetaSystems Cool Cube 1m
- Computer: Dell Optiplex XE2
- IKAROS Karyotyping System, Version 5.7.1
- ISIS FISH Imaging System, Version 5.7.1

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
cvt@uniri.hr
3

other measuring machines
### Instrument
- Monochromator- CM Infinite - RISK
- Monokromator - CM Infinite

### Laboratory affiliation
Laboratory for systemic BioMedicine and Genomics, O-270

### Equipment category
Measuring Machine

### Short description
The machine is composed of:
- Software and -control 1.11 and of the mere machine, which contains 3 optical sets, 3 detectors for the measurement of fluorescence, absorbance, luminescence and a computer.

### Main purpose
The machine is used for the measurement of absorbance, fluorescence and luminescence. For the quantification of DNA, RNA, protein, the study of ion channels, ion throughputs, immunoassays, ELISA assay...

### Technical specifications
- **Light source:** UV xenon lamp
- **Wave length choice:** Quad4 monochromator system (2 excitation and 2 emission monochromators)
- **Wave:**
  - fluorescence: Ex 230 – 850 nm, Em 280 – 850 nm
  - absorbance: 230 – 1000 nm
- **Area for the measurement of microtiter plates:** 6 to 384 microtiter plates, cuvettes, NanoQuant plates

### Source of funding
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

### Contacts
cvt@uniri.hr
LABORATORY EQUIPMENT CATALOGUE
OF THE CENTRE FOR ADVANCED COMPUTING AND MODELLING
**Instrument**: GOM Atos Triple Scan  
**Laboratory affiliation**: Laboratory for HPC, Grid and Cloud Computing  
**Equipment category**: Measuring Machine

**Photograph**

The GOM Atos Triple Scan measuring machine is composed of a rotating surface, a computer with an installed programming environment, as well as a measuring device with related base and a stock of labels which are used as reference points.

**Main purpose** - 3D scanning with the purpose of measurement and reconstruction of measuring objects.

**Technical specifications**
- The precision of the measurement is a line of the size of micrometers.
- 2 different measuring volumes
- Non-contact measurement

**Additional information**

**Source of founding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Prof. D.Sc. Zlatan Car / zlatan.car@uniri.hr
**Instrument**

GOM Aramis

**Laboratory affiliation**

Laboratory for HPC, Grid and Cloud Computing

**Equipment category**

Measuring Machine

**Photograph**

The GOM Aramis measuring machine is composed of a base on which two cameras, with corresponding illumination, are setup. The control system is constituted by a laptop with a programming environment and a control device.

**Technical specifications**

- Non-contact measurement
- Wide range of materials suitable for measurement

**Main purpose**

- Measurement of deformations on materials in real time

**Additional information**

http://www.gom.com/metrology-systems/aramis.html

**Source of founding**

The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**

Prof. D.Sc. Zlatan Car / zlatan.car@uniri.hr
Instrument: System for the visualisation of scientific results received on the Supercomputer

Laboratory affiliation: Laboratory for AI, CAE, DSP and simulation modelling

Equipment category: Other

Photograph: [Image of the system for visualisation]

Short description: The system for the visualisation of scientific results is composed of a working station, with a Nvidia Quadro M6000 graphics card (Inv. No. R-005181), a screen resolution of 4096x2160 pixels (Inv. No. R-005182).

Main purpose: The calculation results, obtained on the Supercomputer infrastructure, have to be visualised in order to be comprehensible to users. Considering that the calculations contain a multitude of details, it is necessary to have a screen with a larger diagonal and higher resolution. With the aim to elaborate faster the data visualisation, the working station is equipped with a higher quality graphics card.

Technical specifications:
- A detailed representation of the simulation results
- A graphics card for the elaboration of large amounts of data
- A screen with diagonal of 200 cm with a resolution of 4096x2160 pixels

Source of founding: The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

Contacts: Prof. D.Sc. Zlatan Car / zlatan.car@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Supercomputer Bura</th>
</tr>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Data Center of the Supercomputer Bura</td>
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<tr>
<td>Equipment category</td>
<td>Other</td>
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</tbody>
</table>

**Photograph**

The Supercomputer Bura is based on a hybrid computer architecture which is composed by multiprocessing and multicomputer systems that are interconnected in a high throughput and low latency network. The Data Centre covers a 100m² surface area.

**Main purpose**

- The Supercomputer is intended for scientific purposes such as computational chemistry, bioinformatics, artificial intelligence and physics, where users have the availability of three different architectures.

**Technical specifications**

- The obtained result on the High Performance Linpack benchmark amounts to 233,6×10⁶ FLOPS
- SMP, CPU and GPU clusters
- 1PB space for data storage with additional 2.5 PB space for archiving
- InfiniBand FDR interconnection

**Additional information**

https://cnrm.uniri.hr/bura/

**Source of founding**

The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**

Prof. D.Sc. Zlatan Car / zlatan.car@uniri.hr
LABORATORY EQUIPMENT CATALOGUE
OF THE CENTRE FOR MICRO - AND
NANOSCIENCES AND TECHNOLOGIES
EQUIPMENT OF THE LABORATORY FOR SURFACE SCIENCE
**Short description**

X-ray Photoelectron Spectroscopy (XPS) uses soft (low energy) X-rays for elemental and chemical characterization of the surface of material.

**Main purpose**

The X-ray beam excites the electrons of the sample atoms and if their binding energy is lower than the X-ray energy, they will be emitted from the parent atom as a photoelectron. Only the photoelectrons at the extreme outer surface (10-100 Angstroms) can escape the sample surface, making this a surface analysis technique. XPS provides elemental information, but because the technique is detecting the binding energy of emitted electrons, it can also provide some chemical bonding information. Depending on what elements the parent atom is bound to, the binding energy of the emitted photoelectrons may shift slightly. The instrument is sensitive enough to detect these electron energy shifts and use them to determine what chemical compounds are present.

**Technical specifications**

X-ray Photoelectron Spectrometer is a SPECS system equipped with:
- X-ray source with monochromator (FOCUS 500) - Al Kα (1486.74 eV) or Ag Lα (2984.3 eV)
- Hemispherical electron energy analyser (PHOIBOS 100 MCD-5):
- Electron gun (FG 500)
- Ion gun for low-energy ions of inert and reactive gases (IQE 11/35)
- Ion gun for low-energy ions with differential pumping (IQE 12/38)
- Residual Gas Analyser, RGA (Prisma Plus QMG 220)

**Additional information**


**Year of manufacture**

2009

**Source of founding**

Croatian Science Foundation

**Contacts**

Assoc. Prof. D. Sc. Ivana Jelovica Badovinac (+385 51 584607, ijelov@uniri.hr)
Assoc. Prof. D. Sc. Robert Peter (+385 51 584621, rpeter@uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Secondary Ion Mass Spectrometer (SIMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Surface Science</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for elemental and in-depth characterisation of materials</td>
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**Photograph**

**Short description** Secondary Ion Mass Spectrometer (SIMS) is a microanalytical technique used to understand the composition (isotopic, elemental, and/or molecular) of a predefined microvolume of solid material, by irradiating it with energetic ions.

**Main purpose** SIMS derives compositional information by directing a focused ion beam to the surface of interest. The primary ions induce the emission of atoms and molecules from the solid’s surface, a small percentage of which exist in the ionized state. The emitted secondary ions are then collected and passed through a mass spectrometer. SIMS measurements can be performed in three operating modes:

- Static SIMS: measurement of mass spectra of the specimen surface
- Dynamic SIMS: depth profiling of selected elements or molecules in the sample
- Surface imaging: elemental imaging of the sample surface

**Technical specifications** The SIMS instrument is a Hidden system with the following equipment:

- ion gun for low-energy ions of inert and reactive gases (IG20) with energy range of 0.5 – 5 keV (O\(^+\) or Ar\(^+\) ions) and ion-beam diameter of 100 μm
- Caesium ion gun (IG5C) with energy range of 0.5 – 5 keV and ion-beam diameter of 100 μm
- quadrupole mass analyser (MAXIM HAL7) with mass range: 1- 500 amu and Puls Ion Counting Electron Multiplier detector
- ionization source for Residual Gas Analyser (RGA) / Sputtered Neutral Mass Spectrometry (SNMS) mode
- electron gun (FG 500 – SPECS system) –neutralization of surface charging effects


**Year of manufacture** 2014

**Source of founding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
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2

EQUIPMENT OF THE LABORATORY
FOR THIN FILMS
### Instrument
**Atomic Layer Deposition (ALD)**

### Laboratory affiliation
**Laboratory for Thin Films**

### Equipment category
**Device for thin film deposition**

### Short description

Atomic Layer Deposition (ALD) is a technique used for a deposition of thin anorganic films, characterized with an excellent precision of thickness of deposited films (in Å-nm range).

### Main purpose

ALD can be used to coat wafers, planar objects and porous bulk materials, as well as particles and complex 3D objects. The essence of this technique is to alternately expose surface of the substrate to two different gas compounds (precursors), and this process is repeated in a cyclic manner. The self-limiting aspect of ALD leads to excellent step coverage and conformal deposition, i.e. the deposited film is homogenous and non-porous. Most commonly synthesized materials in our ALD system are semiconductor or isolating thin films such as oxides: ZnO, Al₂O₃, TiO₂, SiO₂ and nitrides: AlN, TiN, Si₃N₄.

### Technical specifications

Atomic Layer Deposition (ALD) instrument is a Beneq TFS 200 system.
- **substrate temperature range:** 25 - 500 °C
- **maximal substrate dimensions (regular chamber):** 200 mm in diameter, 3 mm in height
- **maximal substrate dimensions for 3D chamber:** 200 mm in diameter, 95 mm in height
- **capacitive coupled plasma system (operates at RF of 13,6 MHz and plasma power up to 300 W)**
- **ozone generator (ozone can be used as an oxygen source for ALD synthesis)**
- **4 liquid sources attached to the instrument**

### Additional information


### Year of manufacture

2015

### Source of founding

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

### Contacts

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3

EQUIPMENT OF THE LABORATORY FOR SCANNING ELECTRON MICROSCOPY
**Scanning Electron Microscope (SEM)**

**Laboratory affiliation:** Laboratory for Scanning Electron Microscopy

**Equipment category:** Device for characterisation of materials on the nanoscale

---

**Scanning Electron Microscope (SEM):** a type of electron microscope that permits the observation and characterization of heterogeneous organic and inorganic materials on a nanometre (nm) to micrometre (μm) scale.

**Main purpose:** The SEM is capable of obtaining 3D-like images of the surfaces of a very wide range of materials. The surface area to be examined or the micro-volume to be analysed is irradiated with a finely focused electron beam, which may be swept in a raster across the surface of the specimen to form images or may be static to obtain analyses at one position. Signals produced from the interaction of the electron beam with the sample are in the form of secondary electrons (emitted from the sample) or backscattered electrons (from the impinging electron beam). Signals are obtained from specific emission volumes within the sample and can be used to examine many characteristics of the sample (surface topography, crystallography, chemical composition, etc.).

**Technical specifications:**

- The SEM is a JEOL Field Emission Scanning Electron Microscope (JSM-7800F) with maximal resolution of 0.8 nm, accelerating voltage of 0.01 – 30 kV and the magnification range: ×25 - ×1000000. It is equipped with the detectors:
  - Lower secondary electron detector (LED)
  - Upper secondary electron detector (USD)
  - Backscattered electron detector (BED)
  - Scanning Transmission Electron Microscopy (STEM) detector
  - Energy dispersive X-ray spectrometer (EDS) – used for the analysis of the elemental composition of the specimen.

**Additional information:**


**Year of manufacture:** 2014

**Source of founding:** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts:** Assoc. Prof. D. Sc. Ivna Kavre Pittaver (+385 51 584618, Ivna.kavre@uniri.hr)
Sample preparation instruments

Laboratory for Scanning Electron Microscopy

Devices for sample preparation

**Short description** Various precision instruments

**Main purpose** Instruments for preparing samples

**Technical specifications**
- Precision Etching and Coating System (Gatan PECS II Model 685) – uses dual ion source for the etching of solid samples by low energy Ar+ ions (energy range 0.1 – 8 keV) and can be used for sample coating with C, Au, Pt/Pd, Cr or Pt.
- Precision Ion Polishing System (Gatan PIPS II Model 695) - uses dual ion source for the polishing of solid samples by low energy Ar+ ions (energy range 0.1 – 8 keV), used primarily for the sample preparation for Scanning Transmission Electron Microscopy (STEM) measurements.
- Critical point dryer (Quorum K 850) – used for dehydrating biological tissue (by replacing water with liquid CO₂) prior to examination in the Scanning Electron Microscope (SEM).
- Precision diamond wire saw (Well 3242) - uses a stainless steel wire with diamonds embedded into the surface of the wire as a cutting tool; produces smooth, sharp-edged surfaces on variety of materials.
- Precision saw with diamond discs (Buehler Isomet 1000) – used for cutting various types of materials (metals, composites, laminates, plastics, biomaterials) with minimal deformation, by only using gravity fed force.

