



# CITADELS

## TESTBED DESCRIPTION

Cultivating Industry 5.0 Talents: Academia-industry collaboration and empowerment through accessible DEep technoLogieS

Project acronym:	CITADELS
Project topic:	HORIZON-WIDERA-2024-TALENTS-03-01
Project number:	101217281
Type of action:	HORIZON-CSA
Project starting date:	1 September 2025
Project duration:	48 months
Dissemination level	PU

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# 1 EX-TRACK<sup>®</sup> CNC Cutting System

TestBed title	EX-TRACK <sup>®</sup> CNC Cutting System
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## 1.1 Short summary

The EX-TRACK<sup>®</sup> CNC Cutting TestBed is a compact, portable system designed to enable experimentation, validation, and deployment of advanced metal cutting processes using both plasma and oxy-fuel technologies. It integrates precision CNC motion control, automated torch-height regulation based on arc-voltage sensing, and a dual-process cutting capability within a single, user-friendly digital platform, supporting accurate and repeatable cutting of a wide range of metal materials. The TestBed provides a flexible and accessible environment for testing cutting parameters, process optimisation, and material behaviour under realistic industrial conditions, supporting Technology Readiness Levels (TRL) 3–7. It enables rapid Proof-of-Concept validation and hands-on experimentation for DeepTech applications in digital manufacturing, automation, and smart fabrication. Aligned with Industry 5.0 principles, the EX-TRACK<sup>®</sup> TestBed promotes human-centric operation, portability, and efficient resource use, while enhancing precision and reducing material waste. Within the CITADELS framework, it offers an accessible infrastructure for SMEs, researchers, and educators to develop, test, and demonstrate advanced manufacturing solutions.

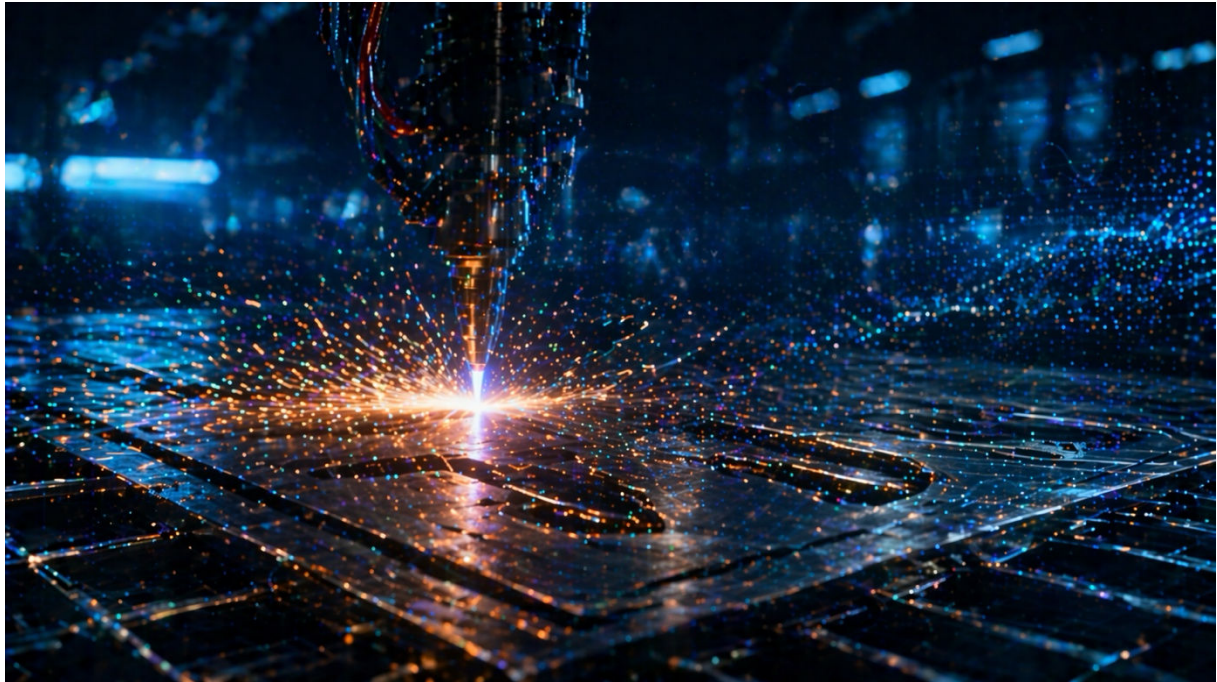
Principal Investigator Name	Goran Rajnar
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Phone No.	+386 51 208 118
ORCID persistent identifier (PID)	N/A
TestBed Responsible Name (if different from PI)	N/A
Funding source(s) for TestBed's acquisition	ABICOR BINZEL Varilna Tehnika d.o.o.
Relevant Keywords	CNC cutting, plasma cutting, oxy-fuel cutting, digital manufacturing, industrial automation, metal processing

