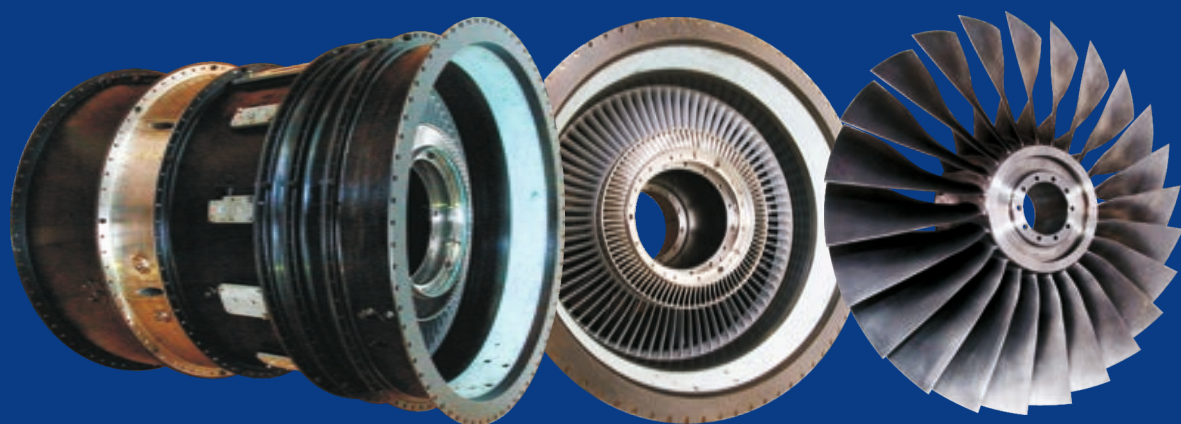




COMOTI
ROMANIAN RESEARCH &
DEVELOPMENT INSTITUTE FOR
GAS TURBINES



A E R O S P A C E
ENERGY &
SAVING ENERGY
ENVIRONMENT
DEFENSE



The only specialized company that integrates
such activities as

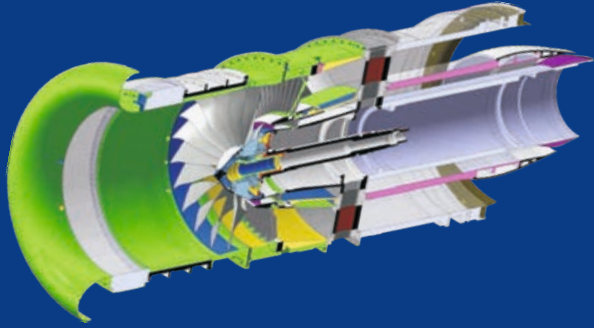
scientific research,
design,
manufacturing,
testing,
experimental activities,
technologic transfer and
innovation

in the field of aircraft, space and industrial gas
turbines and
high speed bladed machinery.

IMPORTANT MILESTONES

- 2025** Naval propulsion groups for Fast Patrol Missile Boat homologated. Solution implementation begin.
- 2023** New R&D project to develop another solution for naval propulsion dedicated to fast speed boats missile carrier.
Already 4 naval propulsion groups in service on board of Romanian frigates.
- 2021** 1st Naval propulsion group delivered.
- 2019** TURBONAV project completed. New naval propulsion system homologated.
Horizon 2020 - CLEAN SKY 2 - AIRSEAL project (Airflow characterisation through rotating labyrinth seal).
- 2018** SCOUT - 1st involving ESA financed project dedicated to Ariane 6 program - National flag on rocket body.
- 2016** Re-launch activity for the defense industry.
- 2015** MAN Diesel & Turbo Starting collaboration.
- 2014** 1st Project Coordinated EC FP7 Aviation R&D Program - TIDE.
GHH RAND – new 4 years License Agreement.
- 2013** EC FP7 1st Aviation R&D Program - OPENAIR.
Manufacturing of FIRST COMPOSITE GUIDES VANE BLADE.
- 2012** ESA – 1st Space Project. HP Compressor – up to 45 bara.
ARIANE V. EXPANDER GROUP Electric Generator.
- 2011** CLEAN SKY – 1st Project ELTESTSYS.
Test Bench Drive System.
- 2009** New Test Bench for Gas Turbines.
- 2008** Screw Compressor Packages - 100 units delivered.
- 2003** EC FP6 1st Aviation R&D Program - VITAL.
- 2001** RESTART AVIATION R&D ACTIVITY.
EC FP5 1st Aviation R&D Program - SILENCE(R).
- 2000** C0-Generation Plant in RO, Suplacu de Barcău – collaboration with PRATT & WHITNEY.
1st C0-Generation Plant in RO, Botoșani - AI 20 aviation engine.
- 1998** 1st Screw Compressor Equipment delivered.
- 1997** GHH RAND – starting collaboration, license agreement.
- 1996** COMOTI – National R&D Institute for Gas Turbines.
- 1995** 1st Centrifugal Air Blower.
1st Waste Water Treatment Plant at SLATINA.
- 1992** 1st Centrifugal Air Compressor Equipment delivered.
Strategic decision: activity diversification (exploring Energy & Environment Market).
- 1990** COMOTI SA
- 1985** INCREST – Scientific center for Aircraft Engines.

A E R O S P A C E

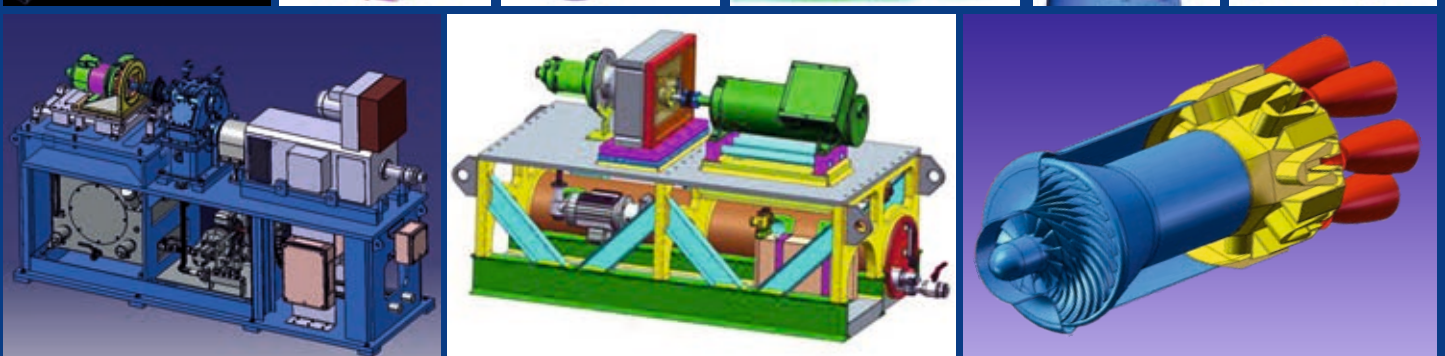
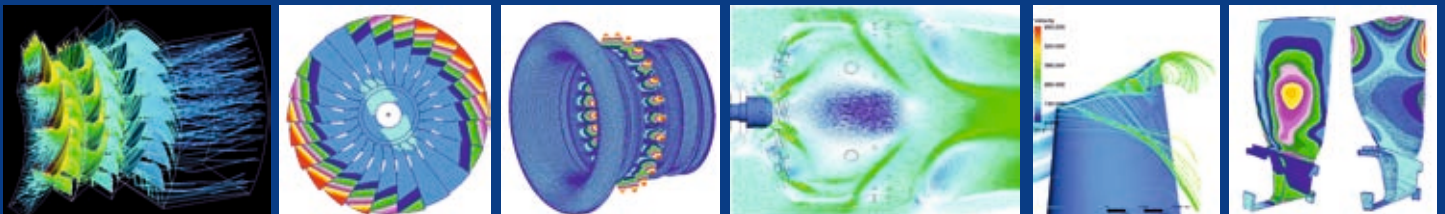
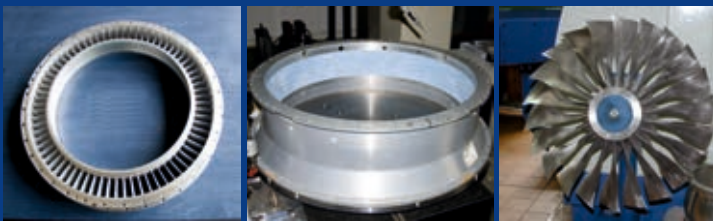


AVIATION R&D Related Activities

Participation in EC funded programs, FP 5, FP6, FP7, CLEAN SKY, HORIZON 2020 in cooperation with leading companies such as SAFRAN AE (former SNECMA), SAFRAN HE (former Turbomeca), Labinal PS, ONERA, DLR.

CAPABILITIES:

- CFD / Numerical simulation;
- Design, 3D modelling;
- Stress and Vibration analysis;
- Composite materials – bladed parts design;
- Prototypes and small serial production of blade parts;
- 3D inspection, validation and mechanical testing;
- Functional test for GT and other assemblies.



A E R O S P A C E

SPACE R&D Related Activities

Since 2013, COMOTI is actively involved in R&D and product development activities for the space domain, contributing to several ESA mission, like: Mars Sample Return (first COMOTI flight hardware), PROBA-3, JUICE and programs, like: Human Robotic Exploration (HRE), Science, ARTES and Space Transportation.