**Additional information**
http://phy.uniri.hr/hr/ustroj/29-hr/ustroj/laboratoriji/794-laboratorij-zapripremu-sem-uzoraka.html

**Year of manufacture** 2014

**Source of founding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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EQUIPMENT OF THE LABORATORY FOR PRECISION ENGINEERING AND MICRO- AND NANOSYSTEMS TECHNOLOGIES
**Instrument**  
Bruker Dimension Icon Scanning Probe Microscope (SPM)

**Laboratory affiliation**  
Laboratory for precision engineering and micro- and nanosystems technologies

**Equipment category**  
Device for characterization of materials and surfaces on atomic scale

**Photograph**

Scanning probe microscope encompassing the functionality of an Atomic Force Microscope (AFM) and a Scanning Tunnelling Microscope (STM) with control software.

**Short description**

Scanning probe microscope encompassing the functionality of an Atomic Force Microscope (AFM) and a Scanning Tunnelling Microscope (STM) with control software.

**Main purpose**

The SPM enables measurements of elasticity modulus, adhesion, lateral force (LFM), spectroscopy and force modulation, electrochemical analysis, electric field and magnetic forces, surface potential, piezoelectric forces; enables also nanolithography, ... Option to measure in liquid for biotechnical applications and measurements with heating/cooling of the samples.

**Technical specifications**

- Supports contact and tapping mode measurements, which limits the contact forces to < 200 pN, i.e. a value far lower than the tapping forces of other devices – PeakForce tapping
- Imaging of measured data on 5’120 x 5’120 pixels.
- Scan range up to 90 µm x 90 µm, Z range 10 µm
- Samples fixed to the support via a 210 mm vacuum chuck can be up to few mm in size and 15 mm thick
- Bidirectional positioning repeatability 3 µm on 180 x 150 mm inspectable area
- Includes heat (creep < 200 pm/min) and vibration isolation (1” Si damping cushion + compressed air $\rightarrow$ < 30 pm RMS), microscope and 5 Mpx CCD camera, …
- CE certified

**Additional information**

https://www.bruker.com/products/

**Year of manufacture**

2014

**Source of founding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Keysight G200 Nanoindenter</th>
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<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Device for measurement of materials’ properties on micro- and nanoscale</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Nanoinnder with data analysis software

**Main purpose**
Accurate determination of elasticity modulus and hardness according to ISO 14577., i.e., quantitative measurement of mechanical properties of small volumes of material

**Technical specifications**
- 4 samples in a 100 x 100 mm sample holder with a scanning resolution of 0.1 μm and 1 μm accuracy
- Electromagnetic actuation (voice coil principle), i.e. load generation: max 0.5 N with a 50 nN resolution; additional built-in high-load system with 0.1 mN … 10 N load range
- Loading system stiffness (guided by leaf springs): 5.10⁶ N/m
- Capacitive displacement measurement: resolution < 0.01 nm for >500 μm indentation depth
- Total indenter travel: 1.5 mm
- Obtainable straightness in a 100 mm range is within 10 nm
- Enables LFM with a ≤ 2 mN resolution and max lateral force ≥ 250 mN
- Berkovich, cube corner, conical, spherical and Vickers tips with calibration and conformity certificate of each tip
- System for sample visualization (10x and 40x zoom), and microscope with CCD camera
- Thermally as well as dynamically (and acoustically) isolated

**Additional information**

**Year of manufacture**
2014

**Source of founding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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D. Sc. Ervin Kamenar (+ 385 51 584 766 , ekamenar@uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
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<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
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<td><strong>Equipment category</strong></td>
<td>Device for additive manufacturing via 3D printing</td>
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<tr>
<td><strong>Photograph</strong></td>
<td><img src="image" alt="3D printer with control software" /></td>
</tr>
</tbody>
</table>

**Short description**
3D printer with control software

**Main purpose**
Create a free-shape three-dimensional object in which layers of material are deposited under computer control

**Technical specifications**
- FDM (Fused Deposition Modelling) technology (heating and extrusion of thermoplastics)
- Material: ABSplus (acrylonitrile butadiene styrene).
- For models with dimension of up to 254 x 254 x 305 mm
- 178 μm layer thickness
- Positioning accuracy of 240 μm
- 2 heads for building and support material
- Import of STL (Standard Tessellation Language) 3D models from CAD environment
- SW for printing process optimization (including support structure optimization)

**Additional information**
https://proto3000.com/fortus-250mc.php

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<td>&quot;Research Infrastructure for Campus-based Laboratories at the University of Rijeka&quot; project financed by ERDF</td>
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| **Contacts**            | Prof. D. Sc. Saša Zelenika (+ 385 51 584 633, sasa.zelenika@uniri.hr)  
<pre><code>                      | D. Sc. Ervin Kamenar (+ 385 51 584 766, ekamenar@uniri.hr) |
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<table>
<thead>
<tr>
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<td>3D non-contact scanner</td>
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### Photograph

![3D scanner comprising a projector, the camera, calibration panels and a rotating table – with control software](image)

### Short description

3D scanner comprising a projector, the camera, calibration panels and a rotating table – with control software

### Main purpose

Capturing real world data and converting it into 3D models

Basis for reverse engineering (and, in combination with 3D printers, of rapid prototyping)

### Technical specifications

- The distance and the angle of the camera with respect to the projector are known, i.e. the distortion of the reflected light pattern (fringes) depends on object’s geometry
- 500 mm scanning area
- Resolution/accuracy: 1‰ of the object size
- Includes SW environment
- Mobile with tripod
- Enables exporting of data to formats compatible with standard CAD SW (e.g. STL)

### Additional information


### Year of manufacture

2014

### Source of founding

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>HAAS Office OM-2A milling machine</th>
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<tr>
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<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Machine tools for sample preparation</td>
</tr>
</tbody>
</table>

**Photograph**

A CNC milling machine characterized by small dimensions as well as outstanding performances and exceptional benefits for the end users.

**Main purpose**

Transforms a stock piece of material into a finished product by means of a controlled material removal process.

**Technical specifications**

- Dimensions within an 1.7 x 0.84 x 1.9 m envelope
- Enables 5-axes machining with up to 20 automatically interchangeable tools
- Machining volume 305 x 254 x 305 mm
- 1 μm displacement resolution
- Spindle velocity of up to 30’000 rpm
- 3.7 kW power
- Includes user-friendly interface and a HAAS/Fanuc control unit

**Additional information**

https://www.techspex.com/machining-centers/haas-automation(2501)/4489

**Year of manufacture**

2014

**Source of founding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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D. Sc. Ervin Kamenar (+ 385 51 584 766 , ekamenar@uniri.hr)
**Instrument**

HAAS Office OL-1 lathe

**Laboratory affiliation**

Laboratory for precision engineering and micro- and nanosystems technologies

**Equipment category**

Machine tools for sample preparation

---

**Short description**

CNC lathe characterized by small dimensions as well as outstanding performances and exceptional benefits for the end users

**Main purpose**

Transforms a stock piece of material into a finished product by means of a controlled material removal process

**Technical specifications**

- Dimensions within an 1.3 x 0.84 x 1.98 m envelope
- 2-axes machining with 12 tools
- Turning diameter of up to 125 mm
- 1 μm displacement resolution
- Spindle velocity of up to 6’000 rpm
- 5.6 kW power
- Includes user-friendly interface and a HAAS/Fanuc control unit

**Additional information**


**Year of manufacture**

2014

**Source of founding**

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D. Sc. Ervin Kamenar (+ 385 51 584 766, ekamenar@uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Ultrasonic cleaner SONOREX Technik RM40</th>
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<td>Laboratory affiliation</td>
<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
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<tr>
<td>Equipment category</td>
<td>Ultrasonic cleaning of samples for (ultra-high) vacuum</td>
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</tbody>
</table>

### Photograph
Ultrasonic cleaning device with multiple components

### Short description
Ultrasonic cleaning device with multiple components

### Main purpose
Equipment for ultrasonic cleaning of samples for (ultra-high) vacuum

### Technical specifications
- 1. heated (up to 70 °C) prewash with oil separation
- 2. ultrasonic cleansing (10 PZT inverters, 40 kHz, 500 W continuous and 2 kW peak power) in a 45 l heated stainless steel bath with a “soft” (pH 9.9) detergent and with filtering of media (particles’ separation)
- 3. 2 baths for rinsing in demineralized water with heating (1.2 kW, 30 … 80 °C)
- 4. drying with hot air (up to 300 °C)

### Additional information

### Year of manufacture
2014

### Source of founding
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
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<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
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<tr>
<td><strong>Equipment category</strong></td>
<td>Measurement of mechanical properties of materials</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**  
Micro-tensile machine

**Main purpose**  
Tensile machine for accurate measurement of mechanical properties (elasticity modulus, strength, tensile tests, compression tests, bending tests, …) of materials with superior performances and practical testing solutions

**Technical specifications**
- Loading range up to 5 kN
- Loading resolution 2 mN
- Displacement resolution 10 μm
- Characterisation of mechanical properties of metals, ceramics, polymers, rubber and composites
- Offers real-time auto tuning of control parameters, based on measured test force and strain data
- High-speed sampling of 1 ms ensures no missed strength changes

**Additional information**  

**Year of manufacture**  
2014

**Source of founding**  
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
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- D. Sc. Ervin Kamenar (+ 385 51 584 766, ekamenar@uniri.hr)
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<tr>
<th>Instrument</th>
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<td>Laboratory affiliation</td>
<td>Laboratory for precision engineering and micro- and nanosystems technologies</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Tools for sample preparation and characterisation</td>
</tr>
</tbody>
</table>

**Short description**
Electro-opto-mechanical tools and devices

**Main purpose**
Tools for sampling, preparation and characterisation of materials

**Technical specifications**
- Newport optical table RS 2000™ with 4 adjustable legs (passively damped working surface, metric)
- Pillar drilling machine BOSCH PBD 400 (digital display, \(d_{\text{max}} = 13\) mm, adjustable rotation speed)
- Oscilloscope Keysight (bandwidth 100 MHz, 4 analog + 8 digital channels, 2 GS/s, WVGA color display)
- Multimeter Fluke x 4 (measurement of I, U, R, C, f, temperature)
- UV Exposure Box for Printed Circuit Boards UV (4 x 15 W, 350 x 250 mm)
- Soldering station Weller PUWAD101 (80 W, temp. span 150-450 °C, 1 output)
- Laboratory power supply - Wellerman (digital, 3 outputs, regulation of voltage 0-30 V and regulation of current 0-3 A)
- Battery drill/screwdriver BOSCH (M = 30 Nm, 18 V Li-Ion, \(n_{\text{max}} = 1250\) min⁻¹)
- Micro drill/grinding machine Wellerman/Proxxon (125 W, \(n = 10’000 – 30’000\) min⁻¹)
- Electric hand drilling machine FEIN BOP6 (1500 W, drilling diameter up to 14 mm, rotational speed up to 4000 rpm)
- Laser distance measurement device (for distances up to 10 m with mm resolution)
- Laboratory calibrated weights (1 mg - 0,5 kg, calibration standard – class F1)
- Digital micrometers SCHUT (0-150 mm, resolution 1 μm)
- Various hand tools

**Additional information**

**Year of manufacture**
2014

**Source of founding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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5
EQUIPMENT OF THE LABORATORY FOR COLLOIDS, POLYElectROlyTES AND INTERFACEs
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Spectroscopic imaging ellipsometer Accurion EP4</th>
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<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for Colloids, Polyelectrolytes and Interfaces</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Thin film characterization</td>
</tr>
</tbody>
</table>

**Short description**
Spectroscopic ellipsometry is a well-known non-destructive optical method for determining the thickness and opto-electronic properties of thin films. Imaging ellipsometry combines the power of ellipsometry with microscopy and overcomes the limits of classical ellipsometers.

**Main purpose**
The modularity of the Accurion EP4 Imaging Ellipsometer offers many advantages:
- Spectroscopic ellipsometry with highest lateral resolution (2μm) – mapping the dielectric function; 3D thickness maps. The EP4 model software enables fitting the thicknesses and iso- or anisotropic dielectric functions for stacked layers of different optical materials. The solid-liquid and electrochemical cells enable measurements in contact with liquid medium, and under electrochemical bias (in combination with potentiostat Autolab PGTSAT 128 N). Brewster angle microscopy - a high contrast image of liquid surfaces without use of dies. Surface plasmon resonance measurements with lateral resolution of 2μm. Typical applications are in the triangle between physics and biophysics, material chemistry and nanotechnology.