## 1.2 Hosting Institution

Name of Host Organization	ABICOR BINZEL Varilna Tehnika d.o.o.
Department or Lab	N/A
Name of Building	Pomurje Technology Park
Physical Address	Plese 9A, 9000 Murska Sobota, Slovenia
Website Links	<a href="https://binzel-abicor.com/SI/slv/">https://binzel-abicor.com/SI/slv/</a>
Institutional contact name	Goran Rajnar
Institutional contact email	goran.rajnar@binzel-abicor.si

### 1.3 Photos/videos

Main photo:



Links:






- <https://youtu.be/wvA8Po0eXsI?si=6vCljdOM9ghl8mIS>

### 1.4 DeepTech Area and Application Domain

DeepTech Area	Check all that apply	Check ONE main area
Extended Reality	<input type="checkbox"/>	
Robotics	<input type="checkbox"/>	
Artificial Intelligence	<input type="checkbox"/>	
Human Machine Interfaces	<input type="checkbox"/>	
Biotechnology	<input type="checkbox"/>	
Other: Industrial Automation, Digital Manufacturing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

The TestBed focuses on CNC-based metal cutting processes, integrating automated motion control with plasma and oxy-fuel cutting technologies. It enables precise and repeatable cutting operations through a digitally controlled system with automated torch-height regulation based on arc-voltage sensing. The system demonstrates key aspects of digital manufacturing by supporting programmable workflows, process optimisation, and consistent cutting quality across different materials and thicknesses. It provides a controlled environment for experimentation with cutting parameters, material behaviour, and process efficiency. Within Industry 5.0 contexts, the TestBed supports

supervised and controlled operation, combining automation with operator involvement to ensure safe and efficient use of advanced manufacturing technologies. It is suitable for training, research, and Proof-of-Concept activities in modern industrial environments.

Application Domain	Check all that apply
Manufacturing 	✓
Healthcare 	<input type="checkbox"/>
Logistics 	<input type="checkbox"/>
Agriculture 	<input type="checkbox"/>
Maintenance & inspection 	<input type="checkbox"/>
Other	<input type="checkbox"/>

### 1.5 Potential Stakeholders and Exploitation Scenarios

Non-academic stakeholders	
Industrial Partners	✓
SMEs	✓
Startups	✓
Government Bodies	<input type="checkbox"/>
Professional Associations	<input type="checkbox"/>
Community	<input type="checkbox"/>
Others 1 (comma-separated)	<input type="checkbox"/>
Academic stakeholders	
Undergraduate students	✓
MSc students	✓
PhD students	✓

Researchers	✓
Others 2 (comma-separated)	
Other types of stakeholders	
Others 3 (comma-separated)	

	Check all that apply	Short notes (optional)
Internal academic research	<input type="checkbox"/>	
Collaborative research with external academic partners	✓	
Contract research / Proof-of-Concept for industry	✓	
Pilot / DeepTech Deployment in operational environment	✓	
Training services (courses, workshops, certification)	✓	
Service provision (testing, benchmarking, validation)	✓	
Open access for walk-in users (e.g. open days / hackathons)	<input type="checkbox"/>	
Other (specify): _____	<input type="checkbox"/>	

## 1.6 Formal Access Conditions

Type of partner asking for access	Type of contractual relationship	Check all that apply
Academic partners	No contract (direct access)	<input type="checkbox"/>
	Direct contract between parties (e.g., research agreement)	✓
	Indirect contract between parties (e.g., project framework)	✓
	Other / Describe	<input type="checkbox"/>
Industrial	No contract (direct access)	<input type="checkbox"/>
	Direct contract between parties (e.g., research agreement)	✓
	Indirect contract between parties (e.g., project framework)	✓
	Other / Describe	<input type="checkbox"/>

Type of prerequisites	Description of prerequisites	Check all that apply
Agreements	Confidentiality agreement for proprietary algorithms	<input type="checkbox"/>
	Data sharing agreement for datasets generated	✓
	IP agreements	✓
	Other / Describe	<input type="checkbox"/>
Insurance	Users must have appropriate liability coverage through their home institution	✓
	Other / Describe	<input type="checkbox"/>

## 1.7 Training and Safety

Mandatory technical training	Mandatory technical training includes basic CNC system operation, as well as practical understanding of plasma cutting and oxy-fuel cutting processes.
Recommended technical training	Recommended technical training includes familiarity with cutting parameters and basic knowledge of metal processing and material behaviour.
Mandatory safety requirements	Mandatory safety requirements include the use of appropriate personal protective equipment (flame-resistant clothing, gloves, and eye protection), compliance with industrial safety protocols for plasma and oxy-fuel cutting, operation under supervision, and adherence to laboratory safety procedures. Users must also be familiar with built-in safety mechanisms, such as emergency stop and crash sensor systems. All activities must comply with the EU Machinery Directive 2006/42/EC and relevant occupational health standards.