S/C Equipment

Mechanisms (sealing and closing, HDRMs, hinges, etc.)



Sealing and Closing system for Sample Return Missions.



HDRMs for Mars Sample Return Mission.

Centrifugal pumps for active thermal control (using non-toxic working fluids or ammonia working fluid)



Centrifugal pump for ATCS (EM level)



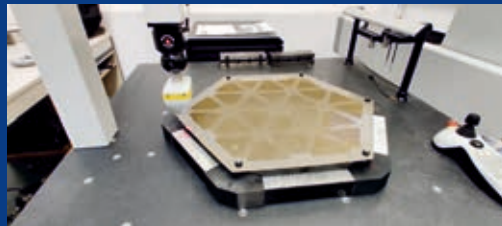
Metallic antenna reflectors and metallic structures



High dimensional accuracy antenna reflector (Ems).



Composite structures (qualified manufacturing process for CFRP panels)

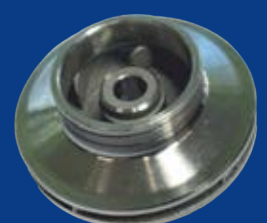
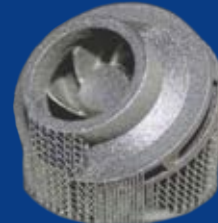


CFRP structure for metallic mesh antenna



Additive Manufactured (AM) Components*

*Printing process qualified according to ECSS standards



Dedicated Mechanical Ground Support Equipment's and Testing Facilities



Wide Range Thermal Facility for JUICE Mission



Spacecraft Tilting and Rotating Trolley for PROBA 3 mission



Spacecraft Transport Container for PROBA 3 mission



ISO 5 Instrument transport container for PROBA 3 mission

A E R O S P A C E

S/C propulsion

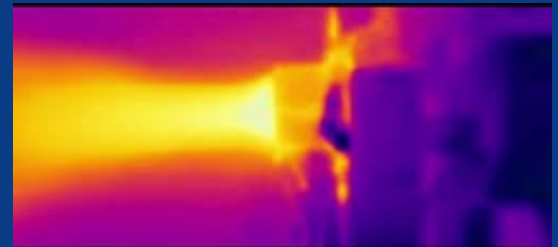


RF Powered Propulsion Technologies for LEO micro-satellite constellations and VLEO ABEP platforms

Pulse Detonation Combustor
70N thrust, air-oxygen/hydrogen, vacuum operation



Green thruster based on water electrolysis, for AOC manoeuvres



Rotating Detonation Combustor. 3 kHz operating frequency
air-oxygen/hydrogen, vacuum operation

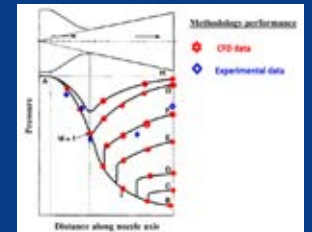
Propulsion for launchers



Electrically Driven Pump Feed Systems for 25kN
LOX/LCH₄ Regeneratively Cooled Rocket Engines)



Diffusers and anti-vortex devices for
LOX and CH₄ Cryogenic tanks



Versatile turbine design
methodology for turbopumps



Test bench for pumps and turbo-pumps for launchers (similitude conditions water/N₂,
shaft power max. 600kW/10000rpm or 250kW/25000rpm, N₂ flow max. 5 kg/s)

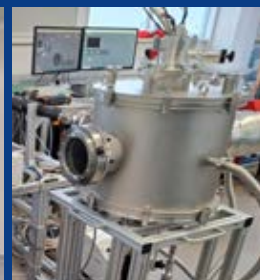


Core LOX/LCH₄ Technologies for
Rocket Engines & In-Space RCS

Manufacturing, Assembly and Testing Facilities



Cleanroom facilities (ISO 8 60sqm, ISO 7 40 sqm)



Small TVAC— $\phi 400\text{mm}$
(-70°C $\div$ 180°C, vacuum $< 1 \cdot 10^{-5}$)



Shock response spectrum facility

UNMANNED AERIAL VEHICLES

R&D of Propulsion Systems for Multi-Role Drones

Mission: A new perspective of UAV industry through groundbreaking R&D activities, integration and testing advanced technologies to foster a culture of innovation, exploration and addressing to the ever-growing demands of the aviation sector.

EVOTURBO - SPARK



- **AIM:** To serve as a platform for developing a proprietary autopilot software.
- **TECHNICAL DETAILS:**
 - Mass: 1.2 Kg
 - Flight autonomy: up to 25 minutes
 - Signal Range: 1 km
 - Flight speed: over 100 km/h

EVOTURBO - DRACON



- **AIM:** UAV platform designed for surveillance operations.
- **TECHNICAL DETAILS:**
 - Mass: 12 Kg
 - Flight autonomy: up to 50 minutes
 - Signal Range: 15 km
 - Payload: Full HD Camera with 30x optical zoom, IR camera and Night Vision

EVOTURBO - MD



- **AIM:** Designed and manufactured to be a platform for testing various equipments and sensors.
- **TECHNICAL DETAILS:**
 - Mass: 5.7 Kg
 - Flight autonomy: up to 35 minutes
 - Signal Range: 15 km

ENFORCING



- **AIM:** Development of an innovative concept of hybrid UAV equipped with a quad-rotor VTOL. It features an AI-driven acoustic system for the automatic interception and localization of specific sound sources.
- **TECHNICAL DETAILS:**
 - Mass: 15 Kg
 - Flight autonomy: over 3 hours in cruise flight
 - Signal Range: 15 km

COMPASS UAV



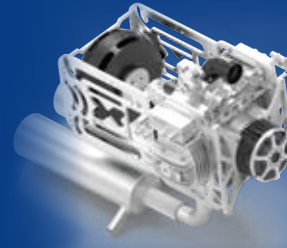
- **AIM:** Development of an innovative concept of a Octacopter UAV equipped with a Hybrid propulsion system.
- **TECHNICAL DETAILS:**
 - Hybrid Dry Mass: 22.7 Kg
 - Fuel capacity: 8 L
 - Signal Range: 30 km (AES 256 and CyberSecurity)
 - Flight autonomy: over 4 hours
 - Energy system: Hybrid
 - Payload: 10 Kg

HYBRID SYSTEM WITH GAS TURBINE FOR UAV



- **AIM:** Transforming thermal energy into electrical energy in order to increase the UAV's autonomy for high altitude flights.
- **TECHNICAL DETAILS:**
 - Engine: Gas turbine
 - Electric power generated: 4 kW
 - Voltage: 48 VDC output
 - Maximum Intensity: 100 A
 - Auto-throttle of gas turbine according to power consumption
 - Fuel consumption: 17 L/h

HYBRID SYSTEM WITH PISTON ENGINE FOR UAV



- **AIM:** Transforming thermal energy into electrical energy in order to increase the UAV's autonomy with lower fuel consumption.
- **TECHNICAL DETAILS:**
 - Engine: Piston engine full injection
 - Electrical power generated: 4kW
 - Voltage: 48 VDC output
 - Maximum Intensity: 100 A
 - Auto-throttle according to power consumption
 - Fuel consumption: 1 L/h

ENERGY & SAVING ENERGY



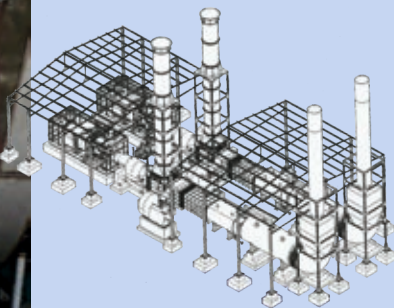
COGENERATION

Cogeneration power plant (electric and thermal with gas turbines) in cooperation with PRATT & WHITNEY CANADA.

SUPLACU DE BARCĂU

CHARACTERISTICS:

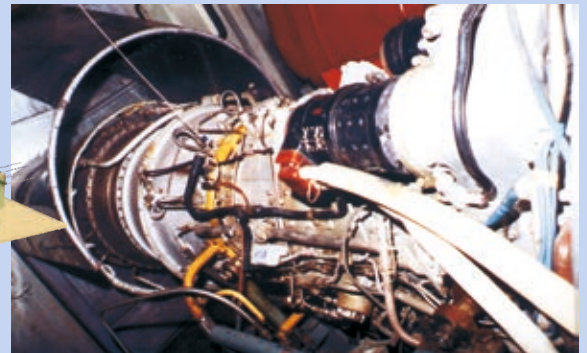
The plant has two cogeneration lines, each producing 1.75 MW (electric power at 6 kV) and 7 t/h (steam at 300°C and 20 bar) out of 670 Nm³/h natural gas.



BOTOȘANI

CHARACTERISTICS:

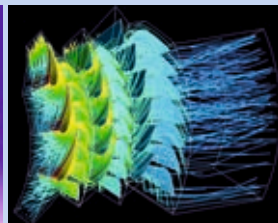
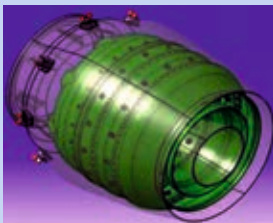
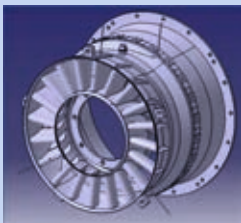
The plant produces 2 MW (electric power at a voltage of 6 kV) and 5 Gcal/h (heat) out of 900 Nm³/h natural gas.