**Technical specifications**
- AOI: 45-70 deg.
- Wavelength range for SE: 380-1700 nm
- Measurement method: nulling ellipsometry
- Optical magnification: 5x, 10x, 20x

**Additional information**
https://www.accurion.com/thin-film-characterization-imaging-ellipsometry/nanofilm_ep4

**Year of manufacture** 2014

**Source of founding**
"Research Infrastructure for Campus-based Laboratories at the University of Rijeka" project financed by ERDF.

**Contacts**
Assoc. Prof. D. Sc. Duško Čakara (+385 51 584555, dacakara@uniri.hr)
## Instrument
Autolab PGSTAT128 potentiostat for electrochemical measurements

## Laboratory affiliation
Laboratory for Colloids, Polyelectrolytes and Interfaces

## Equipment category
Electrochemical measurements

### Short description
Autolab PGSTAT 128N is a state-of-the-art potentiostat offering measurements with three- or four-electrode electrochemical cells. In combination with the NOVA software, it offers a wide range of methods frequently used in preparative and analytical electrochemistry, including chronoamperometry, chronopotentiometry, voltammetry with a range of different potential sweep modes. The additional bipotentiostat module offers the potential sweep at 2 different electrode terminals, while the FRA32 module offers measurements of electrochemical impedance spectroscopy (EIS).

### Main purpose
Electrochemical measurements: cyclic voltammetry, electrochemical impedance spectroscopy, chronoamperometry, chronopotentiometry

### Technical specifications
- Electrode connections: 2, 3 and 4
- Potential range: +/- 10 V
- Maximum current: +/- 800 mA
- Current ranges: 1 A to 10 nA
- Current resolution: 0.0003 % (of current range)
- Input impedance: > 1 TOhm
- Potentiostat bandwidth: 500 kHz
- FRA32 M: frequency range 10 µHz - 1 MHz;
- Frequency resolution: 0.003 %
- Input range: 10 V
- Signal types: 1 sine, 5 sine, 15 sine
- AC amplitude: 0.2 mV to 0.35 V rms inpotentiostatic mode
- Data presentation Nyquist, Bode, Admittance, Dielectric, Mott-Schottky...
- Graphical equivalent circuit modelling and fitting in NOVA

### Additional information
http://www.metrohm-autolab.com/Products/Echem/NSeriesFolder/PGSTAT128N

### Year of manufacture
2014

### Source of founding
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

### Contacts
Assoc. Prof. D. Sc. Duško Čakara (+385 51 584555, dcakara@uniri.hr)
Instrument | Brookhaven NanoBrook OMNI zetasizer
---|---
Laboratory affiliation | Laboratory for Colloids, Polyelectrolytes and Interfaces
Equipment category | Nanoparticle sizing and electrophoretic mobility measurement

**Short description**
The particle size distribution measurement is based on principles of Dynamic Light Scattering (DLS), while Doppler velocimetry (electrophoretic light scattering, ELS) is used for zeta potential measurement. The instrument also includes Phase Analysis Light Scattering (PALS) measurements for samples with low mobilities, while the available three scattering angles (90°, forward and backscattering) allow optimal experimental conditions for sizing of small particles and polyelectrolytes (< 50 nm) or aggregated turbid samples.

**Main purpose**
The NanoBrook Omni particle size and zeta potential analyser is an instrument for size and electrophoretic mobility measurements in suspensions of nanoparticles and polyelectrolytes, including proteins.

**Technical specifications**
- Particle size range: < 0.3 nm to 10 µm
- Three measurement angles: 15°, 90°, and 173°
- Dynamic light scattering at 173° and 90°
- Sizing: Globular proteins, nanoparticles, and small polymers as well as most colloidal-sized materials in any non-absorbing liquid
- Zeta Potential: Proteins, nanoparticle, polymer and colloidal-sized materials, suspended in any non-absorbing liquid, with relative permittivity (dielectric constant) > 1.5 and viscosity < 30 cP
- Mobility range: 10-11 to 10-7 m²/V*s
- Zeta potential range: 220 mS/cm, covering saline and PBS solutions for proteins, sample dependent
- Concentration range: Sizing: 0.1 ppm to 50 mg/mL, depending on refractive index and concentration
- Zeta potential: 40% v/v, sample dependent
- Laser: 35 mW red diode laser, nominal 640 nm wavelength

**Additional information**
https://www.brookhaveninstruments.com/nanobrook-omni

**Year of manufacture**
2014

**Source of founding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

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EQUIPMENT OF THE LABORATORY FOR MACROMOLECULAR RESEARCH
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Fourier Transform Infrared (FTIR) Spectrometer with Universal Attenuated Total Reflexion (UATR)</th>
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<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for Macromolecular Research</td>
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<tr>
<td><strong>Equipment category</strong></td>
<td>Infrared spectrometer</td>
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### Short description

Fourier Transform Infrared Spectrometer

### Main purpose

**Fourier Transform Infrared (FTIR) Spectroscopy** is a technique used to obtain the information about molecular structure on the base of absorption or emission infrared spectra. Particularly it is used in organic chemistry for identification of functional groups. It is often applied to analyze structural parameters of various materials, but also in biomedical research as a powerful method for the rapid differentiation and identification of microorganisms, contributing to clinical medicine. Particularly, in our laboratory this technique is mostly applied for monitoring structural parameters of polymers and polymer composites and their changes caused by ageing or high energy radiation.

### Technical specifications

- Spectral range: 8,300 – 350 cm⁻¹
- Spectral resolution 0.4 cm⁻¹
- Wavenumber Precision 0.008 cm⁻¹ at 2,000 cm⁻¹
- Wavenumber Accuracy 0.02 cm⁻¹ at 2,000 cm⁻¹

### Additional information


### Year of manufacture

2014

### Source of founding

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

### Contacts

Prof. D. Sc. Srećko Valić (+ 385 51 651 135, svalic@uniri.hr)
Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, damir.klepac@uniri.hr)
**Thermogravimetric Analyzer with Mass Spectrometer**

**Laboratory affiliation** Laboratory for Macromolecular Research

**Equipment category** Mass spectrometer

**Main purpose** Thermogravimetric analyser continuously and precisely measures mass while the temperature of a sample is changed over time. Mass, temperature, and time in thermogravimetric analysis are considered base measurements while many additional measures may be derived from these three base measurements.

The thermogravimetric data collected from a thermal reaction is compiled into a plot of mass or percentage of initial mass on the y-axis versus either temperature or time on the x-axis. A TGA can be used for materials characterization through analysis of characteristic decomposition patterns. Particularly, when coupled with mass spectrometry it is a powerful tool in the determination of chemical composition. It is an especially useful technique for the study of polymeric materials, including thermoplastics, thermosets, elastomers, composites, plastic films, fibres, coatings, paints, and fuels. Therefore this technique is very useful in the field of environmental science and food, pharmaceutical and petrochemical industry.

**Technical specifications**
- Temperature range from room temperature to 1000 °C
- Precision from ± 1 °C, accuracy from ± 0.4 °C
- Balance sensitivity from 10-6 to 10-7 (from 0.1 to 1 μg/g)
- Balance precision 0.001%, Balance accuracy ± 0.02%
- All accessories needed for attaching MS to TGA.
- Set of appropriate TGA pans (1000 pcs)

**Additional information** [http://www.perkinelmer.com/category/thermogravimetry-tga-instruments](http://www.perkinelmer.com/category/thermogravimetry-tga-instruments)

**Year of manufacture** 2014

**Source of founding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
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- Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, damir.klepac@uniri.hr)
<table>
<thead>
<tr>
<th>Short description</th>
<th>Gas permeation Chromatograph (GPC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main purpose</td>
<td>Gel permeation chromatography (GPC), also known as size exclusion chromatography (SEC) separates analytes on the basis of the molecular size in solution. The technique is often used for the analysis of various macromolecular systems, particularly natural and synthetic polymers. Basically, this technique give a possibility to measure molecular masses of such compounds, based on their hydrodynamic volume in solution. Additionally, polydispersity index (PDI) or molecular mass distribution (MMD) can be also determined by this technique. These data are very important for mechanical properties of materials, related to their practical application</td>
</tr>
<tr>
<td>Technical specifications</td>
<td>RI and Light Scattering detectors</td>
</tr>
<tr>
<td></td>
<td>Column porosity 3, 5, 10 μm</td>
</tr>
<tr>
<td></td>
<td>Column capacity: 5 x 30 cm</td>
</tr>
<tr>
<td></td>
<td>Max flow rate: (analysis) 2.0 mL/min (solvent exchange) 0.3 mL/min</td>
</tr>
<tr>
<td></td>
<td>Pump flow rate: 0.01 to 10.00 mL/min, programmable soft start</td>
</tr>
<tr>
<td>Additional information</td>
<td><a href="http://www.pss-polymer.com/products/lc-instruments-and-detectors/security2-gpc-system/">http://www.pss-polymer.com/products/lc-instruments-and-detectors/security2-gpc-system/</a></td>
</tr>
<tr>
<td>Year of manufacture</td>
<td>2014</td>
</tr>
<tr>
<td>Source of founding</td>
<td>“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF</td>
</tr>
<tr>
<td>Contacts</td>
<td>Prof. D. Sc. Srečko Valić (+ 385 51 651 135, <a href="mailto:svalic@uniri.hr">svalic@uniri.hr</a>)</td>
</tr>
<tr>
<td></td>
<td>Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, <a href="mailto:damir.klepac@uniri.hr">damir.klepac@uniri.hr</a>)</td>
</tr>
</tbody>
</table>
**Dynamic Mechanical Analyzer (DMA)**

**Laboratory affiliation**
Laboratory for Macromolecular Research

**Equipment category**
DMA

**Short description**
Dynamic mechanical analyser

**Main purpose**
**Dynamic mechanical analysis (DMA)**, also known as dynamic mechanical spectroscopy, is a technique used to study and characterize various materials. It is often applied for studying the viscoelastic behaviour of polymers. A sinusoidal stress is applied and the strain in the material is measured, allowing one to determine the complex modulus. The temperature of the sample or the frequency of the stress are often varied, leading to variations in the complex modulus; this approach can be used to locate the glass transition temperature of the material, as well as to identify transitions corresponding to other molecular motions.

**Technical specifications**
- Temperature range from -190 °C to 600 °C
- Frequency range from 0 to 300 Hz
- Frequency resolution 0.001 Hz
- Dynamic Displacement from 0 to ±1000 μm.
- Modulus resolution 0.0001 Pa; modulus range ~103 to 1016 Pa
- Tan Delta resolution 0.00001
- Maximum Sample Size: 52.5 mm x 12.8 mm x 8.0 mm
- TMA Mode:
  - Measurement range ±1000 μm;
  - Sample size up to 10 mm
  - Geometry: tension and compression
  - Sensitivity: 10 nM
  - Force load min/max 0.002 N / ±10 N

**Additional information**

**Year of manufacture**
2015

**Source of founding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
- Prof. D. Sc. Srećko Valić (+ 385 51 651 135, svalic@uniri.hr)
- Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, damir.klepac@uniri.hr)
Gas Adsorption Porosimeter ASAP 2020

Gas Adsorption Porosimeter is an instrument which gives the possibility to characterize the surface as well as the free volume in various types of materials (polymers, ceramics etc.). The technique is based on the gas adsorption, and the results indicate the size and size distribution of free volume holes inside the investigated sample. This powerful technique can be very useful in the study and production of pharmaceuticals, catalysts, adsorbents, materials for separation technologies, pigments, cosmetics and construction materials. Additionally, it can be applied for geological investigations as well as to identify transitions corresponding to other molecular motions.

Technical specifications
- Gas temperature measurement resolution: 0.01 °C
- Two vacuum independent degassing stations with two temperature zones up to 450 °C
- Specific surface area: ~0.01 m²/g and above (N₂/77K); ~0.0005 m²/g and above (Kr/77K)
- Specific pore volume: from 0.0001 cc/g
- Pore size range: 0.32-500 nm in pore diameter
- Maximum inlet pressure ~150 kPa
- Pressure measurement accuracy better than 0.25%
- Temperature stability: ±0.1°C
- Coolant system: Liquid nitrogen and liquid argon with automatic level control. Automatic Dewar raising and lowering
- Degasser unit accuracy: ±1 % of full scale temperature.