## 1.8 Technical description

Hardware	<ul style="list-style-type: none"> <li>EX-TRACK® CNC Cutting System: Dual-mode CNC cutting system integrating plasma and oxy-fuel technologies for automated metal cutting applications.</li> </ul>
	<ul style="list-style-type: none"> <li>Motion system: Dual linear guide rails with rack-and-pinion drives enabling precise and stable movement across the working area.</li> </ul>
	<ul style="list-style-type: none"> <li>Motorized torch lifter: Vertical axis system with 100 mm stroke for automated torch positioning and height adjustment.</li> </ul>
	<ul style="list-style-type: none"> <li>Arc-voltage height control system: Automatic torch height regulation based on arc voltage sensing, ensuring optimal cutting distance and precision.</li> </ul>
	<ul style="list-style-type: none"> <li>Digital CNC control unit: Integrated control system with user interface for real-time monitoring, parameter setup, and process control.</li> </ul>
	<ul style="list-style-type: none"> <li>Cutting area: 3050 × 1525 mm (10 × 5 ft) working surface for processing medium-sized metal sheets.</li> </ul>
	<ul style="list-style-type: none"> <li>Max. positioning speed: 3000 mm/min (118 IPM) for controlled movement during cutting operations.</li> </ul>
	<ul style="list-style-type: none"> <li>Power supply: Input voltage 230 V / 120 V, 50–60 Hz, 180 W, 0.5 A.</li> </ul>
	<ul style="list-style-type: none"> <li>Cutting capabilities: Oxy-fuel cutting up to 100 mm thickness Plasma cutting up to 35mm thickness</li> </ul>
	<ul style="list-style-type: none"> <li>Safety and auxiliary systems: Integrated crash sensor, plasma interface, and automated control features supporting safe and stable operation.</li> </ul>
<ul style="list-style-type: none"> <li>System weight: 145 kg</li> </ul>	

Software needed to run the TestBed	<ul style="list-style-type: none"> <li>• Embedded CNC control software: Integrated digital control interface for machine operation, parameter configuration, and real-time process monitoring.</li> </ul>
Standards that apply	<ul style="list-style-type: none"> <li>• The system is designed in accordance with applicable safety requirements for industrial machinery, including the EU Machinery Directive 2006/42/EC. In addition, operation complies with relevant occupational health and safety regulations for thermal cutting processes involving plasma and oxy-fuel technologies, ensuring safe and controlled operation in industrial and laboratory environments.</li> </ul>

### 1.9 Existing Software Assets (i.e. in GitHub)

Link:	Short description:
N/A	<p>The EX-TRACK® system operates on a proprietary CNC control software platform that governs all cutting operations and motion sequences. The software environment supports nesting optimisation, path simulation, and toolpath preparation through integration with external CAD/CAM software (e.g. FastCAM, AutoCAD, SheetCAM), which are used for design and program generation. It supports execution of NC/G-code-like programs, ensuring compatibility with commonly used CAD/CAM workflows. Process monitoring is available through the machine interface, including selected parameters such as arc voltage and positional data for basic analysis and optimisation. The system does not provide a public code repository (e.g. GitHub), as it is based on proprietary embedded control software and external commercial CAD/CAM tools.</p>

### 1.10 TestBed documentation

Type	Short description:	Name and source (link):
Documentation	Official product page with technical specifications, system description	EX-TRACK®CNC CUTTING SYSTEM, <a href="https://ex-track.com/ex-track-cnc-cutting-system/">https://ex-track.com/ex-track-cnc-cutting-system/</a>

### 1.11 Application cases

Application case:	Short description:	Photo of the Application case
CNC operator training and process control	Hands-on training in CNC cutting processes, including programming logic, machine calibration, and real-time process monitoring in a controlled environment.	N/A

Validation of cutting parameters and materials	Experimental validation of new materials and optimization of cutting parameters, including comparative studies of plasma and oxy-fuel cutting efficiency.	N/A
Proof-of-Concept for process optimisation	Development and testing of process improvements, including evaluation of cutting repeatability under variable operating conditions.	N/A
Educational and academic use	Use of the TestBed in workshops and practical exercises to support learning in CNC programming, digital manufacturing, and process understanding.	N/A
Demonstration and technology transfer	Use of the portable and self-contained system for on-site demonstrations at partner institutions or industry events, supporting knowledge transfer and awareness of advanced manufacturing technologies.	N/A

Possible TRL application range	TRL4	<input type="checkbox"/>
	TRL5	<input type="checkbox"/>
	TRL6	<input type="checkbox"/>
	TRL7	<input type="checkbox"/>
	TRL8	<input checked="" type="checkbox"/>

### 1.12 Funding source

Funding source acknowledgements
ABICOR BINZEL Varilna Tehnika d.o.o.

### 1.13 Ethical and societal aspects

Ethical and societal aspect:	Short description:
Societal aspect	From a societal perspective, the TestBed contributes to improved worker safety by supporting safer operation of cutting processes. The system supports supervised and controlled operation through structured training and monitored use.
Ethical aspect	No personal or sensitive data are processed during normal operation. In cases where training sessions are recorded for educational purposes, recordings are carried out only with participant consent and in accordance with applicable data protection principles.