Unidad de Investigación y Desarrollo

G.E.M.A.

Grupo de Ensayos Mecánicos Aplicados

CENTRO TECNOLÓGICO AEROESPACIAL

RESEARCH AND DEVELOPMENT ACTIVITIES

Ing. Pablo L. Ringegni

Facultad de Ingeniería

EDUCACIÓN PÚBLICA Y GRATUITA

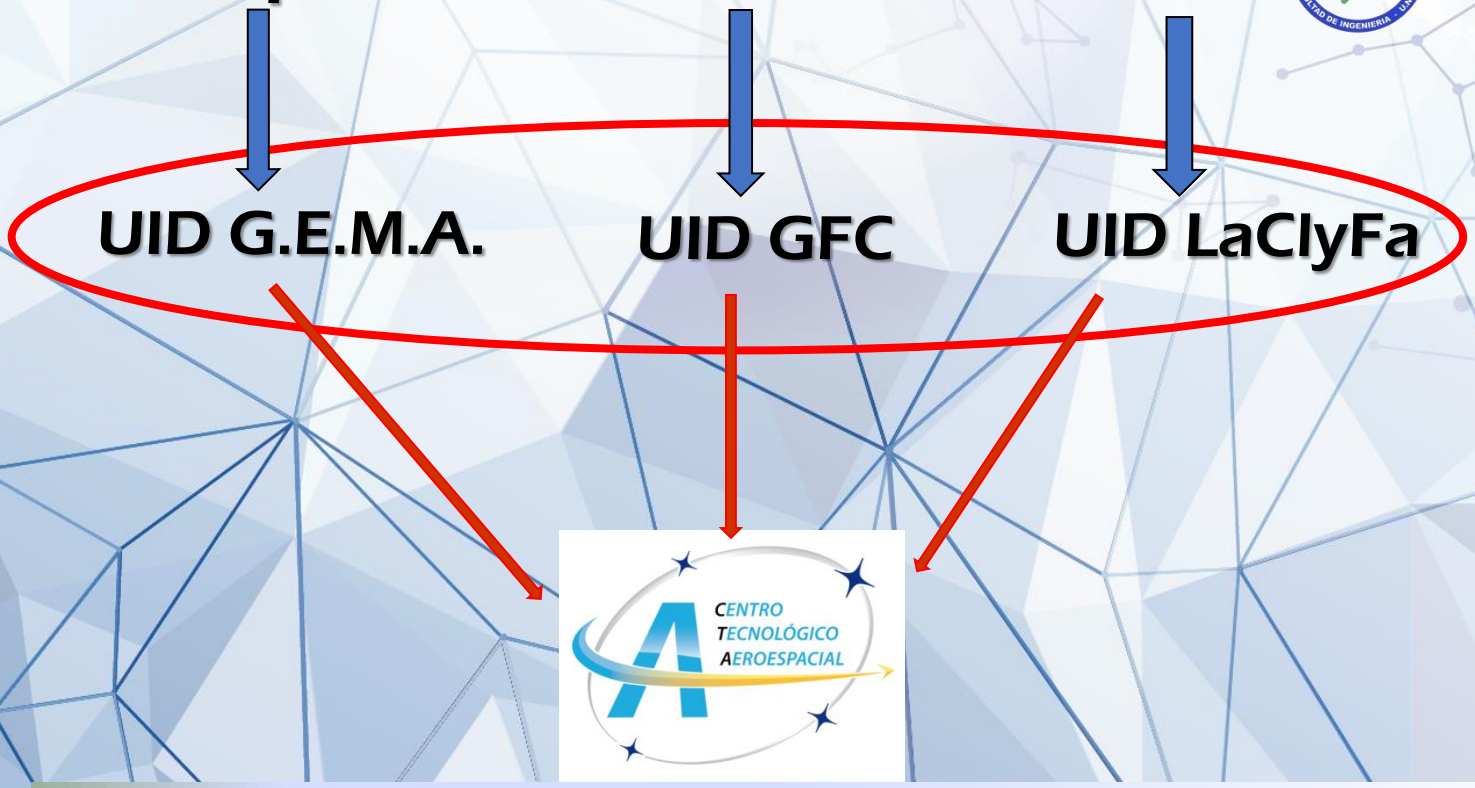
UNIVERSIDAD NACIONAL DE LA PLATA

CTA STRUCTURE

UNIVERSIDAD NACIONAL
DE LA PLATA

Facultad de Ingeniería

Departamento de Aeronáutica



CTA Structure

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Grupo de Ensayos Mecánicos Aplicados

Applied Mechanical Testing Group (GEMA)
Their work and research is related with structures, mechanics and thermal. Specially related with numerical simulation (finite elements) and testing. Its activities are within the area of dynamic loads (fatigue and vibration), analysis and simulation of structures and mechanisms, thermal behavior, space technology, design, testing and integration, and many other related activities. It has also obtained ISO 17025 accreditation for some of their tests and its quality system is certified under ISO 9001.

Computational Fluid Dynamic Group (GFC)
Their work is related to the **numerical analysis and simulation of fluid dynamic and aerodynamics problems.**

LaCLyFA
UIDET

Laboratory of Boundary Layer and Environmental Fluidynamics (LaCLyFA)
Their works interdisciplinary with engineers, physicists, architects, meteorologists and biologists **in problematic associated with wind engineering and aerodynamics**.

CENTRO
TECNOLÓGICO
AEROESPACIAL

UID G.E.M.A.
Research and Development Unit
Applied Mechanics Testing Group
(Since 1994 .....)