Additional information

Year of manufacture
2015

Source of founding
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

Contacts
Prof. D. Sc. Srećko Valić (+ 385 51 651 135, svalic@uniri.hr)
Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, damir.klepac@uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Testing Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for Macromolecular Research</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Characterisation of mechanical properties</td>
</tr>
</tbody>
</table>

**Short description**  
Testing machine allows to measure mechanical properties of materials. In our laboratory it is predominantly used for measuring stress-strain curves of various elastomers and their composites, in one or multiple cycles under the control of frequency and amplitude. We possess standard matrices of various shapes for the sample preparation.

**Technical specifications**
- Testing load range: from 0.5 to 5 kN
- Height: 1000 mm
- Accuracy of the set speed: 0.05 % of set speed
- Repetition accuracy: ±2μm

**Additional information**  
http://www.ssi.shimadzu.com/products/product.cfm?product=eztest

**Year of manufacture**  
2015

**Source of founding**  
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
- Prof. D. Sc. Srećko Valić (+ 385 51 651 135, svalic@uniri.hr)
- Assoc. Prof. D. Sc. Damir Klepac (+ 385 51 651 187, damir.klepac@uniri.hr)
EQUIPMENT OF THE LABORATORY FOR QUANTUM AND NONLINEAR OPTICS
Instrument: Light source
Laboratory affiliation: Laboratory for quantum and nonlinear optics
Equipment category: Light source

Short description: Ultra-Narrow Linewidth CW DPSS Green Laser is based on a Non-Planar Ring Oscillator (NPRO) configuration. The output from Nd:YAG NPRO is frequency doubled in an efficient periodically poled crystal. Output power up to 100 mW is available at green wavelength. In addition, the depleted 1064 nm beam is also available, with output power up to 1.5 W. Linewidth, frequency tuning, frequency stability and noise of both green and IR beams are determined by the unique properties of NPRO and low noise electronics. The Noise Eater circuitry eliminates residual pump diode and relaxation oscillation noise at frequencies below 1 MHz.

Main purpose: Light source for precision measurements in metrology and quantum optics.

Technical specifications:
- Laser power 20 mW @532 nm and 1000 mW @1064nm
- Laser control electronics – analog, stand alone
- Continuous wave
- TEM00 spatial modelling Thermal and PZT tuning
- Single frequency
- Coherence length > 1 km
- Spectral linewidth ~ 1 kHz

Additional information: https://www.coherent.com

Year of manufacture: 2013

Source of founding: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

Contacts: Assoc. Prof. D. Sc. Marin Karuza (+385 51 584 611, mkaruza@phy.uniri.hr)
### Instrument
Oscilloscope

### Laboratory affiliation
Laboratory for quantum and nonlinear optics

### Equipment category
Measurement device

### Short description
Oscilloscopes are used to observe the change of an electrical signal over time, such that voltage and time describe a shape which is continuously graphed against a calibrated scale. The observed waveform can be analysed for such properties as amplitude, frequency, rise time, time interval, distortion and others. Modern digital instruments may calculate and display these properties directly. Originally, calculation of these values required manually measuring the waveform against the scales built into the screen of the instrument.

### Main purpose
Measure and display of electrical signals as waveforms on the screen.

### Technical specifications
- 4 input channels
- Analog bandwidth 1 GHZ
- Rise time 350 ps
- Input coupling AC, DC, GND
- Input impedance 1 MΩ, 50 Ω
- Input sensitivity 1mV/div to 10V/div (1 V/div @50Ω)
- Vertical resolution 8 bits

### Additional information
https://www.tektronix.com

### Year of manufacture
2013

### Source of founding
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

### Contacts
Assoc. Prof. D. Sc. Marin Karuza (+385 51 584 611, mkaruza@phy.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Analog to digital and digital to analog converters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for quantum and nonlinear optics</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Data acquisition and signal generation</td>
</tr>
</tbody>
</table>

**Short description**

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software. Compared to traditional measurement systems, PC-based DAQ systems exploit the processing power, productivity, display, and connectivity capabilities of industry-standard computers providing a more powerful, flexible, and cost-effective measurement solution.

**Main purpose**

Measure and generate electrical signals and process, visualize and store them on a computer.

**Technical specifications**

- Accepts 3U PXI Express, CompactPCI Express, and hybrid slot compatible PXI-1/CompactPCI (PICMG EXP.0 R1.0) modules
- 5 peripheral slots in a rugged, compact chassis with universal AC input, and automatic voltage/frequency ranging
- Integrated MXI-Express controller
- Rise time 1.4 ns, bandwidth 250 MHz, ENOB up to 7.6
- Real time sample rate 2.5 GS/s, RIS up to 50 GS/s
- Jitter < 200 fs, amplitude resolution <0.1 dB
- Amplitude settling time 0.05 dB of final value < 500 ms
- VSWR < 1.8:1, typical, output impedance 50 Ω

**Additional information**

https://www.ni.com

**Year of manufacture**

2013

**Source of founding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**

Assoc. Prof. D. Sc. Marin Karuza (+385 51 584 611, mkaruza@phy.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Optical table with optical and optomechanical elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for quantum and nonlinear optics</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Parts and devices for high sensitivity measurements</td>
</tr>
</tbody>
</table>

**Photograph**

Short description: Optical tables provide damping for applications such as biomedical imaging, scanning microscopy, spectroscopy, interferometry, electrophysiology, precision measurements and more. The optical and optomechanical elements provide the capability to design and construct custom oriented measurement setups. Spherical lenses are used for beam focusing and beam expansion.

**Main purpose**: Support and setup precision experiments and measurements.

**Technical specifications**
- Two precision tunable dampers concentrate damping where it's needed
- Trussed honeycomb core improves table stiffness
- Excellent vibration immunity for a passive table top
- Triple core interface increases point loading capability
- Mounting holes individually sealed with conical polymeric cup
- 100-TPI adjusters
- Hardened carbide pads
- N-BK7 or UV grade fused silica substrates
- Uncoated or AR coated optics
- Lens range $f = -50$ mm to 1500 mm

**Additional information**: [https://www.newport.com](https://www.newport.com)

**Year of manufacture**: 2014

**Source of founding**: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**: Assoc. Prof. D. Sc. Marin Karuza (+385 51 584 611, mkaruza@phy.uniri.hr)
EQUIPMENT OF THE LABORATORY FOR SYNTHESIS OF FUNCTIONAL MATERIALS
<table>
<thead>
<tr>
<th>Instrument</th>
<th>UV system for polymerization (INTELLI-RAY 600)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Synthesis of Functional Materials</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Polymerization system</td>
</tr>
</tbody>
</table>

**Short description** Microprocessor

**Main purpose** The INTELLIRAY is a compact microprocessor controlled UV flood curing system or UV polymerization of monomers in the presence of initiator sensitive on light.

**Technical specifications**
- 600W UVA enhanced arc lamp
- X Microprocessor control of time & intensity
- Integrated exposure shutter
- 175 mW/cm² Intensity
- 8" x 6" curing area
- Shielded benchtop curing chamber

**Additional information** [https://www.brookhaveninstruments.com/nanobrook-omni](https://www.brookhaveninstruments.com/nanobrook-omni)

**Year of manufacture** 2014

**Source of founding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Assoc. Prof. D. Sc. Gabriela Ambrožić
(+385 51 584 632, gabiela.ambrozic@phy.uniri.hr)
LABORATORY EQUIPMENT CATALOGUE
OF THE FACULTY OF CIVIL ENGINEERING
EQUIPMENT OF THE CONSTRUCTION LABORATORY
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Single Girder Bridge Overhead Crane SPB INŽENJERING d.o.o. type JMD 5t/8,6m with Crane Runway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Others</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image-url" alt="Image" /></td>
</tr>
<tr>
<td>Short description</td>
<td>Single girder bridge overhead crane SPB INŽENJERING d.o.o. type JMD 5t/8,583m with crane runway length 16 m</td>
</tr>
<tr>
<td>Main purpose</td>
<td>Lifting and transferring cargo.</td>
</tr>
<tr>
<td>Technical specification</td>
<td>- Crane capacity 5 t</td>
</tr>
<tr>
<td></td>
<td>- Crane span 8,583 m</td>
</tr>
<tr>
<td></td>
<td>- Lifting height 7,28 m</td>
</tr>
<tr>
<td></td>
<td>- Lifting speed 4/1,3 m/min</td>
</tr>
<tr>
<td></td>
<td>- Trolley speed 20/6,7 m/min</td>
</tr>
<tr>
<td></td>
<td>- Crane speed 20-5 m/min</td>
</tr>
<tr>
<td></td>
<td>- Crane runway length 2 x 16 m</td>
</tr>
<tr>
<td>Source of funding</td>
<td>“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF</td>
</tr>
<tr>
<td>Contacts</td>
<td>Dragan Ribarić / <a href="mailto:dragan.ribaric@uniri.hr">dragan.ribaric@uniri.hr</a></td>
</tr>
<tr>
<td>Instrument</td>
<td>Portable Hydraulic Device for Applying Force - MATEST S222-01, S226-1, C405-15, S224-21, S226-05, S226-06</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Testing Device</td>
</tr>
</tbody>
</table>
| Photograph                      | ![Portable Hydraulic Device for Applying Force](image)

**Short description**: Portable hydraulic device for applying force - MATEST S222-01, S226-1, C405-15, S224-21, S226-05, S226-06

**Main purpose**: Portable hydraulic device for applying force.

**Technical specification**
- Capacity 100 kN
- Small hydraulic aggregate 12V DC

**Source of funding**: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**: Davor Grandić / dgrandic@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Optical Measuring System GOM mbH PONTOS 3D 4M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring Device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description** Optical measuring system GOM mbH PONTOS 3D 4M: head with two cameras, cables, support, calibration object, lenses, laser pointer, LED lights, cases

**Main purpose** System with two cameras for 3D non-contact optical measuring of deformations and strains. After the initial calibration, cameras are used to film the whole experiment. By tracking the surface of the experimental model, which has to be treated adequately beforehand, the positions of all the points on the surface of the model are obtained.

**Technical specification**
- Filming speed up to 168 fps with resolution 2400x1728 pixels, or up to 1300 fps with resolution 2400x168 pixels
- One pair of lenses with focal length 20 mm for measuring volumes from 125 x 90 mm² up to 2150 x 1600 mm²
- Calibration object for measuring volumes from 350 x 260 mm² up to 500 x 370 mm²

**Source of funding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts** Gordan Jelenić / gordan.jelenic@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Equipment for Measuring Displacements NI SCXI-1000NI SCXI-1000, NI SCXI-1600, SCXI-1540, SCXI-1315, SCXI-1374, SCXI-1361</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring Device</td>
</tr>
<tr>
<td><strong>Short description</strong></td>
<td>Equipment for measuring displacements NI SCXI-1000NI SCXI-1000, NI SCXI-1600, SCXI-1540, SCXI-1315, SCXI-1374, SCXI-1361</td>
</tr>
<tr>
<td><strong>Main purpose</strong></td>
<td>Equipment for measuring displacements NI SCXI-1000.</td>
</tr>
</tbody>
</table>
| **Technical specification** | - 16-bits data acquisition module  
- 3x 8-channel LVDT input module |
| **Source of funding** | “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF |
| **Contacts** | Davor Grandić / dgrandic@uniri.hr |
Instrument: Cyclic Corrosion Test Chamber – Ascott CC1000ip

Laboratory affiliation: Construction Laboratory

Equipment category: Testing Device

Photograph

Short description: Cyclic corrosion test chamber – Ascott CC1000ip

Main purpose: Cyclic corrosion test chamber designed for an accelerated test of material resistance on the impact of corrosion from atmosphere that contain a sodium chloride as a main component.

Technical specification:

- Chamber capacity: 1000l

Source of funding: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

Contacts: Davor Grandić / dgrandic@uniri.hr
**Instrument**
System with Two Dual-axis Shaking Tables Quanser STI-III

**Laboratory affiliation**
Construction Laboratory

**Equipment category**
Testing Device

**Photograph**

**Short description**
System of two biaxial shaking tables Quanser STI-III actuated by electromagnet motors (control unit, hardware + software)

**Main purpose**
Used for model experiments with dynamic excitation (such as earthquake, harmonic excitation and other). Two shaking tables can be used independently in two experiments at the same time, or together in a way that the model is sitting on both tables. When the tables are used together, the mass of the model can be greater, while the excitation can be the same on both of the tables (synchronous excitation) or different (asynchronous excitation).