Since 2000 COMOTI is Official Packager for P&W GT Engines.

CAPABILITIES

- Computation Fluid Dynamics (CFD) /Numerical simulation, 3D modelling, Detailed Design, Stress, Vibrations and Thermal Analysis, Control Systems Design for Turbomachinery;
- Automation of energetic groups, general revisions, service, maintenance;
- Dynamic balancing, inspection and oil analysis, Machining prototypes and small series;
- Test benches for GT and Compressors, Metrology.



ENERGY & SAVING ENERGY



PRODUCT

High efficient air and natural gas compressor packages for low, medium and high operation pressure up to 45 bar.

Special compressor package with suction pressure from 25 bar up to discharge pressure of 45 bar.

Screw compressor units developed by COMOTI:

- Low pressure discharge series CLP up 16 bar
- Medium pressure discharge series CMP up 25 bar
- High pressure discharge series CHP up 45 bar

Screw Compressors Packages tip ECS

- gas flow $< 6,000 \text{ Nm}^3/\text{h}$;
- discharge pressure up to 45 bar.

Screw Compressors CU units series under Ingersoll Rand License for natural gas market (extract, transport), gas tank vapor recovery offshore, gas compression for GT power (booster), petrochemical industry, refrigeration applications.

- gas flow max $3,750 \text{ Nm}^3/\text{h}$;
- discharge pressure: max. 26 bar;
- compression ratio: max. 15.

High Pressure Screw Compressors with oil injection, type: - CU220, CU200, CU128 (longer shaft) used for gas collection from low pressure (old) wells, gas lift, gas delivery into national pipelines network, off shore stations.

- suction pressure from 4,5 bar;
- discharge pressure up to 45 bar;
- flow $2,000 - 5,000 \text{ Nm}^3/\text{hour}$ ($1,500 - 3,000 \text{ rpm}$).

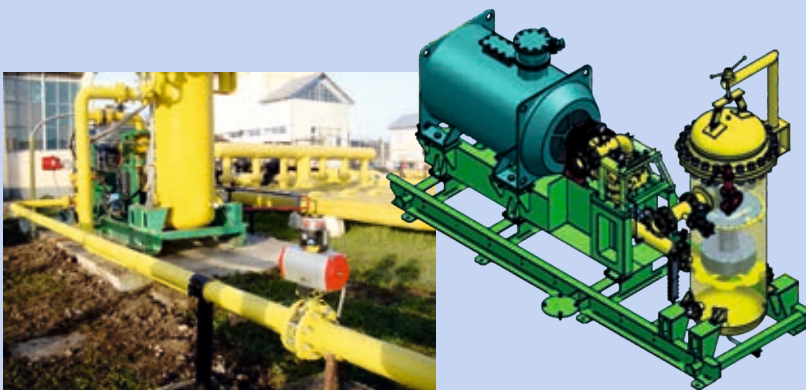
Centrifugal Air Compressor free oil CCAE family used to increase the amount of oil extracted by underground combustion with an average utilization factor of about 90%.

- discharge pressure up to 21 bara;
- flow up to $15,000 \text{ Nm}^3/\text{h}$;
- number of compression stage with intercoolers: 3-5.

EXPANDER

Producing green energy by recovering the energy detention in the lamination process of the natural gas (mechanical energy can be recovered and converted into electrical energy) using a turbo-generator:

- suction pressure 20 bar
- discharge pressure 3.5 bar
- flow $6,000 \text{ Nm}^3/\text{hour}$ ($1,500 \text{ rpm}$)
- electrical power 180 kW



ENERGY & SAVING ENERGY

THE MAIN HYDROGEN RELATED ACTIVITIES OF COMOTI

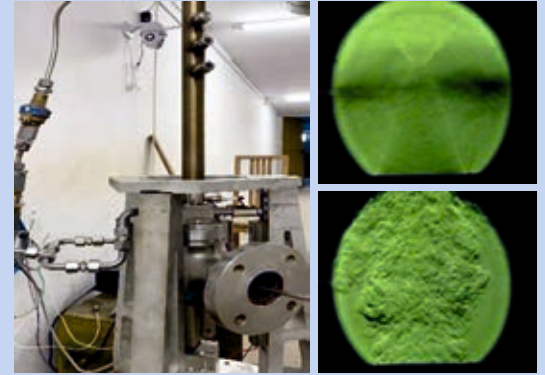
- 1 Hydrogen powered industrial gas turbines for aero, naval and ground applications.



- 2 Hydrogen compressors for transport and storage.



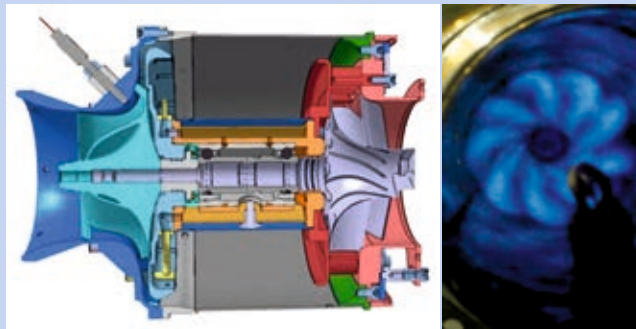
- 3 Hydrogen fueled impulse detonation engines.



- 4 Micro-thrusters with hydrogen/oxygen.



- 5 Hydrogen fueled micro gas turbines.



- 6 Composite materials special structures for liquid hydrogen storage.

- 7 Hydrogen powered piston engines for aero, naval and ground applications.

COMOTI's hydrogen related projects

- „Tangential Impulse Detonation Engine – TIDE”, CE project FP7, no. 335091 (2013–2016);
- “Micro launcher based on detonation engine – MILADEE”, funded by Romanian Space Agency (ROSA) STAR-C3, ctr. no. 624/20.07.2017 (2017-2019);
- „Combustion Chamber with Hydrogen-Natural Gas Mixture Fuel – HIDROCOMB” funded by de UEFISCDI, contract no. 76/2014, PN-II-PT-PCCA-2013 (2014-2017);
- “Pulsed Detonation Thruster – PDT”, funded by European Space Agency (ESA), ctr. no. 4000131302/20/NL/MG (2020–2021);
- „Pulsed Detonation Combustor – PDC”, funded by UEFISCDI contract no. 454PED/2020 (2020-2022);
- „Green thruster for attitude control and orbital manoeuvres of small satellites – GREENTH”, funded by European Space Agency (ESA), ctr. no. 4000117301/16/NL/CBi (2016–2020);
- “Development of water electrolysis systems with application for small-scale satellites – ELySSA”, funded by Romanian Space Agency (ROSA) STAR-C3, ctr. no. 175/20.07.2017 (2017-2019);
- „Development of a new additional jettison fuel tank in advanced composite materials for the IAR 330 PUMA helicopter – FHACT” ctr. 293/2014 (2014-2016) funded by UEFISCDI - PN-II-PT-PCCA-2013-4;
- „Redesign of the screw compressor for the use in compressing hydrogen gaseous mixtures. Type CHP 64G / CHP 90G”, orders no. 6233/2021, and no. 3591/2021, beneficiary ADICOMP – Italy.

Composite materials structural architectures designed for liquid hydrogen storage tanks.

Objective:

Developing a new concept of liquid Hydrogen storage vessel based on polymers developed through additive manufacturing technologies criterion for filling / emptying the tank.



Preliminary tank demonstrator developed during FHACT project - ctr. 293/2014 (2014-2016).



Preliminary tank CAD model developed during FHACT project - ctr. 293/2014 (2014-2016).

Green thruster for attitude control and orbital manoeuvres of small satellites – GREENTH.

Objective:

Evaluating the feasibility of an electro-chemical technology as application for an attitude control system for CubeSat sized platforms, aiming to demonstrate, by experimental means, the capability of the H_2/O_2 mixtures to be pulsed and ignited in a vacuum environment.



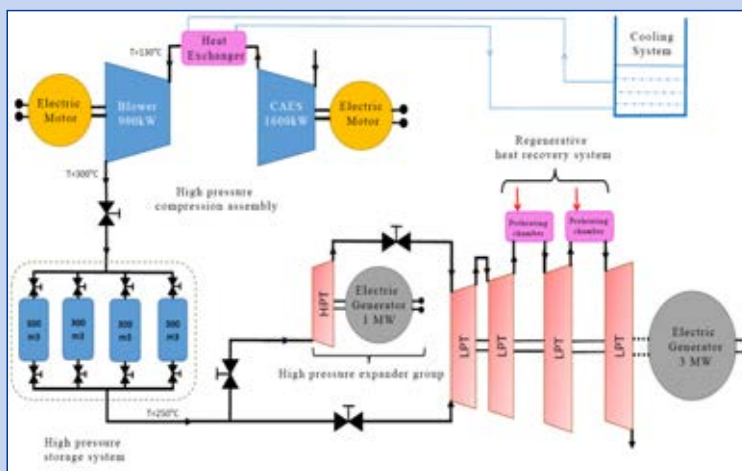
ENERGY STORAGE

“Innovative energy storage technology in CAES system (Compressed Air Energy Storage)”

The innovative CAES (Compressed Air Energy Storage) system proposed by INCD Turbomotoare COMOTI uses excess renewable energy during peak electricity production periods to compress air into constructed reservoirs or natural underground structures that are preserved after industrial exploitation has ended. During peak demand periods, when energy prices are at their highest, the stored compressed air is expanded in the expansion system, generating electricity and stabilizing and balancing the national power grid.