WORKING TEAM (50 people)
- Professors: Doctors, Masters, Specialists, Engineers
- Professionals
- Technicians
- Students (Scholarship holders)

TYPE OF ACTIVITIES
- Applied Research
- Technical Development and Assistance
- Design, Analysis, Integration and Testing

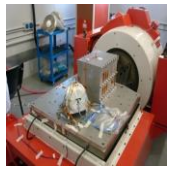
UID GEMA STRUCTURE

Working Group

- Professors
- Professionals
- Technicians
- Students
- Administratives

Main Activities

- Applied Research
- Analysis and Design (simulation)
- Technical Assistance
- Testing
- Manufacturing and Integration
- On site Measurements



Working Areas

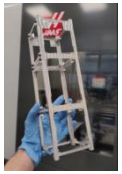
- Structural
- Mechanical
- Materials and Composites
- Thermal

→

- Design
- Analysis
- Simulation
- Integration
- Manufacturing
- Testing

Industries

- Aeronautical
- Aerospace
- Automotive
- Electric
- Metal/Mechanic



INFRASTRUCTURE

Testing Laboratories: (2) (800 y 270 m2)

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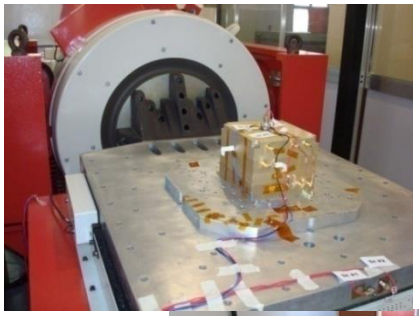
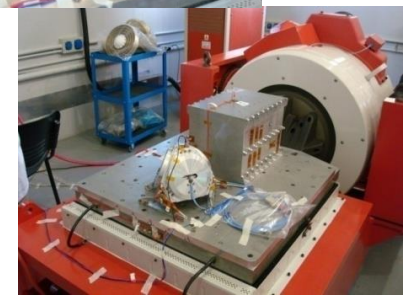
INFRASTRUCTURE

Structural and Thermal TESTS of Aerospace Componentes

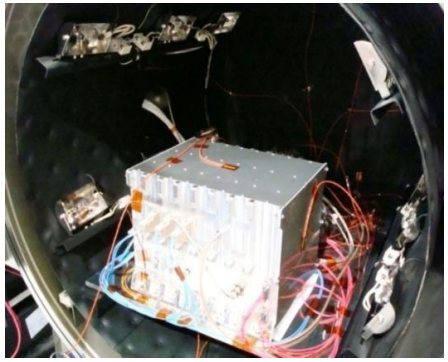





Mechanical

Thermal




INFRASTRUCTURE

Two (2) Clean Room / Integration (26 m2 and 30 m2)

Centro Tecnológico Aeroespacial

Unidad de Investigación y Desarrollo
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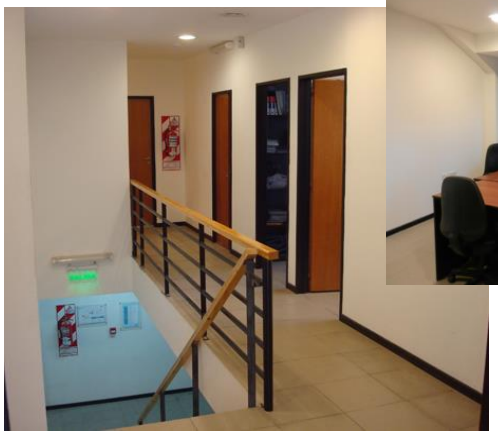
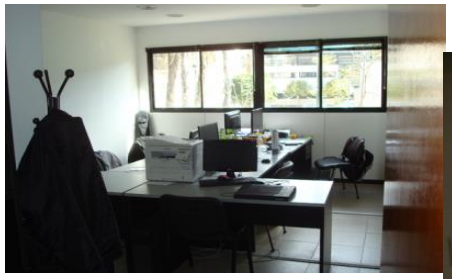
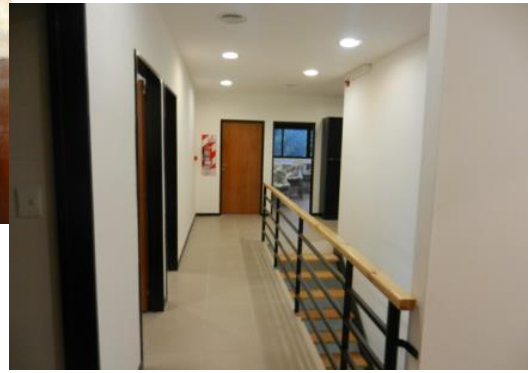
INFRAESTRUCTURA

Offices (Simulation, Análisys and Design): 350 m2







Meeting Room (2)
(16 m2 /10 p– 45 m2 /25p)

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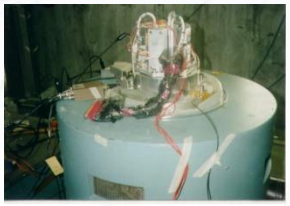
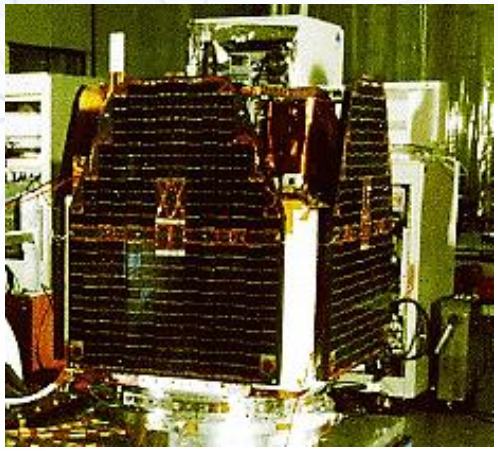
Past Aerospace Projects and Activities

SCIENTIFIC ARGENTINE SATELLITE: SAC-B (CONAE) – 1994

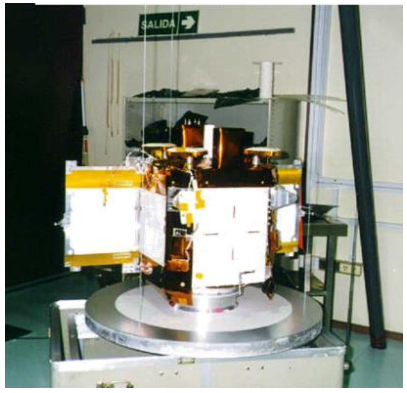
Mechanical Tests and Mass Properties Determination (PF Units and Development Units)