**Technical specification**
- Dimensions of each platform 625 x 625 mm
- Each platform can move along 15 cm in each direction, span of work frequencies is from 0 up to 20 Hz
- Maximum load on each platform is 130 kg with 1g acceleration in each of the two directions
- With no load each platform can go up to 2.8 g of acceleration in x direction and 4.5 g in y direction
- The distance between the two platforms can be from 1 m up to 2.5 m

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Gordan Jelenić / gordan.jelenic@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Portable Phased Array Ultrasonic Flaw Detector for Steel PHASOR XS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring Device</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Portable Phased Array Ultrasonic Flaw Detector for Steel PHASOR XS" /></td>
</tr>
</tbody>
</table>

**Short description**
Portable phased array ultrasonic flaw detector for steel (LCD, probes, cables, software) PHASOR XS

**Main purpose**
Portable phased array ultrasonic flaw detector and thickness gauge work in Conventional and Phased array modes.

**Technical specification**
- Conventional mode: DAC and (DGS) AVG
- Phased array mode: TOPView, Overlay TCG, Fullsector scan
- VGA full-colour display

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Mladen Bulić / mbulic@uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Portable Combined Hardness Tester for Steel MIC 20 TFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Testing Device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Portable combined hardness tester for steel MIC 20 TFT (two sets of probe, cables, software)

**Main purpose**
The MIC 20 supports the quasi-static hardness testing according to the UCI method (Vickers prism) and dynamic hardness testing according to the rebound method.

**Technical specification**
- UCI Method: Probe 98 N (10 kgf) (Vickers prism)
- Rebound Method: rebound impact device, Tungsten-Carbide Metal Tip, Ø=3 mm

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Mladen Bulić / mbulic@uniri.hr
Instrument: Steel Load Frame with Two Eervo-hydraulic Testing Actuators Zwick Roell Capacity 500kN and 250 kN

Laboratory affiliation: Construction Laboratory

Equipment category: Testing Device

Photograph

Short description: Dimension of steel load frame 5.0 x 3.6 m, has the possibility of extending to 7.0 m in the longitudinal direction and to 6.0 m in height. Capacity of actuators are 500 kN and 250 kN. Actuators have been specially designed for dynamic material testing for determining the fatigue strength of material and components of structure. The entire system is controlled via a computer program Cubus.

Main purpose: The main purpose of the actuator is to provide precise static and dynamic testing of prefabricated elements and various components of civil engineer structure and other types of structures. The possibility of testing with displacement and force control.

Technical specification:
- Possibility of cyclic test with a frequency up to 10 Hz with a possible cylinder displacement of 250 mm and power of the hydraulic pump 95 kW.

Source of funding: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

Contacts: Mladen Bulić/ mbulic@uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Universal Tension-compression Test Machine with Temperature Chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Construction Laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Testing Device</td>
</tr>
</tbody>
</table>

**Photograph**

Universal tension-compression testing machine Zwick Z 600E with capacity 600 kN and electro-mechanical drive. Testing machine consists of two workspaces. The upper workspace is primarily designed for tensile tests, while the lower working space is designed for compression and bending tests.

**Short description**

Universal tension-compression testing machine Zwick Z 600E with capacity 600 kN and electro-mechanical drive. Testing machine consists of two workspaces. The upper workspace is primarily designed for tensile tests, while the lower working space is designed for compression and bending tests.

**Main purpose**

The main purpose of the test machine is monotonic static test. In addition, low-cyclic tests up to 0.5 Hz are also possible. Experiments on the testing machine can be performed with the force control, displacement control, and the strain control (with extensometers).

**Technical specification**

- Speed of test for displacement control mode 0,001 do 320 mm/min
- Specimen fixing - hydraulic jaws (600 kN), pneumatic jaws (10 kN) and mechanical jaws (10 kN).
- Tools and specimen grips for the steel testing of round and rectangular cross sections, wood testing and plastic testing

**Source of funding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**

Željko Smolčić/ zeljko.smolcic@uniri.hr
EQUIPMENT OF THE MATERIALS LABORATORY
**Instrument** | Climatic Chamber  
---|---  
**Laboratory affiliation** | Laboratory for Materials  
**Equipment category** | Preparation of specimens  

![Climatic Chamber](image)

**Short description**
A multipurpose climatic chamber suitable for testing various construction materials such as aggregates, cement, concrete, bricks, blocks, asphalt etc. It has monobloc stainless steel cabinet with shelves capable of holding heavy specimens. It is designed to condition the air circulating in the cabinet. The temperature is controlled by a sensor which is movable inside the cabinet area and can also be located inside the test sample. During test data can be monitored. Chamber is equipped with software for data transfer to a computer.

**Main purpose**
Simulation of thermal and weathering properties: freezing and thawing cycles, wetting and drying cycles.

**Technical specification**
- **Capacity 520 l**
- **Function controller**: cycle programmer for 50 programs and 1000 segments
- **Digitally controlled temperature range** from -25°C to +70°C
- **Digitally controlled humidity range** from 10% to 95%
- **Internal air circulation**
- **Shelves loading capacity**: 4 shelves, 60 kg each
- **Programmable**

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
Doc.dr.sc. Silvija Mrakovčić / silvija.mrakovcic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Water Permeability Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Materials</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Durability Test Equipment</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
The water permeability device consists of a robust steel frame with clamping system incorporating the hydraulic circuit, valves, gauge to check the water pressure and measuring transparent burettes mounted on top of the tester. The clamping system can accept cube or prismatic specimens up to 200 mm side and cylinders up to 300 mm height. It is supplied complete with gaskets for 150 mm cube specimens. It has to be fit with a suitable air compressor, max. working pressure 10 bar.

**Main purpose**
To determine the depth of penetration of water under pressure in the cube and prismatic concrete specimens according to standard HRN EN 12390-8.

**Technical specification**
- Number of test positions: 6
- Supplied with gaskets for 150 mm cube specimens
- Max. working pressure: 1000 kPa
- Net weight: 155 kg
- Operating temperature: +10 to +40°C

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
Doc.dr.sc. Silvija Mrakovčić / silvija.mrakovic@gradri.uniri.hr

---

**Table**

<table>
<thead>
<tr>
<th>Number of test positions: 6</th>
</tr>
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<tbody>
<tr>
<td>Supplied with gaskets for 150 mm cube specimens</td>
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<tr>
<td>Max. working pressure: 1000 kPa</td>
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<tr>
<td>Net weight: 155 kg</td>
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<tr>
<td>Operating temperature: +10 to +40°C</td>
</tr>
<tr>
<td>Instrument</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Laboratory affiliation</td>
</tr>
<tr>
<td>Equipment category</td>
</tr>
</tbody>
</table>

**Photograph**

Chloride penetration meter is used for measuring the electrical resistance of concrete against the penetration of chloride according to the standard methods. The test device is equipped with 4 independent channels and 4 test cells suitable to perform tests on up to 4 specimens. Equipped with vacuum saturation apparatus necessary to fully saturate the specimen with water.

**Main purpose**

To determine resistance of concrete to the penetration of chloride ions according to ASTM C1202 standard. The measurement data derived from this test methods can be used to estimate the chloride diffusion coefficient of concrete in service life predictions and structure design, as well as durability-based quality control of concrete.

**Technical specification**

- Testing up to 4 specimens
- Every channel is independent
- Programmable test duration
- Adjustable measuring rate starting from 1 minute
- Measurement and record of the test temperature during the whole test
- Unlimited data storage on SD card
- Accuracy: +/-0.1V, +/-1mA

**Additional information**

http://www.controls-group.com

**Source of funding**

The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**

Doc.dr.sc. Silvija Mrakovčić / silvija.mrakovic@gradri.uniri.hr
The oxygen permeameter device consists of an aluminium permeability cell used to house the test sample; a rubber sleeve used to prevent oxygen permeation along the lateral face of the sample; an air chamber to keep the rubber sleeve well attached to the sample and wall panel. The wall panel is supplied with 3 flow meters, bubble type, used to measure oxygen flow; 1 digital pressure gauge complete with pressure transducer; 1 high precision flow control valve to control the input pressure and 1 distribution panel with valves to activate the flow meters. The device is fitted with a suitable air compressor.

Main purpose: To determine permeability of the cast and cored cylindrical concrete specimens 150 mm diameter, 50 mm high to oxygen by the Cambureau method. The test result is the mean specific coefficient of oxygen permeability.

Technical specification:
- Panel (l × d × h) 700 x 1100 x 120 mm, mass 14 kg
- Cell (d × h) 345 × 80 mm, mass 19 kg
- High precision pressure regulator
- Digital readout unit and pressure transducer
- Permeability cell for specimens 150 mm diameter, 50 mm height

Additional information: [http://www.controls-group.com](http://www.controls-group.com)

Source of funding: The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

Contacts: Doc.dr.sc. Silvija Mrakovčić / silvija.mrakovic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Compression Testing Frame - 3000 kN capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Materials</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test Machine</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Compression Testing Frame" /></td>
</tr>
</tbody>
</table>

**Short description**
The servo-hydraulic compression frame 3000 kN capacity can be used to perform various building material tests. It is suitable for testing cubes up to 200 mm and cylinders up to diameter 160 x 320 mm. The frame is completed with suitable distance pieces conforming to the specimen size.

**Main purpose**
The test machine is used for compression tests on concrete cubes, cylinders and blocks according to the standards EN 12390-4 and EN 772-1.

**Technical specification**
- Capacity: 3000 kN
- Calibration accuracy: class 1
- Platens diameter: 300 mm
- Ram travel: 50 mm
- Max. vertical daylight: 350 mm
- Horizontal daylight: 370 mm
- Power supply: 230 V 1 ph 50 Hz 750 W

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
dr.sc. Natalija Bede / natalija.bede@gradri.uniri.hr
Instrument: Universal Testing Flexure Frame - 300 kN capacity

Laboratory affiliation: Laboratory for Materials

Equipment category: Test Machine

Photograph

Short description: The servo-hydraulic flexure test machine has C-shaped open structure for loading specimen and high stiffness closed structure during the test. It is connected to control console capable of applying load in displacement and strain rate control. The test machine is supplied with displacement transducer for measurement of crack opening (CMOD according to EN 14651), accessories for measurement of beam deflection and toughness, for energy absorption test on square (EN 14488-5) or round slabs, for kerb slabs and accessories for compression tests.

Main purpose: The test machine can be used for testing in flexure various building materials (three- or four-point bending tests), deformability tests, CMOD tests, energy absorption tests and ductility index.

Technical specification:
- Max. load: 300 kN
- Calibration accuracy: class 1
- Load sensor: strain gage load cell
- Rate: load, displacement and strain rate
- Max. vertical daylight without accessories: 546 mm
- Distance between accessory lower rollers: adjustable from 80 to 1500 mm
- Distance between accessory upper rollers: adjustable from 80 to 500 mm
- Piston travel: 110 mm

Additional information: http://www.controls-group.com

Source of funding: The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

Contacts: dr.sc. Natalija Bede / natalija.bede@gradri.uniri.hr
**Instrument**
Le Chatelier Water Bath

**Laboratory affiliation**
Laboratory for Materials

**Equipment category**
Preparation of specimens

**Short description**
The internal chamber and the insulated exterior case of the bath are manufactured from stainless steel. It has timer which is used to set the time for reaching the boiling point in 30 minutes by using two heater units. The bath is supplied complete with a 12 place Le Chatelier mould rack.

**Main purpose**
For the determination of the soundness of cement paste, fly ash for concrete and lime. Le Chatelier Water Bath is used with Le Chatelier moulds for the determination of the soundness of cement paste according to HRN EN 196-3.

**Technical specification**
- Capacity 10 l
- Timer for automatic heating
- Raise the water temperature from 20 ± 2°C to boiling point in 30 ± 5 min
- Maintain the water at boiling point for 3 hours ± 5 min.
- Supplied complete with a 12 place Le Chatelier mould rack
- Mains supply: 230V, 50 - 60 Hz, 1ph

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
dr.sc. Natalija Bede / natalija.bede@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Motor Operated Flow Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for Materials</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test Machine</td>
</tr>
</tbody>
</table>

**Photograph**
![Motor Operated Flow Table](image)

**Short description**
The machine consists of motorized flow table and automatic digital counter. Motor operated model conforming to EN standards is driven by a motor speed reducer. The number of drops is set on the counter and the machine stops automatically at the end of the cycle. The flow table is manufactured from stainless steel and has a 300 mm diameter table. The conical mould is made of brass and has dimensions of 100 mm base diameter x 70 mm top diameter x 60 mm height. This model is supplied complete with tamper and the filling hopper.

**Main purpose**
To determine the consistency of mortar, building lime and cement specimens conforming to HRN EN 459-2 and HRN EN 1015-3.