The technology involves the use of high-efficiency compression, expansion, and electricity generation equipment. To recover process heat, it proposes multiple stages of heat recovery at different phases of the technological process. The intention is to use an adiabatic cycle for the energy storage station.

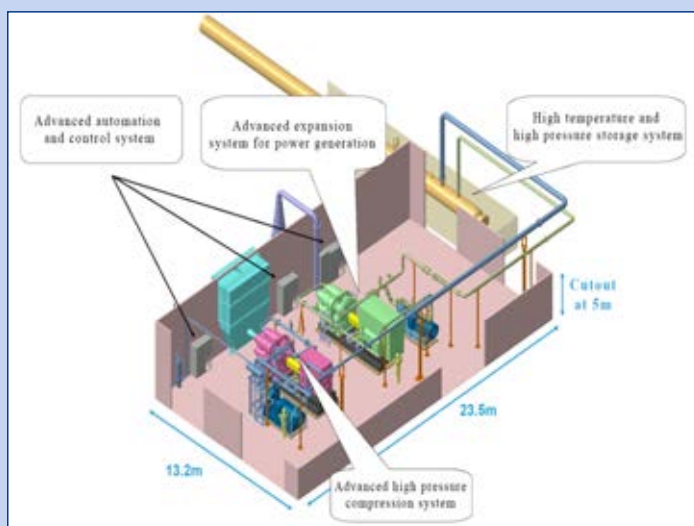
Electric energy storage system in the form of compressed air – generic size 4 MWe



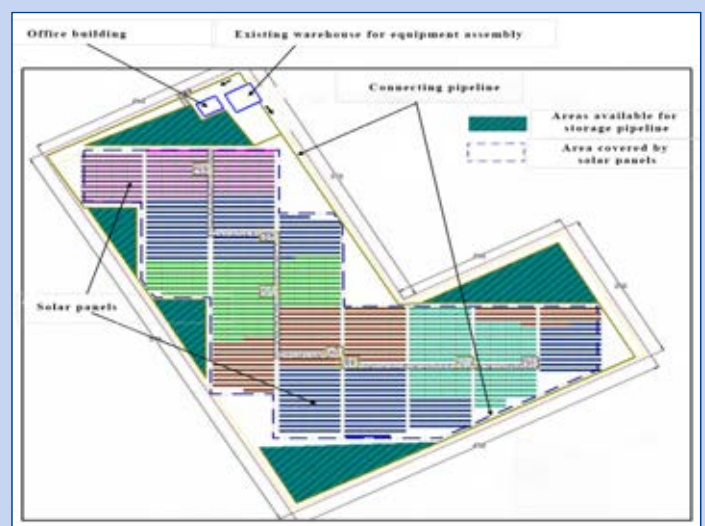
- Compression group:
 - 1x Centrifugal Compressor: **25bar**
 - 1x Centrifugal Blower: **80 bar**
 - Mass airflow: **0,5 kg/s**
- Expansion group:
 - 1x High pressure expander **1 MWe**
 - 1x Low pressure expander **3 MWe**

Over 70% of the equipment is designed and manufactured in Romania, e.g.: compression and expansion systems, automation and control systems, etc.

The revenue of the storage plant: approx. 4000 €/operating cycle (per day), at 4 MWe size



Energy storage system using advanced compression and expansion system



The plan for a photovoltaic power plant that uses CAES systems for energy storage

ENERGY STORAGE

The advantages of developing the "ProCAES storage system" are:

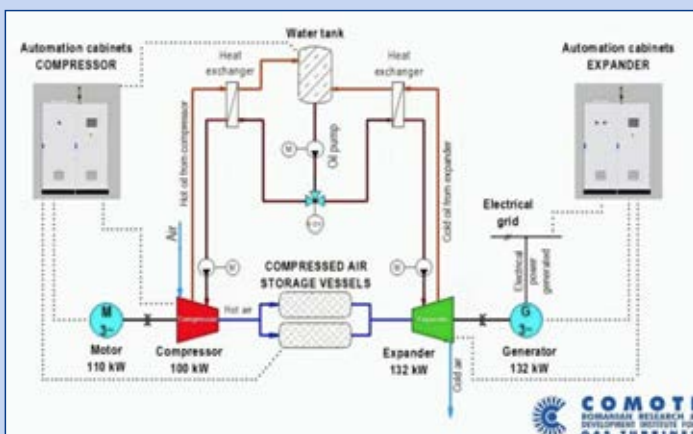
- Balancing of the power grid.
- Improving energy efficiency
- maximizing the use of renewable energy sources, such as wind and solar energy.
- Operational flexibility by providing a reliable backup energy source.
- Reducing carbon emissions by decreasing dependence on conventional power plants.
- Energy security through the diversification of storage sources.
- Average lifespan of the equipment: minimum 30 years.



Isometric view of the COMOTI CAES power plant with a emphasis on the key systems

The size of the storage station can be scaled up by adding additional compression and expansion lines to reach a maximum of 12-16 MWe

COMOTI's experience in the field of CAES – The ROCAES pilot storage station, developed within the POC program, section "G" – 2014-2020, A partnerships for knowledge transfer.



Pilot energy storage plant installed and commissioned at POPECI - Heavy Equipment, Craiova

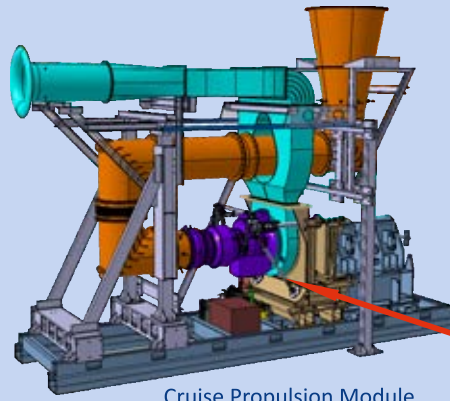
The ROCAES pilot plant was installed and commissioned in 2019 in the industrial hall of the POPECI — Heavy Equipment plant in Craiova, Romania. It comprises an electric screw compressor driven by a 110 kW motor and a screw expander driving a 132 kW electric generator. The compressed air is stored in a 50 cubic meter buffer tank with a maximum pressure of 25 bar. The pilot plant is equipped with a 5 m³ water tank to minimize thermal energy losses, increasing efficiency and power generated.

DEFENSE

TURBONAV 1



R&D project successfully ended - New naval propulsion system, based on ST40M, targeting to replace old Rolls Royce Tyne related ones on Ro Navy frigates, cruise propulsion.



Cruise Propulsion Module



Prototype on the stand



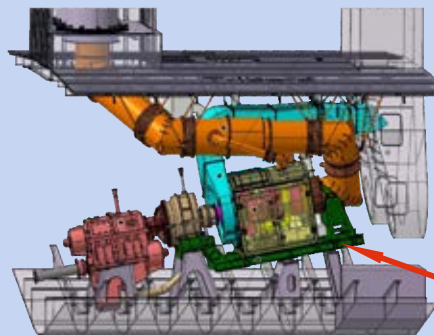
ST40M

P&WC gas turbine engine

TURBONAV 2.1



R&D project - New naval propulsion system, based on ST40M, targeting to replace old soviet related ones on Ro Navy fast moving boats (missiles carrier), cruise propulsion.
Project successfully ended, solution homologated.



Cruise Propulsion Module



Prototype on the stand



ST40M

P&WC gas turbine engine

Micro Gas Turbine Engines



Low cost jet propulsion system dedicated high speed target aircraft.

- Thrust: 40 daN
- Dimensions: 399 x 165 mm
- Rotation speed: 80,000 rpm
- Air flow: 0.67 + kg/s
- Flight speed: 700 km/h
- Flight ceiling: 6,000 m

EDF financed Projects



ENGHE (EU Next Generation Helicopter Engines) – developing 100% EU engine for the next generation of European military helicopters

Project integrated by EURA (European Military Rotorcraft Engine Alliance) – 50/50 JV MTU Aero Engines & Safran Helicopter Engines.