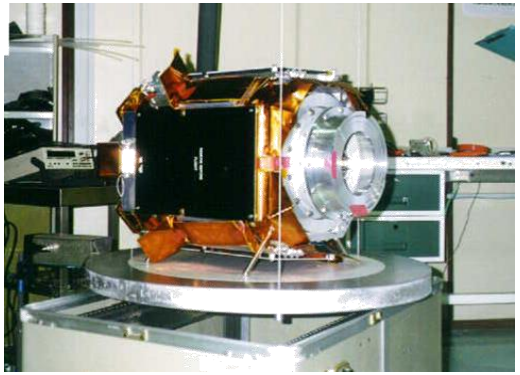




SCIENTIFIC ARGENTINE SATELLITE: SAC-A (CONAE) – 1997

Mass Properties Determination

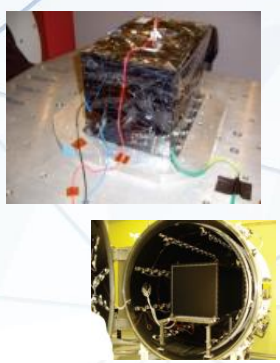




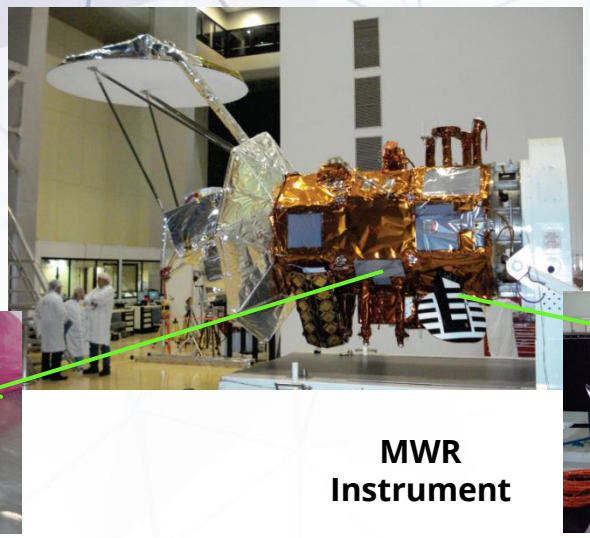
Past Aerospace Projects and Activities

SCIENTIFIC ARGENTINE SATELLITE SAC-D (CONAE)
SAC-D/Aquarius (NASA) MISSION – 2006-2011

NIRST Instrument



MWR Instrument



Four of five Argentina´s Instruments were developed at the UNLP laboratories with the participation of IAR, CIOP, LEICI , CETAD and GEMA

Activities for MWR and NIRST

- Structural, Mechanical and Thermal Design, Simulation and Analysis.
- Structure and Thermal Hardware manufacture.
- PF Instruments Integration
- Environmental Tests: Structural (Vibrations and Shock) and Thermal.
- Mass Properties: CG., Mass, M.I.

Activities for different SAC D´s Instruments:

- Mechanical Vibration Tests (ROA, ROSA, GPS, PAD, TDP, X and S Antennas)
- MLI design and manufacture (SP, S and X band Antennas)

Centro Tecnológico Aeroespacial

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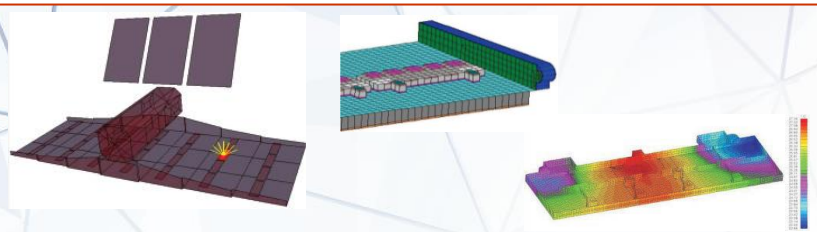
Past Aerospace Projects and Activities

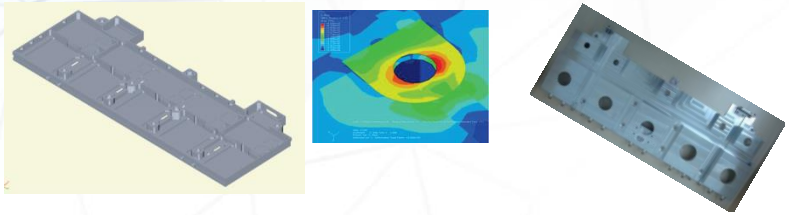
SCIENTIFIC ARGENTINE SATELLITE SAOCOM 1A - 1B (CONAE)
2011 - 2020

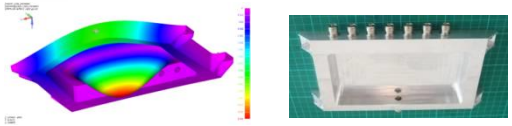
Thermal analysis and design of SAOCOM SAR Antenna and its components



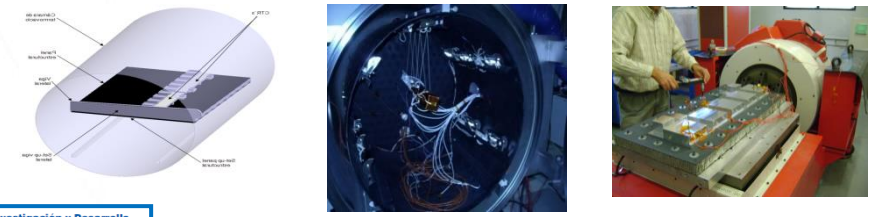
SAOCOM SAR Antenna

SAOCOM SAR Antenna components structural analysis and design

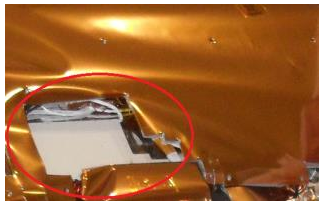




Design and performing thermo-vacuum and structural tests of SAOCOM SAR Antenna components



Design, construction and integration of different devices and thermal hardware (MLI).



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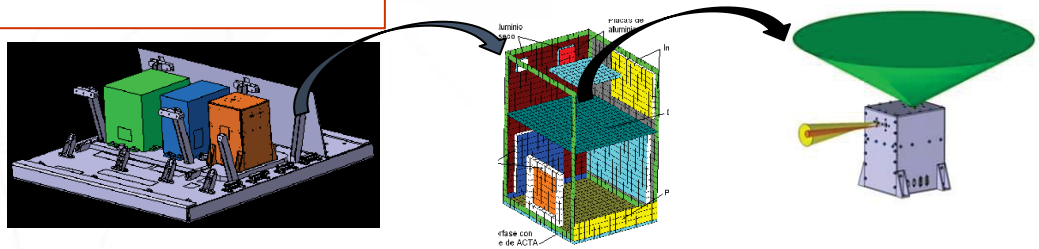
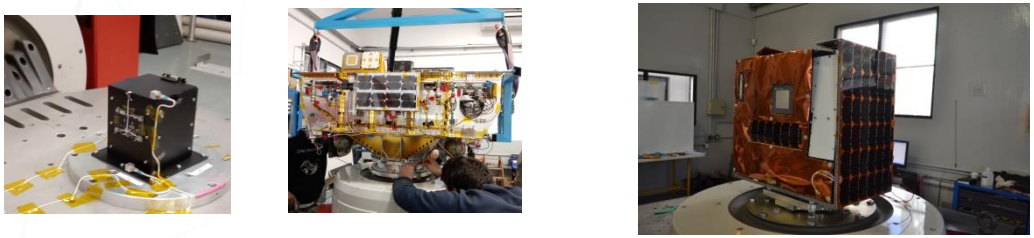
Past Aerospace Projects and Activities