**Technical specification**
- Motorized with counter
- Table diameter: 300 mm
- Height of drop: 10 mm
- Conical flow mould (base × diameter × height) 100 mm × 70 mm × 60 mm
- Power: 180 W

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
dr.sc. Natalija Bede / natalija.bede@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Los Angeles Abrasion Machine</th>
</tr>
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<tbody>
<tr>
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<td>Laboratory for Materials</td>
</tr>
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<td>Test Machine</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Los Angeles Abrasion Machine" /></td>
</tr>
</tbody>
</table>

**Short description**
The machine consists of an electronic control unit and a rolled steel drum having an inside diameter of 711 mm and internal length of 508 mm. The drum is rotated by a speed reducer driven by an electric motor at a speed of 31 to 33 r.p.m. The machine is equipped with an automatic counter. It is possible to set 2 different test procedures: the required number of revolutions of the drum or the total working time. It is supplied with set of 12 abrasive charges conforming to EN standards. The machine is upgraded with the noise reduction and safety cabinet.

**Main purpose**
The Los Angeles abrasion machine is widely used for testing coarse aggregates resistance to abrasion. It can be used for determination of the particle loss (abrasion) of porous asphalt mixtures and the determination of the resistance of a bituminous mixtures or pavement to aviation fuel.

**Technical specification**
- High stiffness welded steel frame
- Graphic display and membrane keyboard
- Power: 740 W
- Weight approx.: 350 kg
- Dimensions approx.: 1005 mm x 820 mm x 950 mm

**Additional information**
http://www.controls-group.com

**Source of funding**
The Development of Research Infrastructure at the University of Rijeka Campus (EFRR)

**Contacts**
dr.sc. Natalija Bede / natalija.bede@gradri.uniri.hr
3

EQUIPMENT OF THE GEOTECHNICAL LABORATORY
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Soil Extruder</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for sample preparation</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
The machine consist of a movable table and a hydraulic piston which can be adjusted either in horizontal or vertical position.

**Main purpose**
Extruding samples from proctor moulds and borehole samplers.

**Technical specification**
- Power: 750 W
- Max. load: 60 kN
- Max. ram stroke: 900 mm
- Max. working ram speed: 6 mm/sec.
- Max. external diameter of sample tubes: 160 mm
- Overall dimensions:
  - Horizontal working position (lxwxh): 2730x409x1180 mm
  - Vertical working position (lxwxh): 1025x409x1080 mm without accessories

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Muffle furnace</th>
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<tr>
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<td>Geotechnical laboratory</td>
</tr>
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<td><strong>Equipment category</strong></td>
<td>Other</td>
</tr>
<tr>
<td><strong>Photograph</strong></td>
<td><img src="image" alt="Muffle furnace" /></td>
</tr>
</tbody>
</table>

**Short description**
Muffle furnace used for combustion of organic materials.

**Main purpose**
Main purposed to determine the amount of residual mineral matter in the binder extract.

**Technical specification**
- Max. temperature: 1100°C
- Power: 3.9 kW
- Chamber dimensions (lxwxh): 210x320x145 mm
- Outside dimensions: 510x750x660 mm
- Weight approx: 89 kg

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Laboratory oven</th>
</tr>
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<tbody>
<tr>
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<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Other</td>
</tr>
</tbody>
</table>

**Photograph**

Machine used for drying material. It consists of three grid shelves, cooling fan and temperature gauge.

**Main purpose**

Drying of samples.

**Technical specification**

- Nominal capacity: 250 l
- Max. temperature: 200 °C
- Power: 2100 W
- Internal dimension: 554x660x700 mm
- External dimensions: 951x1056x970 mm
- Number of grid shelves: 3
- Weight approx.: 130 kg

**Additional information**

http://www.controls-group.com/eng/general-lab-testing-equipment/laboratory-ovens.php

**Source of funding**

The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**

Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Laboratory crusher</th>
</tr>
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<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Production device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Device used for crushing coarse material into finer size.

**Main purpose**
Crushing of materials.

**Technical specification**
- Jaw opening: 100 x 60 mm
- Jaw crushing adjustment: 2 to 18 mm
- Capacity: 100 to 400 kg/h
- Power: 736 W
- Dimensions: 885 x 390 x 1169 mm (w x d x h)
- Weight approx.: 135 kg

**Additional information**
http://www.controls-group.com/eng/aggregates-testing-equipment/laboratory-crusher.php

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Fiac Air compressor</th>
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</tr>
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</tr>
<tr>
<td><strong>Photograph</strong></td>
<td><img src="image" alt="Fiac Air compressor" /></td>
</tr>
</tbody>
</table>

**Short description**  
Machine consists of compressor, tank for condensed air and dessicator.

**Main purpose**  
Supply of compressed air to other testing equipment in the laboratory.

**Technical specification**
- Engine power: 15 HS
- Tank capacity: 500 l
- Noise: 65 dB
- Dimensions (wxdxh): 2040 x 630 x 1430 mm
- Weight approx.: 390 kg
- Max. pressure: 13 bars

**Additional information**
http://www.fiac.it/wwwfiac/main.php?p=wi_pag08_b_01e

**Source of funding**  
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**  
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Trinocular microscope, Sole-Mark</th>
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<tbody>
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<td>Geotechnical laboratory</td>
</tr>
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<td>Equipment category</td>
<td>Other</td>
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</table>

Photograph

<table>
<thead>
<tr>
<th>Short description</th>
<th>Microscope with a digital camera and an USB cable. It can be used in combination with a computer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main purpose</td>
<td>Enlargment and analysis of small objects. The possibility of taking photographs using adapter and digital camera.</td>
</tr>
</tbody>
</table>
| Technical specification | - Digital camera: 5.5 MP  
                          - Zoom range: 0.67x – 4.5x (enlargment factor: 6.71:1)  
                          - Max. Enlargment: 45X  
                          - Base dimensions: 270x210x30 mm  
                          - Column dimensions: height 315 mm, diameter 32 mm  
                          - Weight: 4 kg |
<p>| Additional information | <a href="http://www.optikamicroscopes.com">http://www.optikamicroscopes.com</a> |
| Source of funding  | The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF). |
| Contacts           | Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (<a href="mailto:vedran.jagodnik@gradri.uniri.hr">vedran.jagodnik@gradri.uniri.hr</a>) |</p>
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Direct and residual shear testing machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
</tbody>
</table>

**Short description**
The device consists of electromotor, measuring cell, two LVDT and weights for vertical load.

**Main purpose**
Determination of shear strength of sands and fine grain materials.

**Technical specification**
- Test speed: from 0.00001 to 9.99999 mm/min
- Maximum shear force: 5000 N
- Maximum vertical load: 500 N or 5000 N using 10:1 cantilever device
- Maximum horizontal travel: 20 mm
- Digital display: LCD 4 rows of 20 symbols.
- Sample type size: 60 and 100 mm², 50; 60; 63.5 i 100 mm diametrically.
- Power supply: 110-220 V, 50-60 Hz, 1 ph , 100 W
- Dimensions: 953x387x1180 mm

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Oedometer, front loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Test device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Additional parts of the machine are: moulds for samples with all the parts (cap, ring, porous stone, screws), weights, LVDT for measuring vertical displacement and burette for measuring permeability coefficient.

**Main purpose**
Determination of compressibility of soil.

**Technical specification**
- Three hanger positions: 9:1, 10:1, 11:1
- Max. load (using 11:1 beam ratio): 1848 kg;
- Sample diameter: 50 mm;
- Overall dimensions: 500x200x750 mm;
- Weight approx.: 21 kg

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Compactor Proctor</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for sample preparation</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**  
Additional parts of the device are: rammer and two moulds for samples of diameter 100 and 150 mm.

**Main purpose**  
Determination of compaction and optimum moisture of materials.

**Technical specification**
- Main purposed for moulds of diameter 100-102 mm and 150-152,4 mm
- Rammer drop height: 300, 305, 450 i 457 mm
- Number of blows per minute: 30
- Power: 740 W
- Overall dimensions: 521x403x1438 mm
- Weight approx.: 140 kg

**Additional information**  

**Source of funding**  
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**  
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Multispeed press CBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring device</td>
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<tr>
<td>Photograph</td>
<td><img src="image_url" alt="Multispeed press CBR" /></td>
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</tbody>
</table>

**Short description**: Press used for CBR testing and determination of uniaxial strength of soil samples. It is used in combination with the Proctor rammer. It consists of adapters for CBR and uniaxial strength, LVDT, measuring cell and an USB for data transfer.

**Main purpose**: CBR (California Bearing Ratio) and uniaxial strength of soils.

**Technical specification**:
- Maximum capacity: 50 kN
- Test speed: from 0.05 to 51 mm/min or from 1 N/sec to 1000 N/sec
- Power: DC motor 750 W
- Sampling frequency: 50 Hz
- Horizontal clearance (distance between columns): 270 mm
- Maximum vertical clearance: 730 mm
- Platen travel: 100 mm
- Dimensions: 392x495x1213 mm


**Source of funding**: The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**: Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
## Instrument
GDS back pressured shear box

## Laboratory affiliation
Geotechnical laboratory

## Equipment category
Test device

### Photograph
![GDS back pressured shear box](image)

### Short description
Device consists of external hydraulic unit for controlling the pressure in the chamber, central control unit, servo pump for obtaining internal strain in the sample and bender elements.

### Main purpose
Determination of shear strength of soil in saturated and unsaturated conditions. Possibility of measuring very small strains (10E-5) while using bender elements.

### Technical specification
- Sample size: 100 x 100 mm
- Max. normal and shear stress: 10 kN
- Power supply: 110-240 V, 50-60 Hz, 1 ph
- Max. vertical displacement: 15 mm
- Max. horizontal displacement: 25 mm
- Dimensions (L x W): 850 x 350 mm

### Additional information

### Source of funding
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

### Contacts
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@grad.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Automatic oedometer ACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Automated Oedometer" /></td>
</tr>
</tbody>
</table>

### Short description
Additional parts of the device are: mould for sample with all the parts (cap, ring, porous stone, screws) and LVDT for measuring vertical displacement and burette for measuring permeability coefficient.

### Main purpose
Determination of compressibility of soil under automatic pressure control.

### Technical specification
- Maximum vertical force: 15 kN
- Displacement transducer: 10 mm maximum travel
- Maximum air pressure supply: 10 bar.
- Specimen size: diameter from 50.47 to 112.80 mm
- Measurement accuracy: ±1 %
- Overall dimensions: 280x300x600mm (w x d x h)
- Weight approx.: 25 kg

### Additional information

### Source of funding
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

### Contacts
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Triaxial apparatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Triaxial cell. Consists of: LVDT, measuring cell, pressure transducers. Triaxial cell can be changed depending on the sample size. Possibility of using benders and on-sample transducers.

**Main purpose**
Determination of strength of soils (fine-grained and coarse-grained) under triaxial state of stress.

**Technical specification**
- Soil sample size diameter: 38, 50, 70 and 100 mm
- Test speed: from 0.00001 to 99.99999 mm/min
- Maximum compression force: 50 kN
- Maximum tensile force: 5 kN
- Vertical clearance: from 335 to 1100 mm
- Max. horizontal clearance: 364 mm
- Platen diameter: 158 mm
- Platen travel: 100 mm

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@grad.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Triaxial cell for unsaturated soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Other</td>
</tr>
</tbody>
</table>

**Short description**
Triaxial cell with double walls and 25 kN measuring cell.

**Main purpose**
Research of unsaturated soil behavior.

**Technical specification**
- Soil sample diameter: 70 mm
- Maximum working pressure: 2000 kPa
- Maximum cell height: 690 mm
- Cell diameter (with valves): 478 mm
- Weight approx.: 30 kg
- Number of inlet ports: 6

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Resonant column</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Test device</td>
</tr>
</tbody>
</table>

| **Photograph**         | ![Resonant Column Photograph](image)                |

**Short description**: Device for testing resonant characteristics of fine grained soil. Pedastel for 50mm sample, LVDT, brass and steel calibration rod

**Main purpose**: Determination of small strain and soil resonance. Torsional shear test and torsional soil behaviour.

**Technical specification**:
- Maximum torque: 1.2 Nm
- Maximum angular deformation: 10°
- Maximum cell and back pressure: 1 MPa.
- Two electro-pneumatic converters for cell and back pressure
- Excitation frequency: Dynamic (RC) 1-300 Hz; Cyclic (TS) from 0 to 50 Hz maximum
- Dimension: Control Box 51x45 x 35 cm (h x w x d); Cell 55 cm x 27 cm (h x diam.)
- Weight: approx 50 kg


**Source of funding**: The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**: Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Dynamic cyclic triaxial system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Measuring device</td>
</tr>
</tbody>
</table>

**Short description**
Contains: cell for triaxial test with dynamical/cyclic load, LVDT, measuring cell and pressure transducers. Depending on the sample size, triaxial cell can be changed. Possibility of testing samples of diameter: 38, 50 and 70 mm. Can simulate earthquake accelerations.