ENVIRONMENT



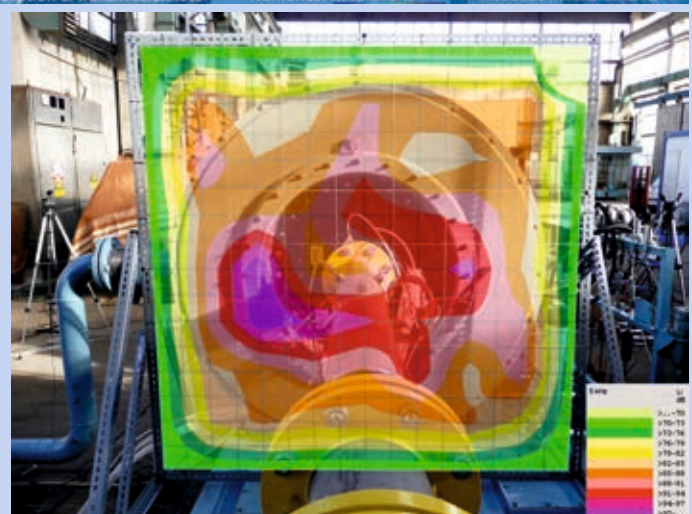
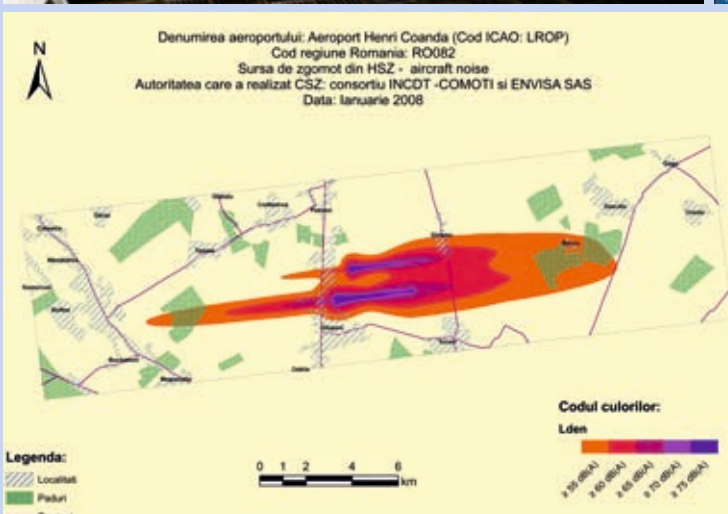
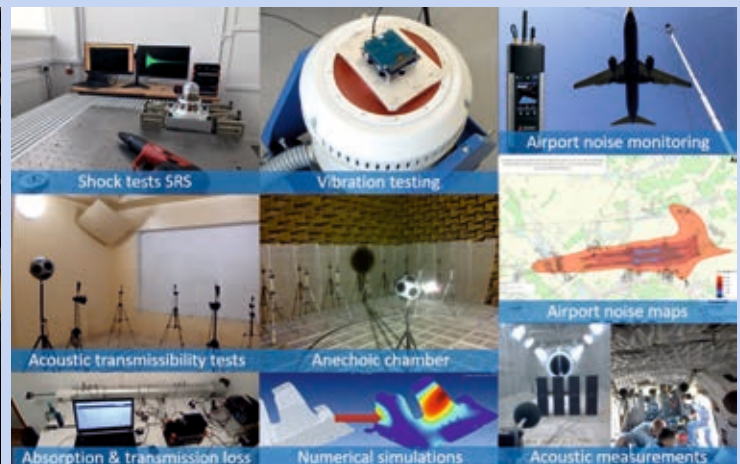
CENTRIFUGAL AIR BLOWERS

and control system for biological stage waist water treatment plants.

Developed a family of CAB, type TS and ESC with flow between 3,000 m³/h (ESC 3) and up to 10,000 m³/h (ESC10).

- Oil free and with airflow variation between 50% ÷ 100%.
- Blower type: centrifugal rotor with backwards curved blades (3D rotors).
- Drive type: asynchronous electric motors with 400V supply.

- ACOUSTIC and VIBRATION MEASUREMENT
 - NOISE MAPPING
 - PHYSICS AND CHEMICAL TESTING LABORATORY
- for source emission measuring GT Noise Suppression.

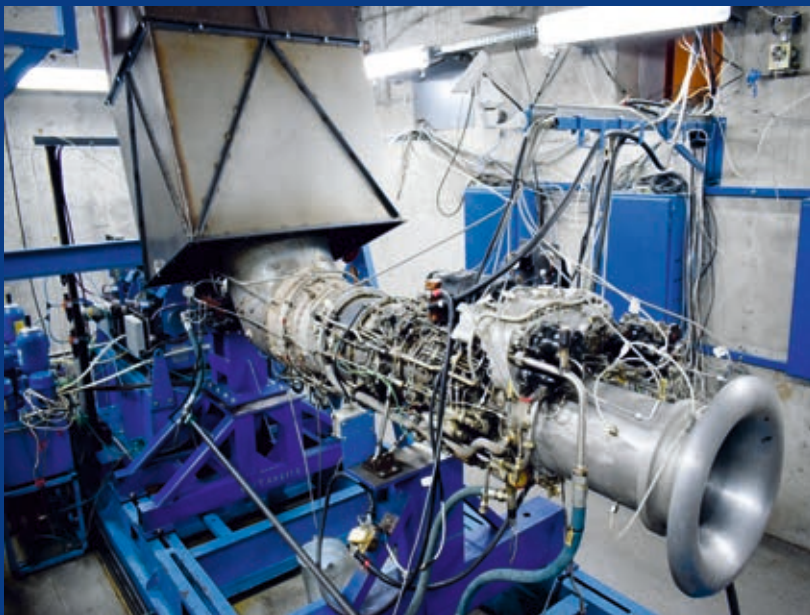


GAS TURBINES TESTING FACILITY



The testing facility integrates 3 testing cells dedicated with a wide variety of turbine engines for aircraft (civil or military) and industrial application that incorporates all the system necessary for testing, such as air, oil, fuel and dynamometers systems.

Test Cell No. 1: For testing turboshaft engines with a power from the tandem dynamometers up to 5.4 MW and 25,000 rpm from Froude. The cell is equipped with a D.A.C.S. (data acquisition control system) and M.A.C. (mobile acquisition cabinet) from Safran Cenco International that operates all the system necessary for testing through the CYRES Software, including the auxiliary systems: for air, oil and fuel. It has two power dynamometers that can operate in tandem or single handle for different laws of loading with a dedicated software. The following engines was tested in this test cell: turboshaft TV2-117A, turboshaft TV3-117MT, turboshaft ST40M.



Test Cell 1-Turboshaft engines testing facilities, TV2-117A, TV3-117MT



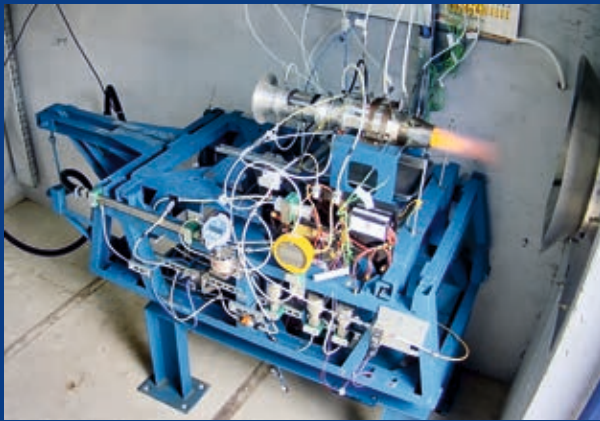
ST40-M Marine Turboshaft



Test Cell no.2-Turbojet or turbofans engines testing facilities

Test Cell No. 2: For testing turbojet or turbofans engines, with a maximum thrust of 7,000 daN. The cell is equipped with a D.A.C.S. (data acquisition control system) and M.A.C. (mobile acquisition cabinet) from Safran Cenco International that operates all the system necessary for testing through the CYRES Software, including the auxiliary systems: for air, oil and fuel. The following engines was tested in this test cell: R-11F2-300.

GAS TURBINES TESTING FACILITY



Test Cell no.3-Microjet engine testing facilities

Test Cell No. 3: For testing micro turbo engine with a thrust up to 250 daN. It contains a data acquisition and control system from National Instruments for both engine and auxiliary equipments and a programable software in LabView with manual and automated control system. The following engines was tested in this test cell: AMT Titan, Comoti experimental prototype micro jet engine 40 daN.

SPECIFIC APPLICATIONS:

A particular operation mode of testing, for an industrial application for a twin engine TV2-117A. The application refers to one stage axial gas free power turbine, run by the gases provided from two gas generator of TV2-117A turboshaft engines.



Twin engine TV-117A for industrial application

CONTROL ROOM



Test banch control room.

Control Room: It holds the D.A.C.S. system for the CYRES software for the engine testing cells with a system that is monitoring and controlling the engines and the auxiliary systems. The M.A.C. is contained of dedicated modules for all types of parameters with a numerous number of channels for all type of applications.

EQUIPEMENT:

- hydraulic brake, HOFFMAN FROUDE;
- Central control unit Techspace Aero-CENCO Europe, Belgium;
- Cyres software.

Auxiliary control and instrumentation unit: Is made of data acquisition unit for all auxiliary systems including the video system for the test cells, dedicated vibration system for the turboshaft and turbojet cell and a power system for the control systems.



Auxiliary control and instrumentation unit.