SCIENTIFIC ARGENTINE SATELLITE SAOCOM 1A - 1B (CONAE)
2011 – 2020
Structural and Thermal Analysis of SAOCOM S Band and X band Antennas and Tests

ARSAT 1 (ARSAT - INVAP CNEA) - 2010
Structural and Thermal Design and Analysis of MARE (Space Radiation Argentine Monitor)



SATELLOGIC / Innova Space / Immer / EPIC– 2010-2023
Performing Structural Tests over Small Satellites and Platforms

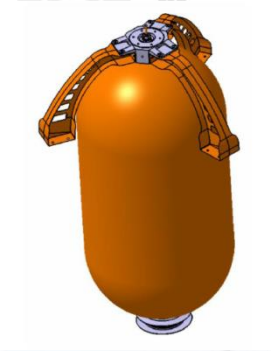


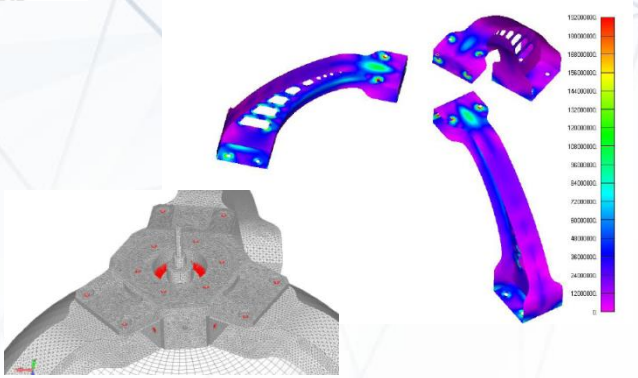
Past Aerospace Projects and Activities

INVAP ARSAT 1 &ARSAT 2 - 2010

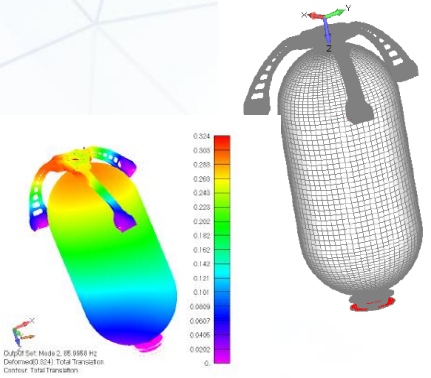
Structural Analysis of Satellite´s Components

ARSAT 1 HELIUM TANK SUPPORT

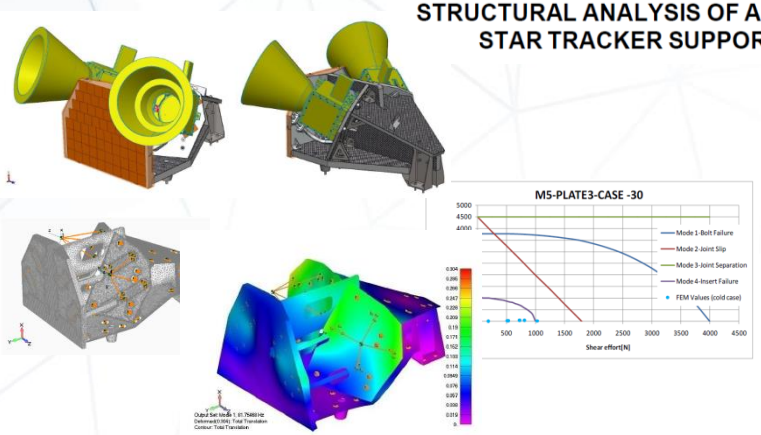




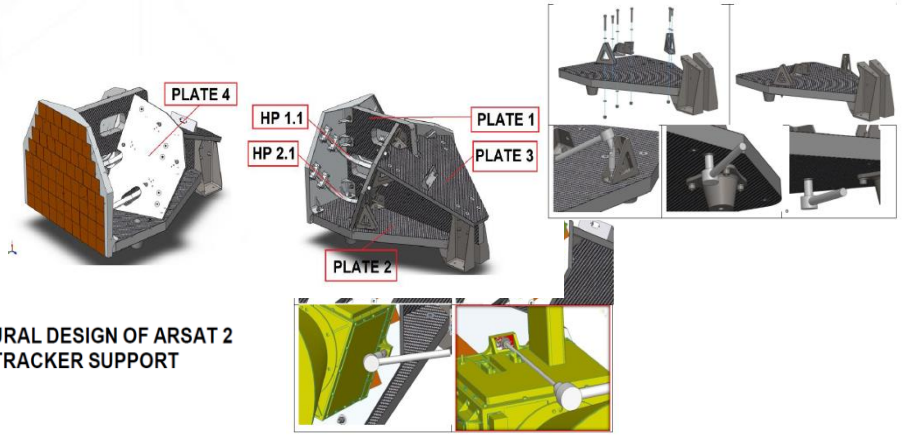
STRUCTURAL ANALYSIS OF ARSAT 2 HE TANK SUPPORT SIMPLIFIED FE MODEL



STRUCTURAL ANALYSIS OF ARSAT 2 STAR TRACKER SUPPORT

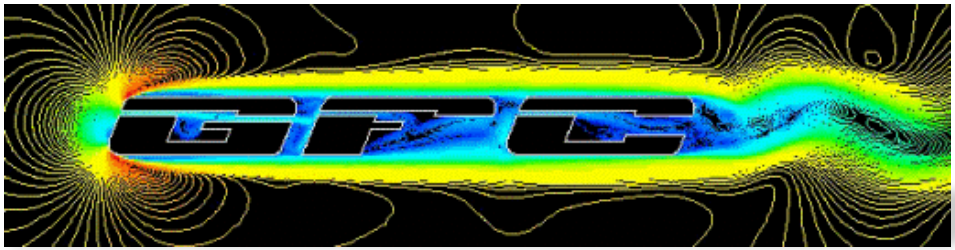


STRUCTURAL DESIGN OF ARSAT 2 STAR TRACKER SUPPORT



UID Computational Fluid Dynamic Group (GFC)

Directors : Professor. Ana Scarabino / Proffesor Federico Bacchi



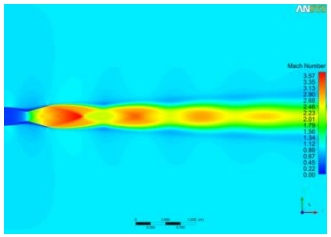
Numerical Analysis and Simulation of Fluid Dynamic and Aerodynamics Problems.