**Main purpose**
Research of cyclic and dynamic soil characteristics under medium and large axial cyclic shear deformations.

**Technical specification**
- Dynamic load capacity: ±5 kN or ±14 kN
- Static load capacity: 50 kN or 100 kN
- Nominal operating frequency: to 10 Hz (depending on the type of test)
- Max. diameter sample: 150 mm
- Max. cell and back pressure: 1000 kPa

**Additional information**

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Continuous consolidation cell CRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
<tr>
<td>Short description</td>
<td>Inner cell contains sample, outer cell used for loading, ring for sample preparation, LVDT with pressure transducers.</td>
</tr>
<tr>
<td>Main purpose</td>
<td>Determination of soil compressibility under constant rate of strain.</td>
</tr>
</tbody>
</table>
| Technical specification | - Sample dimensions: 25.4 mm height x 63.5 mm diameter.  
                        | - Maximum pressure: 800 kPa  
                        | - Maximum load: 50 kN  
                        | - Dimensions: 240x410 mm (h)  
<pre><code>                    | - Weight approx.: 10 kg |
</code></pre>
<p>| Additional information | <a href="http://www.controls-group.com/eng/soil-mechanics-testing-equipment/continuous-consolidation-cell-crs.php">http://www.controls-group.com/eng/soil-mechanics-testing-equipment/continuous-consolidation-cell-crs.php</a> |
| Source of funding   | The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF). |
| Contacts            | Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (<a href="mailto:vedran.jagodnik@gradri.uniri.hr">vedran.jagodnik@gradri.uniri.hr</a>) |</p>
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Hydraulic oedometer, Hydrocon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Test device</td>
</tr>
</tbody>
</table>

**Photograph**

Cell used for measuring compressibility and retention curve. Contains ring for specimen preparation, LVDT and pressure transducers.

**Main purpose**

Determination of soil compressibility under saturated and unsaturated conditions. Possibility of water and air pressure control.

**Technical specification**

- Sample diameter: 100 mm
- Maximum working pressure: 3500 kPa
- Dimensions (diameter x h): 260x450 mm
- Weight approx.: 10 kg

**Additional information**


**Source of funding**

The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**

Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
**Instrument**  Large Shear apparatus  
**Laboratory affiliation**  Geotechnical laboratory  
**Equipment category**  Test device  

**Photograph**

<table>
<thead>
<tr>
<th><strong>Short description</strong></th>
<th>Machine used for direct shear of samples dimensions 30 x 30 cm. LVDT: horizontal and vertical, shear platen used for better grip sample.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main purpose</strong></td>
<td>Determination of shear strength of coarse-grained soil.</td>
</tr>
<tr>
<td><strong>Technical specification</strong></td>
<td></td>
</tr>
</tbody>
</table>
| ■ Sample size: 300 x 300 mm  
| ■ Shear and vertical force: 100 kN  
| ■ Test speed: from 0 to 11.00000 mm/min  
| ■ Maximum travel: 75 mm  
| ■ Steps of consolidation: up to 50  
| ■ Power: 2000 W  
| ■ Overall dimensions (wxdxh): 1470x758x1570 mm  
<p>| ■ Weight approx.: 800 kg  |
| <strong>Additional information</strong> | <a href="http://www.controls-group.com/eng/soil-mechanics-testing-equipment/large-shear-testing-machine.php">http://www.controls-group.com/eng/soil-mechanics-testing-equipment/large-shear-testing-machine.php</a> |
| <strong>Source of funding</strong> | The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF). |
| <strong>Contacts</strong> | Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (<a href="mailto:vedran.jagodnik@gradri.uniri.hr">vedran.jagodnik@gradri.uniri.hr</a>) |</p>
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Universal press for rock testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**

Hydraulic unit, triaxial cell, sample stand, sample deformation gauges, uniaxial strength and tensile strength adapters.

**Main purpose**

Determination of uniaxial, triaxial and tensile strengths of rocks.

**Technical specification**

- Maximum load: 2000 kN
- Sample size diameters: 57, 82 and 102 mm
- Piston stroke: 50 mm
- Distance between columns: 400 mm
- Dimensions of upper and lower pressure plate: 320x420x75 mm
- Overall dimensions: 2700x1900x2670 (h) mm
- Power supply: 2,5 kVA 50 Hz 3x400+N+PE
- Weight: 11000 kg

**Additional information**

http://www.formtest.de/en/

**Source of funding**

The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**

Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Jaws for testing tensile strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Geotechnical laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image-url" alt="Image of the device" /></td>
</tr>
</tbody>
</table>

**Short description**
The device consists of two parts, one comprising a movable part on the spring. The entire device is placed under the rock press.

**Main purpose**
Determination of tensile strength of rocks. Used in the combination with Universal press for rock testing (I/N 4986)

**Additional information**
http://www.formtest.de/en/

**Source of funding**
The equipment has been procured within the framework of the Project “The Development of Research Infrastructure at the University of Rijeka Campus”, co-financed by the European Regional Development Fund (ERDF).

**Contacts**
Doc.dr.sc. Vedran Jagodnik, mag.ing.aedif (vedran.jagodnik@gradri.uniri.hr)
EQUIPMENT OF THE LABORATORY OF TRANSPORTATION ENGINEERING
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Controls water bath</th>
</tr>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for conditioning specimens</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Circulating water bath with digital termoregulator.

**Main purpose**
Conditioning of specimens before testing.

**Technical specification**
- Capacity 110 litres,
- Temperature range: ambient to testing to 95 °C,
- Resolution 0,1 °C,
- Accuracy ±0,5 °C,
- Continuous recirculation.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Inko water bath</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for conditioning specimens</td>
</tr>
<tr>
<td>Photograph</td>
<td></td>
</tr>
</tbody>
</table>

**Short description**  Circulating water bath with digital termoregulator..

**Main purpose**  Conditioning of specimens before testing.

**Technical specification**
- Capacity 160 litres,
- Resolution 0.1 °C,
- Continuous recirculation,
- Connection to water supply system for cooling.

**Additional information**  [http://inko.hr/hr/home](http://inko.hr/hr/home)

**Source of funding**  “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**  Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Alfametal mixer LM-75 with electrical heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for preparation</td>
</tr>
</tbody>
</table>

**Short description**  
Mixer with heaters for heating material.

**Main purpose**  
Laboratory preparation bitumen mixes conforming HRN EN 12697-35.

**Technical specification**  
- Mixer volume 75 litres,
- Mixer capacity 30 litres,
- Minimal capacity 6 litres,
- Mixing speed 56 rpm.

**Additional information**  
http://www.alfametal.hr/

**Source of funding**  
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**  
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Memmert laboratory oven UF260, glass door</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for conditioning specimens</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description** Ventilating laboratory oven with glass door.

**Main purpose** Drying and conditioning of samples.

**Technical specification**
- Volume 256 litres,
- Temperature range +10 °C to 300 °C,
- Ventilation regulation in 10 steps,
- Adjustment of pre-heated fresh air admixture by air flap control in 10 steps,
- Two stainless steel grids,
- Glass door.

**Additional information**

**Source of funding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts** Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Memmert laboratory oven UF260</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for conditioning specimens</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Memmert laboratory oven UF260" /></td>
</tr>
</tbody>
</table>

**Short description** Ventilating laboratory oven.

**Main purpose** Drying and conditioning of samples.

**Technical specification**
- Volume 256 litres,
- Temperature range + 10 °C to 300 °C,
- Ventilation regulation in 10 steps,
- Adjustment of pre-heated fresh air admixture by air flap control in 10 steps,
- Two stainless steel grids.


**Source of funding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts** Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Memmert compressor cooled incubator ICP110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for conditioning specimens</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="Memmert compressor cooled incubator ICP110" /></td>
</tr>
</tbody>
</table>

**Short description**
Movable conditioning chamber with four locable castors.

**Main purpose**
Conditioning of samples.

**Technical specification**
- Volume 108 litres,
- Working temperature range -12 °C to 60 °C,
- Adjustment of pre-heated fresh air admixture by air flap control in 10 steps,
- Two stainless steel grids.

**Additional information**
https://www.memmert.com/products/incubators/compressor-cooled-incubator/ICP110/

**Source of funding**
"Research Infrastructure for Campus-based Laboratories at the University of Rijeka" project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
**Instrument**
Trailer mounted falling weight deflectometer-GRONTMIJ Primax 1500

**Laboratory affiliation**
Laboratory for transportation engineering

**Equipment category**
Measuring device

**Short description**
Trailer mounted mobile device for deflection measurement. On board generator for power supply. PC computer for data collection programme.

**Main purpose**
Measuring pavement deflection with impact loading.

**Technical specification**
- Load range to 150 kN,
- Beam with 9 geophones,
- Temperature sensors (air, pavement surface, pavement layers),
- PC computer with data collection software.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
Instrument: Lightweight deflectometer
Laboratory affiliation: Laboratory for transportation engineering
Equipment category: Measuring device

Short description: Portable device for deflection measurement. Loading plate 100 and 300 mm diameter. One integrated and two additional geophones. Device for wireless data acquisition system.

Main purpose: Deflection measurement of in situ materials.

Technical specification:
- Drop weight 10 kg,
- Additional drop weight 5 kg,
- Automatic data collection integrated in measuring device,
- Wireless and cable transfer of stored data.

Additional information: http://www.pavement-consultants.com/media/5691/PRIMA100_LWD__product_sheet_.pdf

Source of funding: "Research Infrastructure for Campus-based Laboratories at the University of Rijeka" project financed by ERDF

Contacts: Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>PC controlled gyratory compactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Device for sample preparation</td>
</tr>
</tbody>
</table>

**Photograph**

*Gyratory compactor for preparation of samples in cylindrical mould 100 and 150 mm dia. Electrical extruder.*

**Short description**

Gyratory compactor for preparation of samples in cylindrical mould 100 and 150 mm dia. Electrical extruder.

**Main purpose**

Sample preparation according to HRN EN 12697-31.

**Technical specification**

- Internal angle of gyration adjustable from 0 to 3°,
- Internal angle of gyration preset to 0,82°,
- Measuring shear resistance during compaction.

**Additional information**

http://www.controls-group.com/eng/asphaltbituminous-mixture-testing-equipment/pavelab-gyrocomp-research-gyratory-compactor.ph

**Source of funding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**

Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Automatic electro mechanical slab compactor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Device for sample preparation</td>
</tr>
<tr>
<td><strong>Photograph</strong></td>
<td><img src="image" alt="Slab compactor for sample preparation" /></td>
</tr>
</tbody>
</table>

**Short description** Slab compactor for sample preparation.

**Main purpose** Sample preparation according to HRN EN 12697-33.

**Technical specification**
- Vertical force to 30 kN,
- Vertical force control to 30 kN and trolley speed up to 10 cycles in minute.

**Additional information**

**Source of funding** “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts** Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Automatic electro-mechanical compression tester min. capacity 50 kN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Testing device</td>
</tr>
<tr>
<td><strong>Photograph</strong></td>
<td><img src="image" alt="Compression Tester" /></td>
</tr>
</tbody>
</table>

**Short description**  
Compression tester with load cells of 2.5 and 50 kN. Test set for stability and indirect tensile test.

**Main purpose**  
Testing samples according to HRN EN 12697-23 and HRN EN 12697-34.

**Technical specification**  
- Test speed from 0.1 to 50 mm/min,
- Two testing load cells 2.5 kN and 50 kN,
- Data storage in MS Office.

**Additional information**  

**Source of funding**  
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**  
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Double wheel tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Testing device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Device for testing plastic deformations (rutting) of asphalt pavements. Moulds for testing samples prepared by slab compactor, gyratory compactor and field drilled pavement specimens.

**Main purpose**
Testing samples according to HRN EN 12697-22 procedure B.

**Technical specification**
- Testing temperature from ambient to 70 °C,
- Possibility for testing in water,
- Data storage in MS Office.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Dynamic device for asphalt stiffness and fatigue testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Testing device</td>
</tr>
</tbody>
</table>

**Photograph**

Dynamic device for asphalt stiffness and fatigue testing. Moulds for fatigue and stiffness testing on cylindrical and prismatic samples. PC with monitor.

**Main purpose**

Testing samples according to HRN EN 12697-24 and HRN EN 12697-26

**Technical specification**

- Testing temperature adjustable from -25 to 60 °C,
- Servo-hydraulic frame capacity to 30 kN,
- Dimensions of prismatic samples to 70x70x400,
- Diameter of cylindrical samples 100 or 150 mm.