MATERIALS DEVELOPMENT & TEST FACILITIES

Composite Processing & Manufacturing technologies

Conventional Manufacturing technologies



CNC prepreg cutting machine



ISO 8 Clean Room



VA-RTM



Autoclave - Scholz
Ø1500 mm; length 2500 mm max.
400°C; max.20 bar; 6 vacuum lines/

Additive Manufacturing technologies



CF-FDM -3D printer
Markforged-X7



Liquid Crystal Magna 3D Printer
Technology: DLP 3D printing
Build volume: 510x280x350mm
Printing speed: 13.3 mm/h (at 100 µm)
Layer thickness: from 25 to 100 µm



Cure L2
Post curing oven
Heat/UV led



Air Wash L
Solvent Cleaning

Post Manufacturing operations



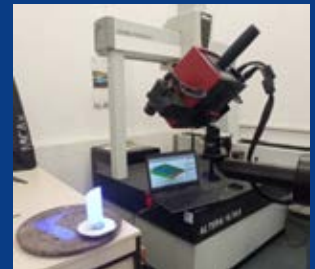
Mechanical work facilities (3,4 and 5 CNC turning, milling and grinding machines)



Water jet cutting machine



LC15Dx CMM automatic laser scanner,
1.9µm accuracy/ 22µm resolution



Structural & Thermal analysis



Calorimetry
Perkin Elmer, DSC 8000



TA Instrumets
TMA 450



TA Instrumets
DMA 850



TA Instrumets
DXF 900



Environmental chamber
Temp. range: -40°C up to
+190°C/ CryoFreezer -140°C



Oven assisted vacuum system
temperature range [20-300°C],
H=600mm, L=800mm,
I=500mm, heating rate
1 to 10°C/min

MATERIALS DEVELOPMENT & TEST FACILITIES

Research and development projects

Project: FP7-234313 (2009-2014) **OPENAIR SNECMA (France) coordinator** (COMOTI and 46 partners)

TRL 4 validated CFRP composite OGV Stator vane, integrating active noise control technologies (actuators) for **civil aircraft** noise reduction



OGV (outer guide vane)



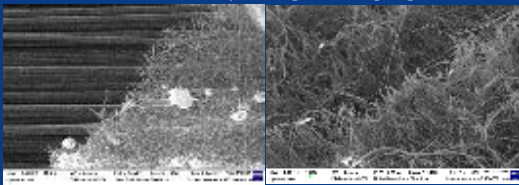
10 OGV prototypes were developed



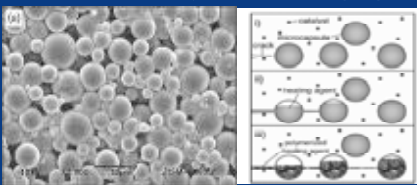
Triplet OGV mounted on a 3D printed stator case section

Development of Self-Healing Advanced Composite Materials for Space Debris impact events

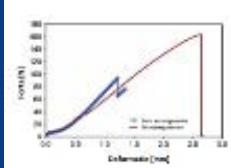
Path 1: electrospinning healing agent



Path 2: micro encapsulated healing agents



Carbon composite Antenna, Parabolic Reflector **embedin self-healing network** fo increased on-orbit mission lifespan



Achivements: recovery of 60-70% of structural performaces static/post impact 30J/15m/s

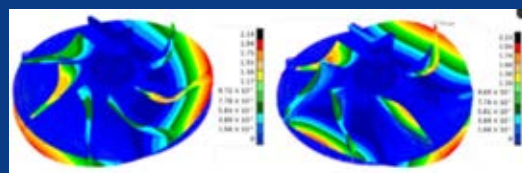
Advanced solar thermal propulsion system for increasing satellite operational life



N2 gas propulsion system for ground testing



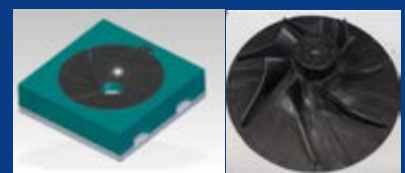
Development vertical axe 4.5 m wind turbine blades x3- C/GFRP composites



Optimized design: blades number from 17 to 7, x2 thickness, efficiency similar to the reference metallic impeller



CCAЕ 9-125 compressor



Rotor assembly stage I-17-4PH steel(reference) manufactured in **CFRP composite**



600% mass reduction vibration tests/11,353 rot/min

MATERIALS DEVELOPMENT & TEST FACILITIES

Research and development projects

Project: FHACT

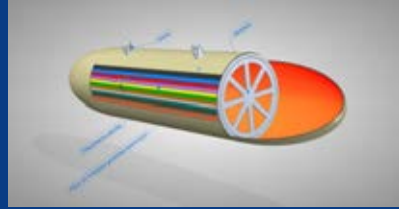
Development of CFRP composite external fuel tank attached to IAR Puma Naval helicopter



IAR 330 Puma Naval



CFRP composite external fuel tank

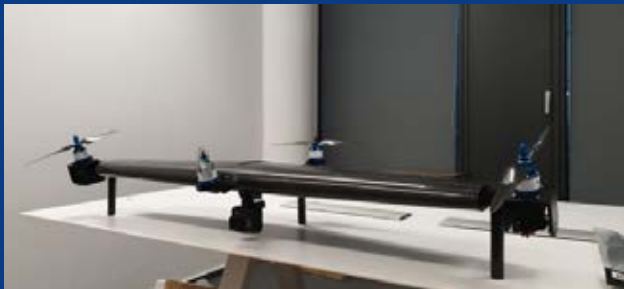


Anti-slosh inner membrane

ADCOSSPA- ADvanced COMposite Structure for Spacecraft Applications ctr.no9/2012



Full scale CFRP composite Lightweight micro-satellite structure-design & manufacturing
Low Z-High Z-Low Z concept Design
TRL4 validated
(housing Advanced Data and Power Management System -ADPMS)



CFRP composite Fixed wing UAV



CFRP composite structure for Octocopter UAV equipped with hybrid propulsion solution



Innovative STATor - InnoSTAT

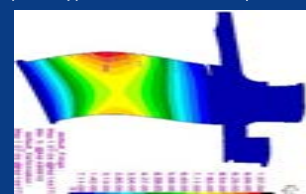
2019-2023

JTI-CS2-2018-CfP09-LPA-01-60-GA no 865007

Innovative low noise fan stator technologies for 2030+ powerplants



1/3 scale 3D printed OGV prototypes aero-acoustically tested



CFD&FEA stress analysis



- Up to 5dB noise reduction depending on the BPF order on 2 low noise concepts
- Passive low noise technology integration at Full scale and TRL4 validation
- 50% weight reduction for the Full scale OGV-CFRP composite

Development of passive low noise technologies and weight reduction for UHBR fan stator OGV blades –TRL 4 validation

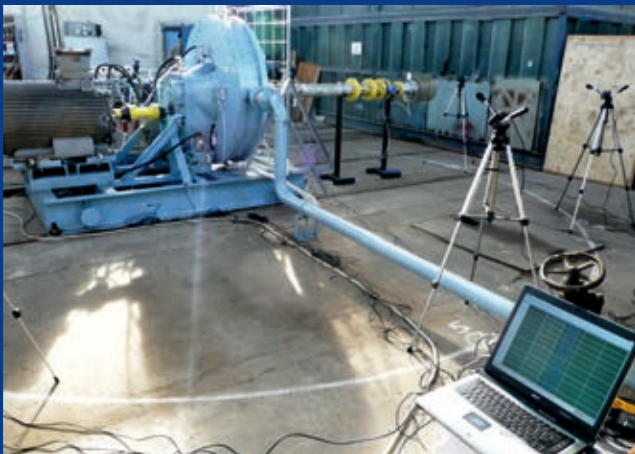
ACOUSTIC AND VIBRATION TEST FACILITIES



Acoustic tests - Anechoic chamber (1,200 m³).



Reverberant chamber.



Measurement and studies for noise directivity of the industrial sources.

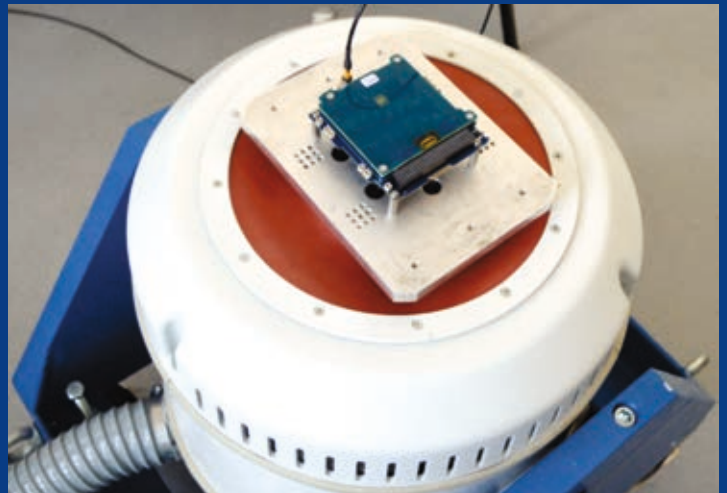
The Research and Experiments Center in The Field of Noise and Vibrations - COMOTI is certified by The Accreditation Organization from Romania - RENAR according with SR EN ISO/CEI 17025/2005.

The laboratory can perform studies in the following specialized chambers:

- **The Anechoic Chamber** realized according with ISO 3745;
- **The Reverberation Chamber** realized according with ISO 3741- Annex D ISO 354;
- **The Transmissibility Chambers** according with ISO 140/1, /7, /8, STAS 6161/4, STAS 6691.



Chamber with traps.



Vibration tests for components specific to the space domain using the TiraVib 50303 2kN shake.



Studies and measurements for the determination of acoustic absorption coefficient and acoustic impedance of sound-absorbing materials with the Kundt tube set.