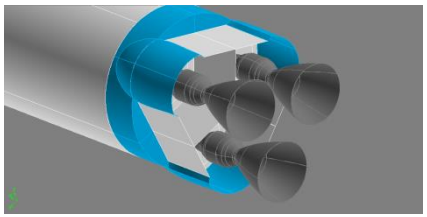
MAIN GOALS

- Development and Validation of CFD codes for Research and Analysis of complex problems.
- Numerical and Experimental Research in Fluid Mechanics.
- Fluid Dynamic and Aerodynamic research Activities (Thermodynamics and Propulsion).
- HR Training and Postgraduate Courses on Fluid Mechanics, Aerodynamics and Turbomachinery.

Activities - PROJECTS

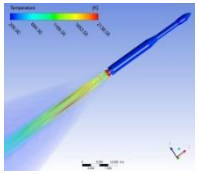
Deflector jet Design of a rocket engine

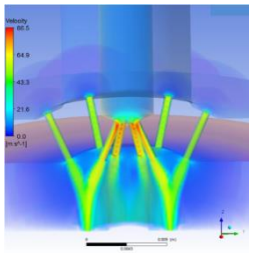


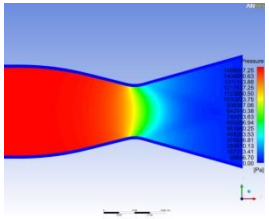


Fuid Dynamic and Thermal Analysis of rocket engine

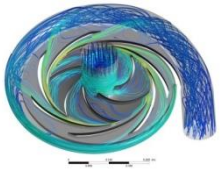
Rocket motor bipropelent injectors Design

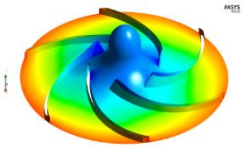






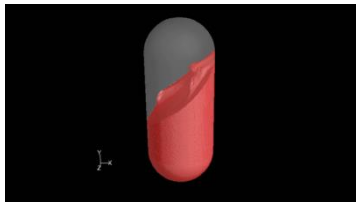
Nozzle Pressure Analysis

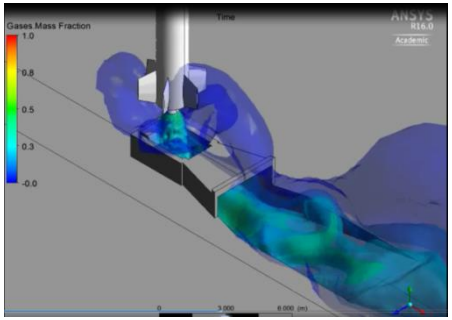




Turbopump Flow Simulation and Analysis

Sloshing Analysis in fuel tank





Jet Rocket Analysis on ramp

UID LaCLyFA

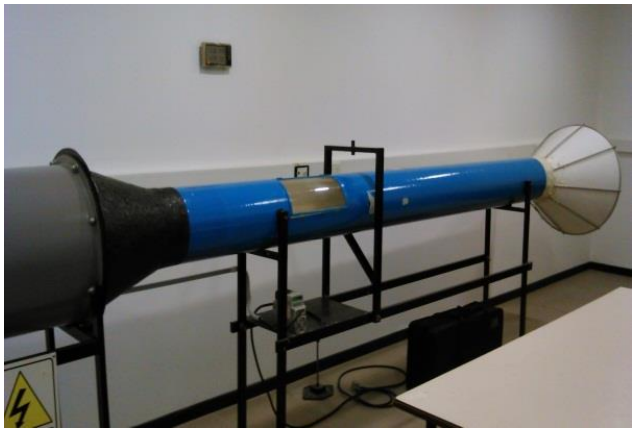
[Research And Development Unit – Boundary Layer and Environmental Fluid Dynamic Laboratory]

Directors : Professor Julio Marañón / Sebastián Delnero

Fluid Dynamic and Aerodynamics Design and Tests.

UID LaCLyFA

[Research And Development Unit – Boundary Layer and Environmental Fluid Dynamic Laboratory]