**Additional information**


**Source of funding**

“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**

Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
**Instrument**
Laser profiler- beam with 5 laser measurement sensors ARRB
HAWKEYE 2000

**Laboratory affiliation**
Laboratory for transportation engineering

**Equipment category**
Testing device

**Photograph**
![Photograph of the equipment]

**Short description**
Five laser measurement sensors with accelerometer on a front mounted beam.

**Main purpose**
Testing of longitudinal road profile, rut depth, and pavement surface texture (macrotecture).

**Technical specification**
- Adjustable recording rate,
- Survey speed from 20 km/h to 110 km/h,
- Longitudinal profile accuracy ±0,5 mm,
- Transverse profile accuracy ±0,5 mm,
- Operating temperature from 0 to 40 °C.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Digital imaging system ARRB HAWKEYE 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
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<td>Testing device</td>
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<tr>
<td>Photograph</td>
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</tbody>
</table>

**Short description**
Video camera in waterproof enclosure connected with laser profiler measurement system.

**Main purpose**
Imaging captures during laser profile measurement to enable accurate inventory recording, condition and measurement.

**Technical specification**
- Lens type 3.8 mm to 13 mm,
- 3x optical zoom,
- Angle of view from 80 to 28°,
- Resolution 1600x1200 pixels,
- Picture size 1600x1184 pixels.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>GPS system ARRB HAWKEYE 2000</th>
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<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Testing device</td>
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</tbody>
</table>

**Photograph**

Short description: GPS antenna integrated with GPS Acquire Manager system.

Main purpose: Recording GPS positions during laser profile measurement to enable the referencing measurement data against GPS coordinates.

Technical specification:
- High performance receivers tracks up to 12 satellites,
- Operating temperature from -30 to 85 °C,
- Acquisition speed 15 sec (hot weather), 45 sec (cold weather),
- Accuracy 5 m,
- Format NMEA 0183 version 2.0 ASCII.


Source of funding: “Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

Contacts: Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>PC with data acquisition software “Onlooker live” and office based analysis software “Processing toolkit”</th>
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<td><strong>Laboratory affiliation</strong></td>
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<tr>
<td><strong>Equipment category</strong></td>
<td>PC for data processing and analysis</td>
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<td><strong>Photograph</strong></td>
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</table>

**Short description**
PC with own power supply. Software package for collection data (Onlooker Live) and processing and analysis of data (Processing Toolkit).

**Main purpose**
Data acquisition during measurement and processing and analysis of measurement data from laser profiler.

**Technical specification**
- Data processing according to: World Bank Technical Paper 46-Class1, ISO 13473, TRL Lab Rep. 639, AASHTO PP37, AASHTO PP38.

**Additional information**

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.grad. / marijana.cuculic@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>GEORADAR-IDS RIS-HI PAVE-PC computer with application</th>
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</thead>
<tbody>
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<td>Laboratory affiliation</td>
<td>Laboratory for transportation engineering</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Testing device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
Antenna 2 GHz and dual frequency antenna 400-900 MHz. High speed survey wheel for distance measurement, mechanical frame to install system on vehicle and PC for data acquisition.

**Main purpose**
Ground Penetrating Radar for non destructive imaging of pavement layers

**Technical specification**
- Acquisition speed to 130 km/h,
- High speed survey wheel for distance measurement,
- PC for data acquisition,
- Multi channel control unit DAD MCH Fast-Wave.

**Additional information**
http://idsgeoradar.com/products/ground-penetrating-radar/ris-hi-pave

**Source of funding**
“Research Infrastructure for Campus-based Laboratories at the University of Rijeka” project financed by ERDF

**Contacts**
Marijana Cuculić, dipl.ing.građ. / marijana.cuculic@gradri.uniri.hr
EQUIPMENT OF THE HYDRAULIC LABORATORY
<table>
<thead>
<tr>
<th>Instrument</th>
<th>3D printer</th>
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<tbody>
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<td>Laboratory affiliation</td>
<td>Hydraulic laboratory</td>
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<tr>
<td>Equipment category</td>
<td>Samples preparation device, production device</td>
</tr>
<tr>
<td>Photograph</td>
<td><img src="image" alt="3D printer Stratasys Connex 500" /></td>
</tr>
</tbody>
</table>

**Short description**
- 3D printer Stratasys Connex 500
- Desktop computer Lenovo ThinkCentre
- LCD LG 22M45, 2 pieces
- UPS Riello Sentinel Pro
- High pressure water cleaning apparatus for 3D models - Krumm

**Main purpose**
- 3D printing of physical models

**Technical specification**
- Printing area 500 x 400 x 200 mm
- PolyJet technology
- The option of printing several different materials, 14 combination of materials within a single model
- Resolution 600 DPI by XY, layer thickness 0.016 mm - 0.03 mm

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Experimental flume – GUNT HM-162</th>
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<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Hydraulic laboratory</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Test device, measuring device</td>
</tr>
</tbody>
</table>

**Photograph**

![Experimental Flume GUNT HM-162](image)

**Short description**
- Experimental groove
- Monochromatic wave generator
- Pump for sediment transport
- 50 piezometers
- 10 thermometer range 0-50°C
- 4 moving carrier for measuring converters

**Main purpose**
Hydraulic testing of hydraulic structures and hydraulic processes

**Technical specification**
- Cross section: 309 x 450 mm
- Length: 12.5 m
- Tilt range -0.5… + 2.5%
- Maximum flow: 132 m³/h
- Electromagnetic flow meter
- All parameters are controlled by computer

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
Experimental pool with wave generator

Hydraulic laboratory

Test device, measuring device

Experimental pool with a wave generator for testing of physical models of naval construction and deformation of waves. The experimental pool offers also the possibility of modeling ocean currents.

To study the interaction of water eaves and floating structures.

600 x 300 x 40 cm
6 blades with backwash sensors with the ability to generate rhythmic and nonrhythmic waves parallel to the generator or angled
Control of the wavelength generator by computer and specification of different spectrum of waves
The ability to model monochromatic waves to height of 0.25 m

http://www4.edesign.co.uk/

The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Pump (2 items)</th>
</tr>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
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<td>Measuring device</td>
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<td>Photograph</td>
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</table>

**Short description**
Pump with non-contact flowmeter and multi-parameter interface that defines pump dynamics. All pump operation parameters are controlled by the computer.

**Main purpose**
The pump is used for water circulation in experiments carried out in the laboratory.

**Technical specification**
- Flowrate range 9-21 m³/h
- Management of pump and meter data via computer
- The increment of flow changes 0.1 l/min

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
| **Instrument** | Wind tunnel |
| **Laboratory affiliation** | Hydraulic laboratory |
| **Equipment category** | Test device, measuring device |

**Photograph**

**Short description**
Wind tunnel for testing aerodynamic characteristics of different physical models.

**Main purpose**
The wind tunnel is used to define the pressure fields over physical models in the test chamber. Data acquisition for velocity and pressure is conducted continuously on a computer.

**Technical specification**
- Dimensions of the test chamber (width × height × length): 305 mm x 305 mm x 600 mm
- Air speed: 0 to 40 m/s
- Bus with 32 connecting places
- 32 channels for pressure measurement
- Scales for the measurement of lift and drag
- Equipped with a variety of physical demonstration models
- Visualization of the flow through the smoke generator

**Additional information**
https://www.tecquipment.com/subsonic-wind-tunnel

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
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<table>
<thead>
<tr>
<th>Instrument</th>
<th>Chamber for advanced hydrological studies</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Hydraulic laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Test device, measuring device</td>
</tr>
</tbody>
</table>

**Photograph**

The advanced hydrological test chamber is equipped with 8 nozzles that can be used to model various hydrological conditions.

**Main purpose**

The chamber has a sloping bottom and can be used to analyze surface erosion. It is equipped with two flow meters and the rainfall simulation nozzles are controlled by the computer so different rainfall conditions.

**Technical specification**

- 8 nozzles into 4 groups by two jets
- The flow through the nozzle 1-4,7 L/min
- Maximum flow through pumps 1500 L/h
- The water tank capacity 220 L
- 19 meters: 300 mm WC
- Dimensions: L x W x H: 2300 x 1100 x 1950 mm

**Additional information**


**Source of funding**

The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**

Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th><strong>Instrument</strong></th>
<th>Vectrino profiler</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laboratory affiliation</strong></td>
<td>Vectrino profiler</td>
</tr>
<tr>
<td><strong>Equipment category</strong></td>
<td>Vectrino profiler</td>
</tr>
</tbody>
</table>

**Short description**
Vectrino profiler is used for measurement the velocity vector along a water column with length between of 0.5 m to 3 cm.

**Main purpose**
Vectrino profiler can be used in a laboratory environment, but also in-situ.

**Technical specification**
- Speed range: increment of 0.1 m/s to maximum 3.0 m/s
- Adaptive ping interval: once, once per second up to 1 / h
- Accuracy: ± 1% measured ± 1 mm/s
- Sampling time: 1-100 Hz
- The minimum/maximum range: 20 mm up to 2 m
- Embedded temperature sensor ranges from -4 °C to 32 °C
- Resolution of the thermo sensor: 1 °C / 0.1 °C

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
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<table>
<thead>
<tr>
<th>Instrument</th>
<th>Vectrino (4 pieces)</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Hydraulic laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring device</td>
</tr>
</tbody>
</table>

**Short description**
The instrument is used to measure the velocity vector at a point in the flow space. The instrument works on the basis of ultrasonic technology, thereby significantly reducing the interaction with the measured field.

**Main purpose**
The measuring transducer can be used in a lab environment, but also in-situ.

**Technical specification**
- Speed range: increment of 0.1 m/s to a maximum of 3.0 m/s
- Adaptive ping interval: once, once a second to 1/h
- Accuracy: ± 1% of measured value ± 1 mm/s
- Sampling time: 1-100 Hz

**Additional information**

**Source of funding**
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**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Aquadopp profiler – ADCP 2MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Hydraulic laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring device</td>
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</tbody>
</table>

**Photograph**

- ADCP allows measurements of characteristics of sea currents.
- Intended for oceanography in shallow waters, < 100 m. It is used for monitoring port, research in rivers and lakes.

**Technical specification**
- Operating frequency: 2.0 MHz
- Range of measured profile: 4-10 m
- Number of rays: 3
- Maximum sampling speed 1Hz
- Sensors: temperature -4 °C to 30 °C, magnetometer (compass), pressure gauge 0-100 m

**Additional information**

**Source of funding**
- The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
- Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>AWAC - 1MHz (2 pieces)</th>
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<td>Measuring device</td>
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<td>Photograph</td>
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</tbody>
</table>

**Short description**
Acoustic Waves and Currents (AWAC) is used for measuring the flow characteristics of sea currents and waves at depths up to 10 m.

**Main purpose**
The equipment is intended for in-situ studies of sea currents and waves.

**Technical specification**
- Operating frequency: 1 MHz
- Range of measured profile: 4-10 m
- Number of rays: 4
- Modes: either alone or “online monitoring”
- Recording water currents: to 30 m
- Recording of waves: maximum depth 35 m (1 MHz)

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
<thead>
<tr>
<th>Instrument</th>
<th>StreamPro ADCP - Compass</th>
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<tbody>
<tr>
<td>Laboratory affiliation</td>
<td>Hydraulic laboratory</td>
</tr>
<tr>
<td>Equipment category</td>
<td>Measuring device</td>
</tr>
</tbody>
</table>

**Photograph**

**Short description**
ADCP is designed for surface recording of flow characteristics in rivers and lakes.

**Main purpose**
The device is used to obtain the kinematic and geometric characteristics of the flow in rivers and lakes.

**Technical specification**
- Frequency: 2 MHz
- Measure the speed of the water to 3 m/s
- Accuracy: +/- 1%
- Resolution: 0.5 cm/s
- The maximum number of cells by depth: 128
- The size of the load cells: 7-150 mm

**Additional information**

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr
<table>
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<td>Hydraulic laboratory</td>
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<tr>
<td>Equipment category</td>
<td>Measuring device</td>
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</tbody>
</table>

**Short description**
The synchronized high-speed camera and laser assembly allows the reconstruction of the flow field in a flow plane.

**Main purpose**
The equipment offers the possibility of reconstructing the velocity field and all relevant kinematic flow parameters in the same plane (vorticity, circulation, turbulence intensity,..)

**Technical specification**
- Camera: ImagerLX
- Laser: Shuttered CW Laser
- Timing Unit: PTU 9 (Programmable Timing Unit)
- Optics: Sheet Optics (divergent)
- Software: FlowMaster

**Additional information**
http://www.lavision.de/en/techniques/piv-ptv/

**Source of funding**
The development of research infrastructure on the Campus of the University of Rijeka (EFRR)

**Contacts**
Assoc. Prof. dr. sc. Vanja Travaš / vanja.travas@gradri.uniri.hr