COMBUSTION CHAMBER TEST FACILITIES

Five different testing lines for combustion of low and high pressure flows, for gaseous and liquid fuels

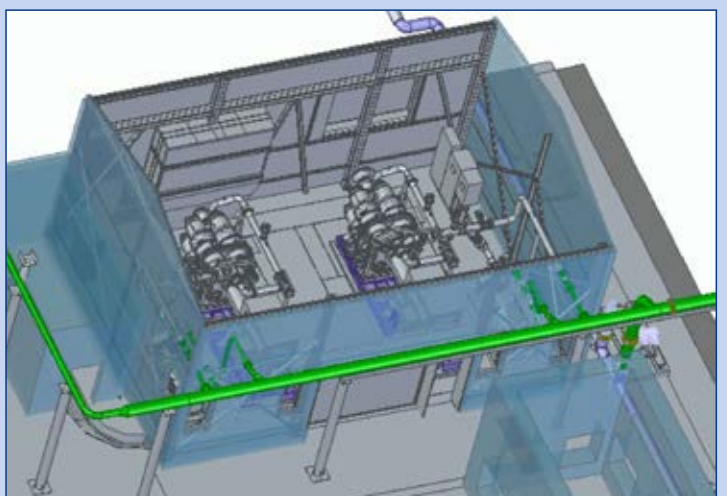
- Maximum inlet for air source: Air Flow 10 Kg/s, 50 bar, 550°C
- Two experimental testing buildings and one dedicated building for air sources.

Main Services

- Combustion chambers design, manufacturing, testing and development
- Low and high pressure combustion experiments
- Experimental measurements of combustion chamber, flame stability and aero dynamical parameters
- CFD for reactive and non-reactive flows
- Non - intrusive Laser based measurements of velocity, gas composition and temperature
- Green and Renewable energies experiments: hydrogen, biofuels, gasification, biomass combustion



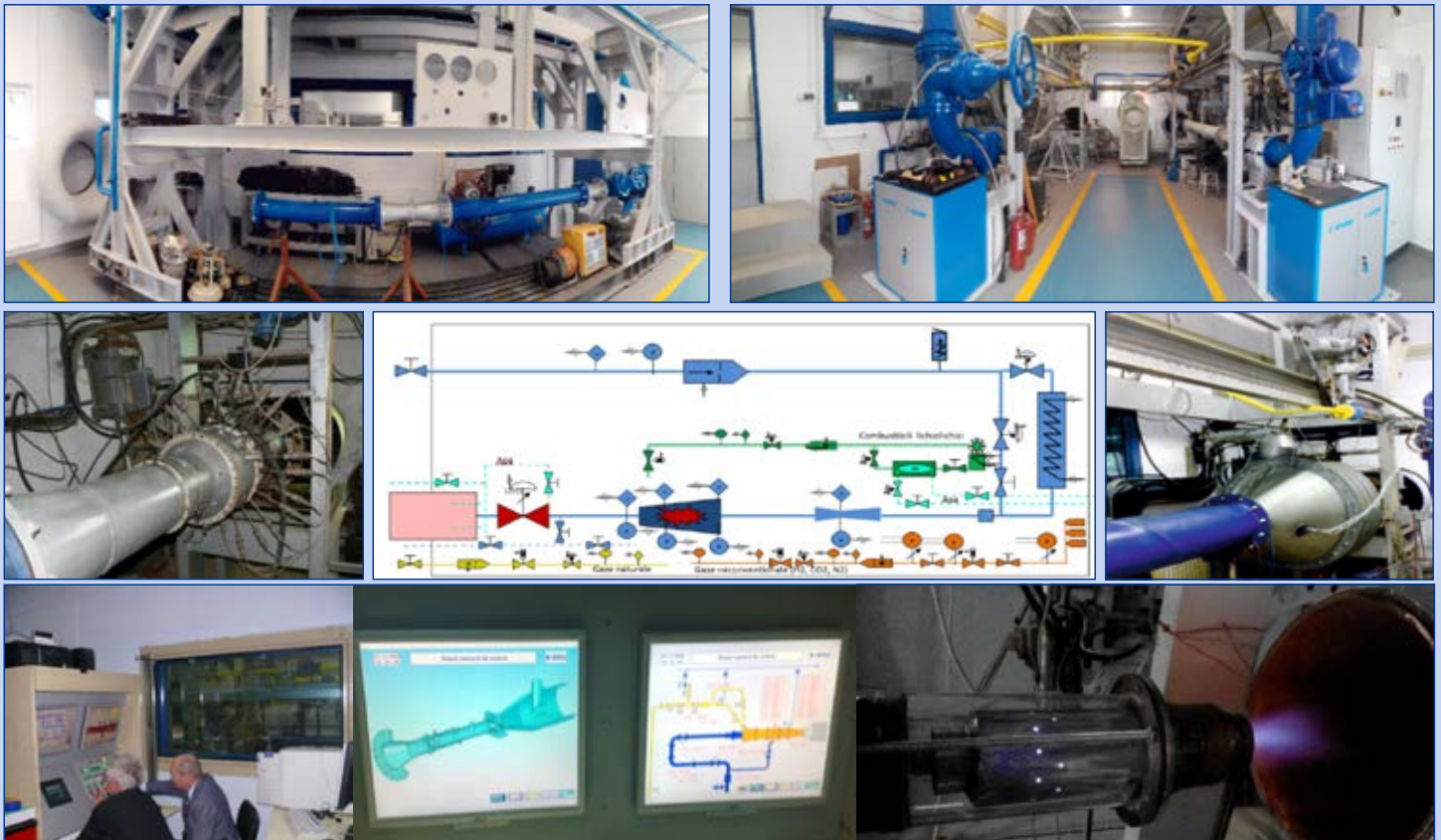
Combustion chambers testing facilities



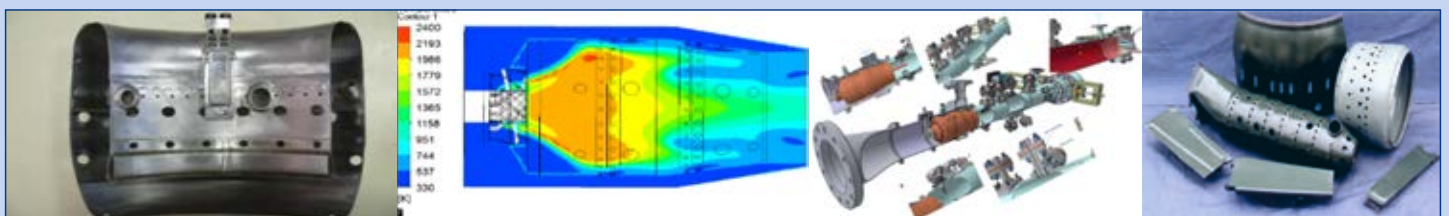
Air sources for testing facilities – 10kg/s, 50 bar

COMBUSTION CHAMBER TEST FACILITIES

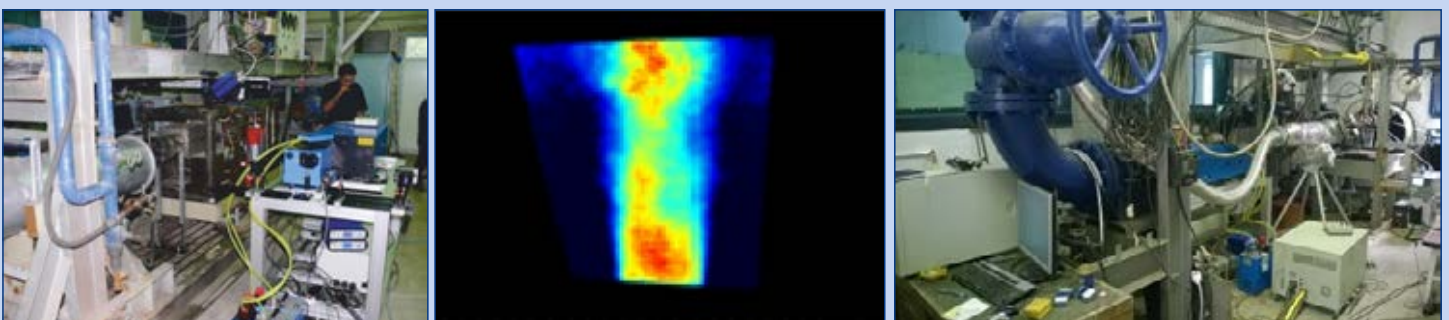
Testing lines



Combustion chamber experimental, research and testing laboratory.



Design, CFD, execution and testing of combustion chambers



PIV – LIF Laser measurements laboratory.