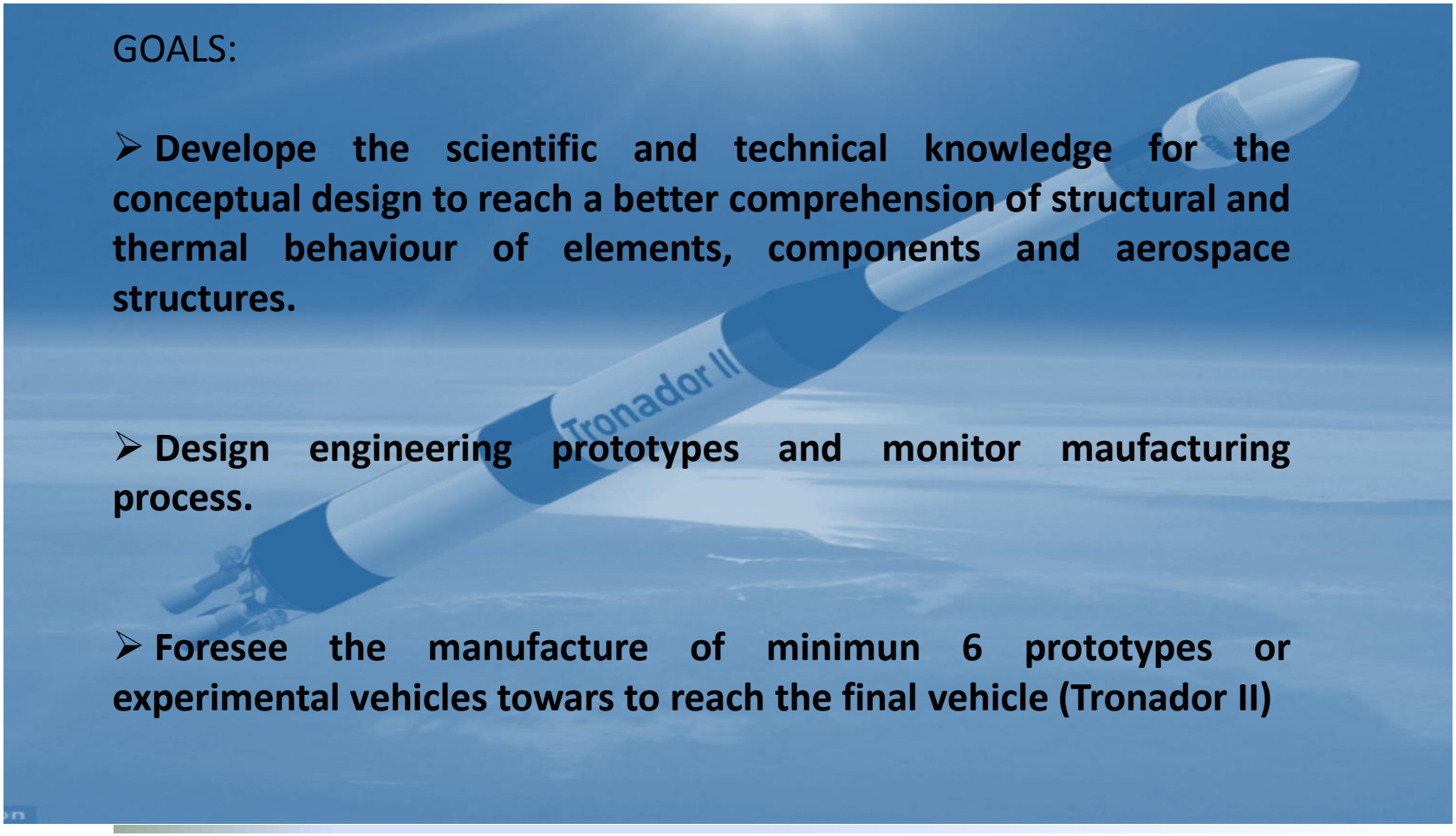


Test Laboratory: Wind Tunels

PROJETS – LAUNCH VEHICLES

TRONADOR II LAUNCH VEHICLE PROJECT

Conceptual and Preliminary Design for the integral project to develope structures, mechanical, auxuiliar systems and mechanical GSE of the TRONADOR II prototype.



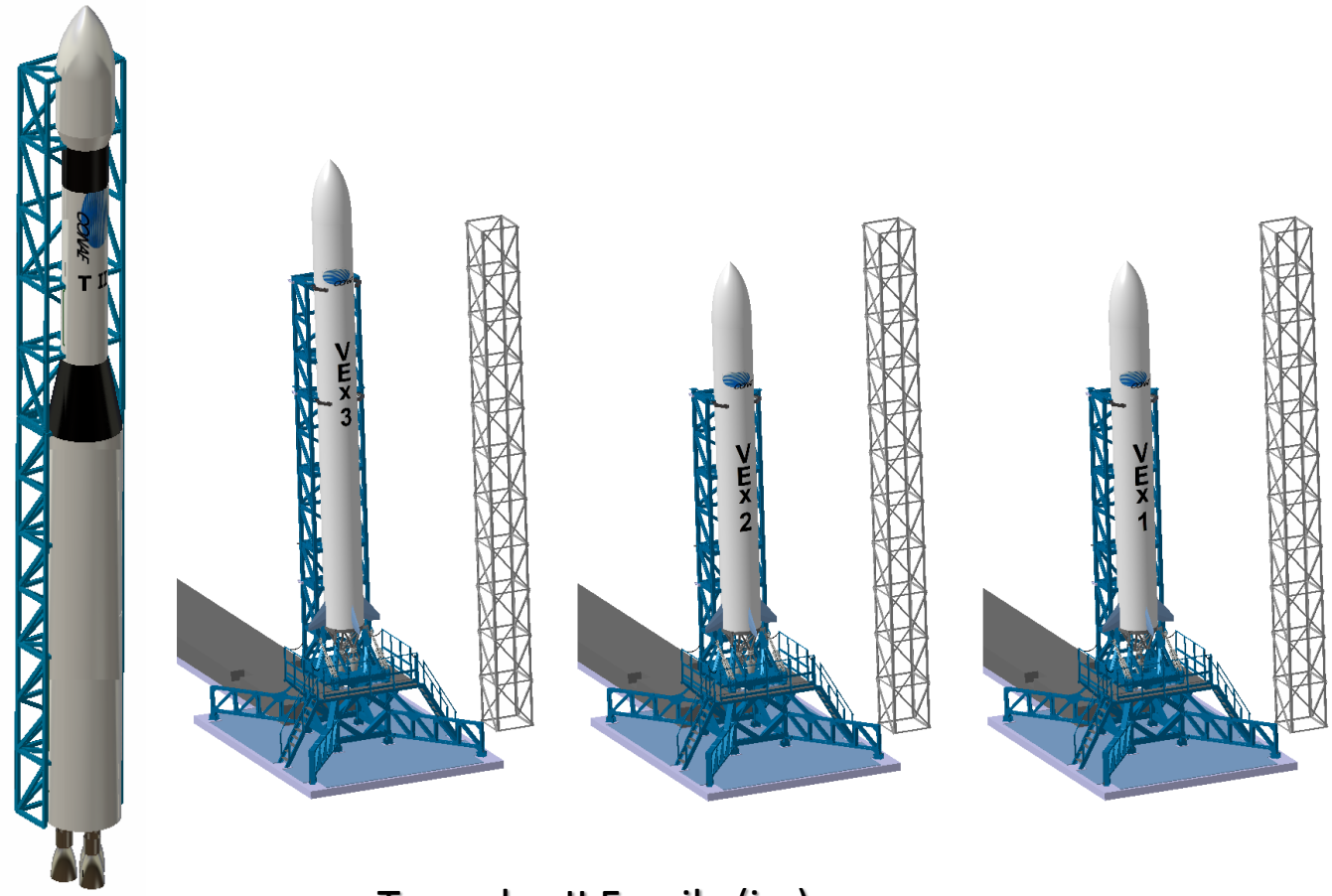
GOALS:

- **Develope the scientific and technical knowledge for the conceptual design to reach a better comprehension of structural and thermal behaviour of elements, components and aerospace structures.**

- **Design engineering prototypes and monitor maufacturing process.**

- **Foresee the manufacture of minimun 6 prototypes or experimental vehicles towars to reach the final vehicle (Tronador II)**

PROJETS – LAUNCH VEHICLES

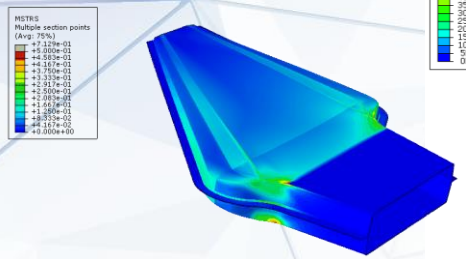


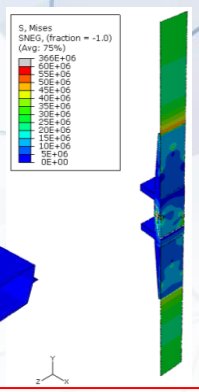
Tronador II Family (i.e)

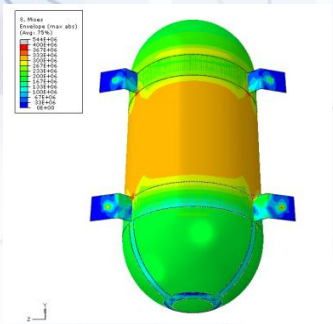
CENTRO TECNOLÓGICO AEROESPACIAL

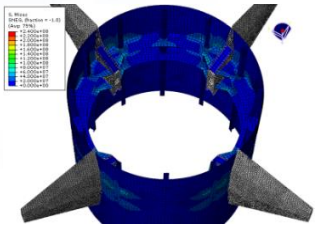
Past Aerospace Projects and Activities

VEx1





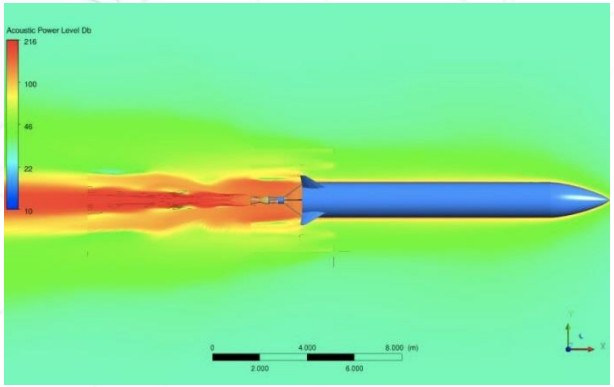


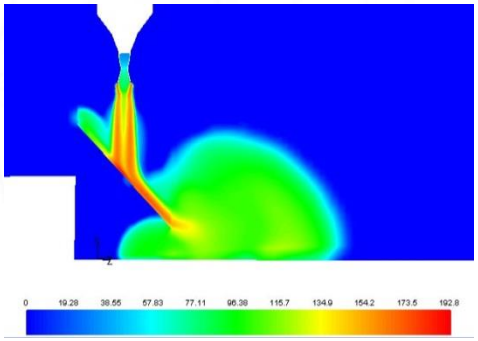


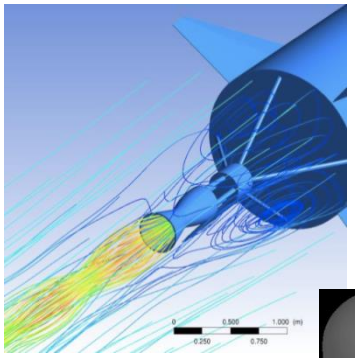
Structures

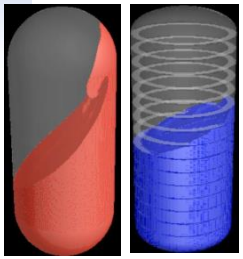
Unidad de Investigación y Desarrollo
G.E.M.A.
Grupo de Ensayos Mecánicos Aplicados

Analysis and Simulation (statics and dynamics) / Design / Testing

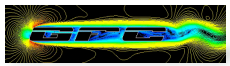








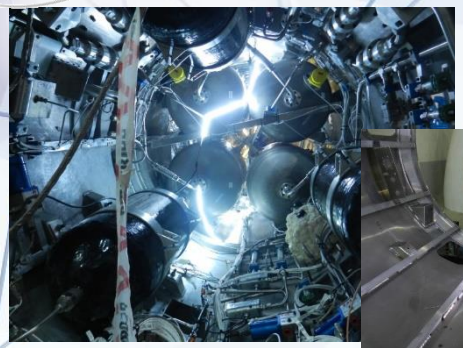
Fluid Mechanics



Analysis / Simulation / Performance analysis / Pogo / Sloshing / Antivortex / Piping