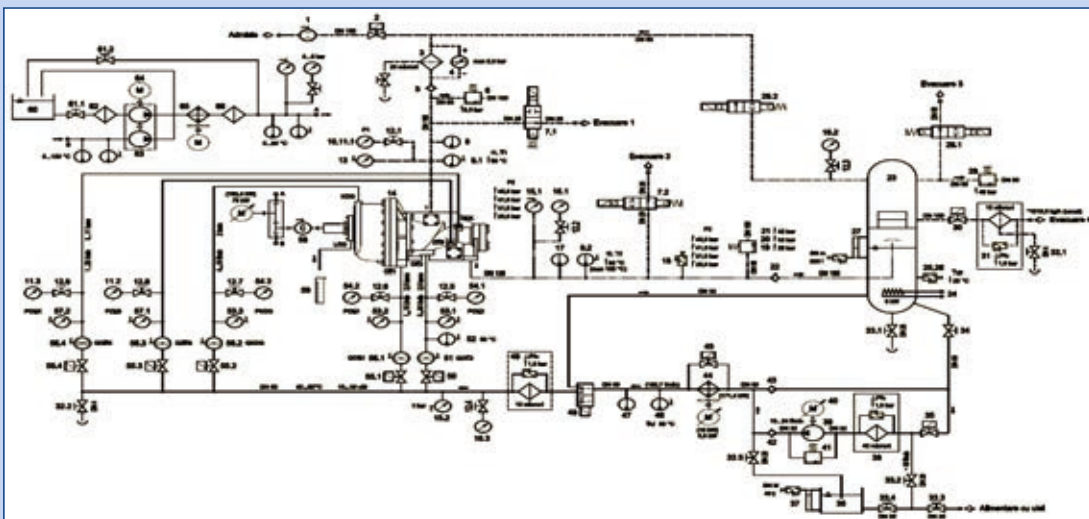
NATURAL GAS SCREW COMPRESSORS TESTING FACILITY

The testing facility is entirely designed by COMOTI and is dedicated to test CU licensed family, CU stainless steel case family, High Pressure Screw Compressors.

- Rotational speed range DC motor: **512 - 1,200 RPM**;
- Power: **max. 75 kW, DC electric motor**;
- Test pressure: **max. 50 bar**;
- Rotational speed for:
 - first output **1,152 - 2,700 RPM**;
 - second output **2,573 - 6,075 RPM**.

Process parameters:

- Rotational speed for the DC motor: **tahogenerator CROUZET**;
- DC motor torque: **T10F, non-contact torque measuring system, Hottinger Baldwin MessTechnik, BRD accuracy class 0.1, max. rotational speed 10,000 RPM, nominal torque: 3 kNm**;
- Pressure sensors: **Tensometric system Rittmeyer, Switzerland, accuracy class: 0.01**.

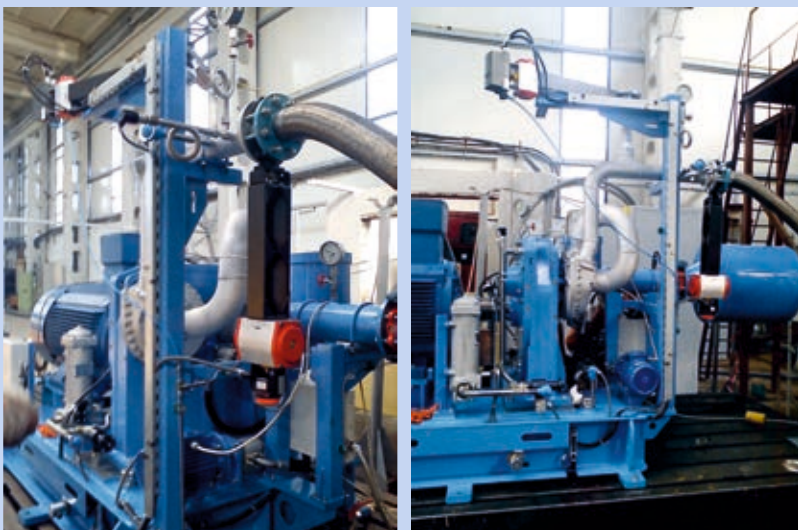


Technological diagram of test rig.

CENTRIFUGAL COMPRESSORS TESTING RIGS



1.3 MW test rig with two stage, non intercooled MTI 1,500 compressor.



The arrangement of two other centrifugal compressors, with and without intercooling on the other test rig.

Compressor CCAE 6-43 on the test rig (no intercooling).



Compressor CCAE 9-125 (intercooled) on the test rig.

COMOTI has different capabilities to test and to qualify centrifugal compressors, one stage and multistage, with or without intercooling. These facilities are designed to assure all required parameters, as follows:

- Oil pressure, oil injection temperature, oil flow;
- Buffer instrumental air pressure, flow and temperature;

General cooling water parameters, flow, pressure, temperature.

All test rigs are fully governed by electronic systems, specially high speed, multi channel PLC, mainly produced by FE FANUC and SIEMENS.

Data acquisition process is assured by the use of state of the art sensors, laboratory precision class.

Torque is measured using Hottinger Baldwin Messtechnik contactless sensors, various capable loads. Temperatures are controlled via Pt100 and Pt150 sensors. Oil and water flows are controlled using dedicated sensors, many of them being combined p, T, flow high precision sensors.

Data acquisition process is integrally automatic, without human intervention.

All test rigs are fitted with noise suppressors, to assure the compliance the with european standards.

There are two main facilities:

- Test rig able to assure testing of intercooled, multistage centrifugal compressors, equipped with alternative current motor with 0.7 MW / 3,000 RPM;
- Test rig able to test individual centrifugal stages, equipped with DC motor with 1.3 MW / 1,200 RPM capability. The link to the compressor is assured by a RENK geared transmission able to reach 25,000 RPM. Test rig is equipped with torque measurement on compressor shaft.

All installations are equipped with automatic control loops, able to protect the test rig and tested equipment in case of failure.

AUTOMATION

The Department of Automation and Electrical Engineering carries out research and development activities in the field of control systems, including explosion-proof installations, and is responsible with the automation part of the projects and installations within COMOTI. Our team realizes the research, design, execution, software programming, implementation, and commissioning of automation systems for a wide range of equipment. We conduct activities of research, design, and execution of custom and small-series products in the field of automation for rotary bladed machines (such as compressors, expanders, gas turbines, blowers, etc.). The team has expertise in the integration and development of supervisory control and data acquisition (SCADA) systems, delivering custom solutions and software applications, designed for each specific application. For design and programming, we use the following programs: **Eplan**, **AutoCAD**, **ProgeCAD**, **Solid Edge**, respectively **Proficy Machine Edition**, **Codesys**, **Lab View**, **Matlab**. The automation systems integrate components from renown producers such as: **Eaton**, **Emerson**, **Lapp Kabel**, **Turck**, **National Instruments**, etc.



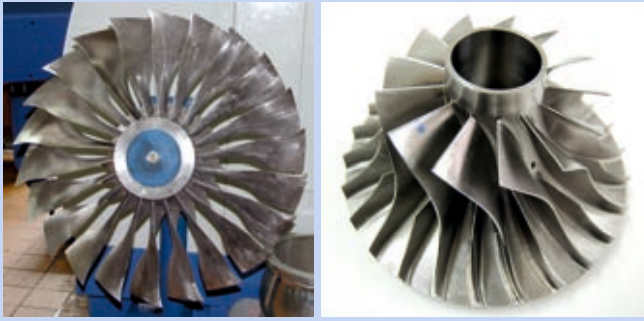
Automation system designed for testing ST40M marine gas turbine engines



Automation cabinets for compressors, installed in control rooms within stations for oil and gas industry

Test bench automation for piston engines used in marine applications

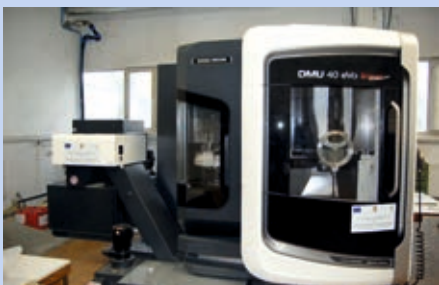
MANUFACTURING



- Experimental Parts, Prototypes and Small Series Production for Aviation and Industrial Gas Turbines and other Rotating Machinery (titanium alloys, Ni-Co alloys, stainless steel, aluminium alloys).

- Machining Types:

- DMU 40 Evo, 5 simultaneously axes milling machine;
- HAAS CA3330, 5 simultaneously axes grinding machine;
- CNC DAHLI9 high speed 5 axes milling machine;
- CNC FOREST LINE 5 axes milling machine;
- CNDMU 70 e VO linear Deckel Maho;
- STARRAG copy milling machine;
- CNDMU 70 Deckel Maho;
- GILDEMAISTER CTX 620 linear;
- CUT E 350 - Wire EDM machine (Electrical Discharge Machining);
- Doosan DB 130CX - 5 Axis CNC Horizontal Boring & Milling Machine;
- Forest-Liné - CNC Gantry Milling Machine;
- SC14CNC – CNC Vertical Turning Lathe;
- SKM ZNC T50/T60 – ZNC EDM Machine with Solid Electrode.



PATENTS

Awards and medals for our patents in various international exhibitions:



Geneve 2022 - Bronze medal



Geneve 2022 - Bronze medal



Geneve 2018 - Silver medal



Geneve 2017 - Silver medal



Geneve 2016 - Gold medal



Geneve 2016 - Silver medal

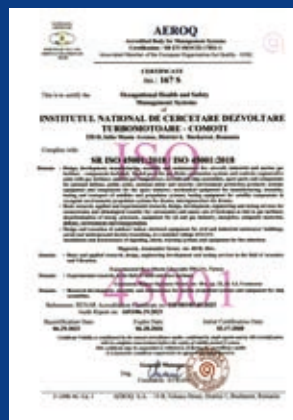


Eureka 2016 - Gold medal



Geneve 2014 - Gold medal

QUALITY



- AEROQ Quality System Certifying according to SR EN ISO 9001:2015, SR EN ISO 14001:2015, SR ISO 45001:2018 and SR ISO/CEI 27001:2018.
- Certificated as PETROM SA - member of OMV Group - Products and Services Supplier.



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