Past Aerospace Projects and Activities

VEx1



VEx 1 in La Plata Laboratory

Integration and Manufacturing

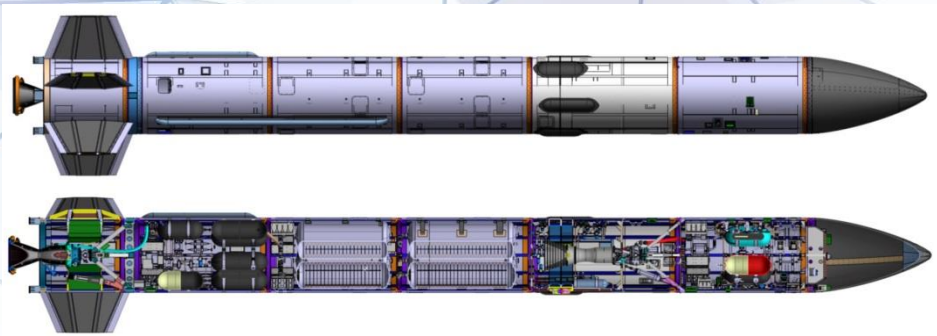
Man Power

Past Aerospace Projects and Activities

VEx1 at Launch Pad

VEx1

Past Aerospace Projects and Activities



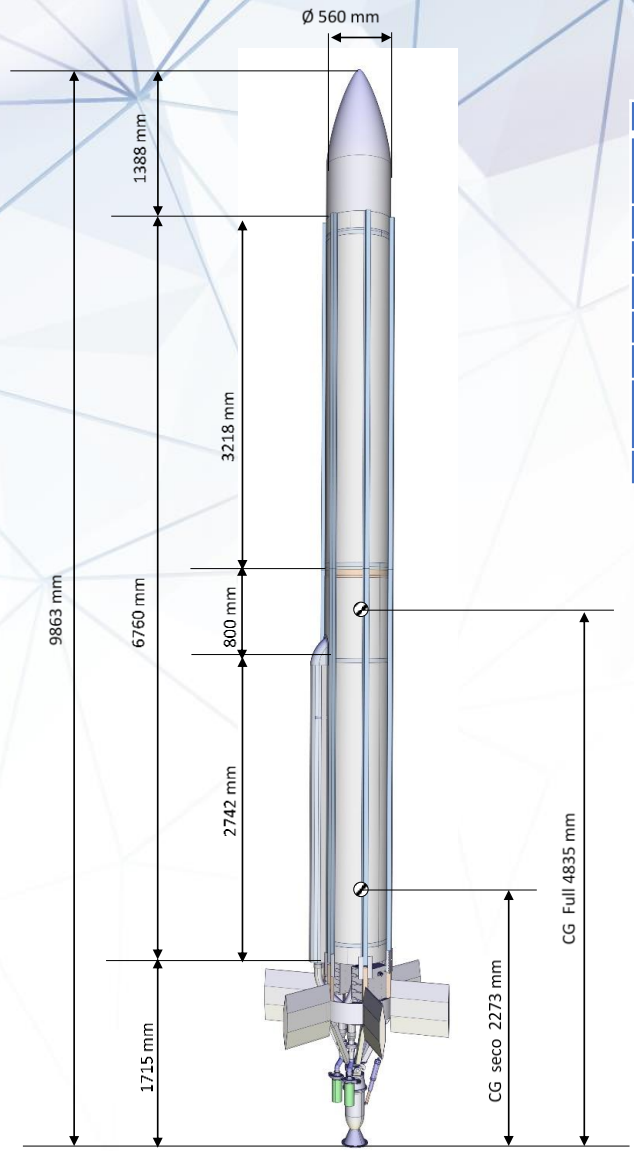
VEx5A

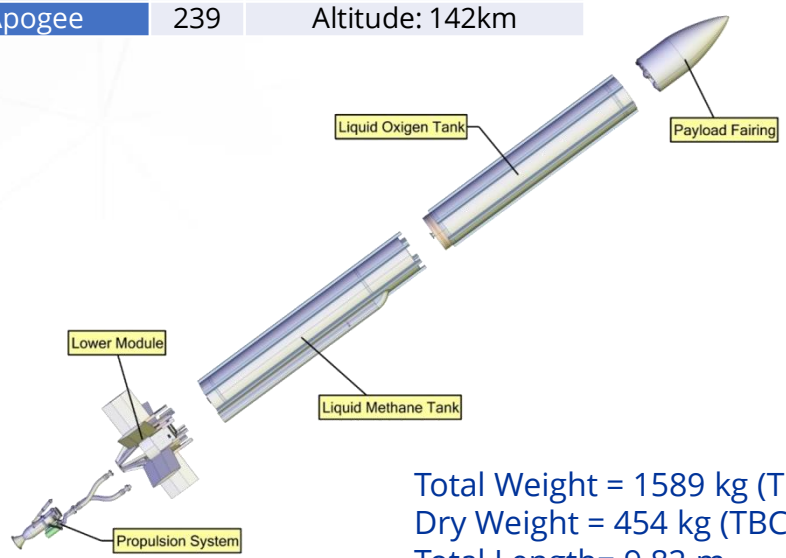
Design / Layout Manufacturing
Structural Analysis

Today and Future Projects

VE-CTA Performance

Events	t (s)	Description
Fire	-2	Thrust (nominal at SL 25kN
Lift Off	0	Accel: 1,53g
Mach 1	44	Altitude: 6,7km
Max Q	50	30kPa, Altitude: 8,9km
Max accel.	119	5,8g, Altitude: 69,2km
MECO	120	Altitude: 70,7km
Fairing Opening	133	Altitude: 85km
Apogee	239	Altitude: 142km

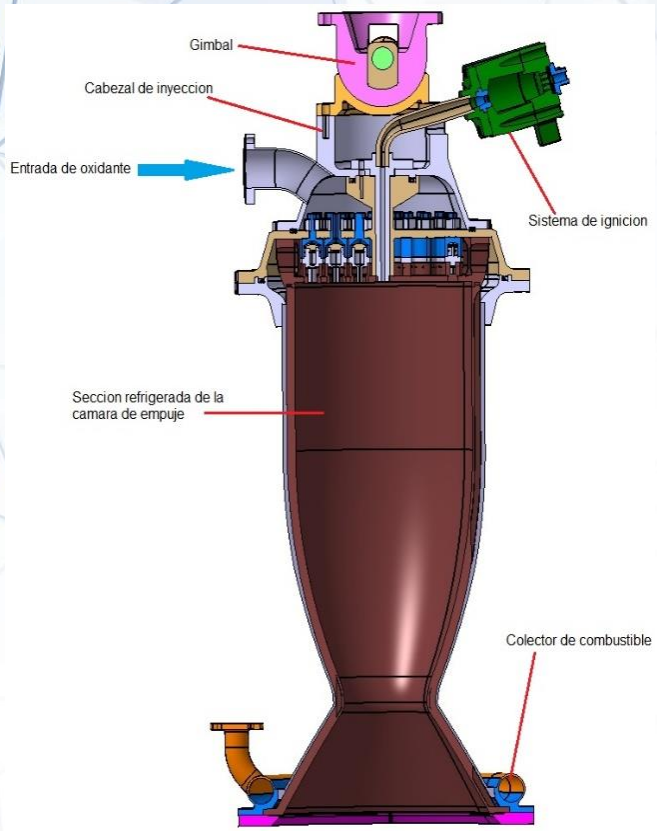




Total Weight = 1589 kg (TBC)
Dry Weight = 454 kg (TBC)
Total Length= 9.82 m
Aluminum Tanks
CRP Fins and Fairing
LiPo/LiFePO4 Batteries

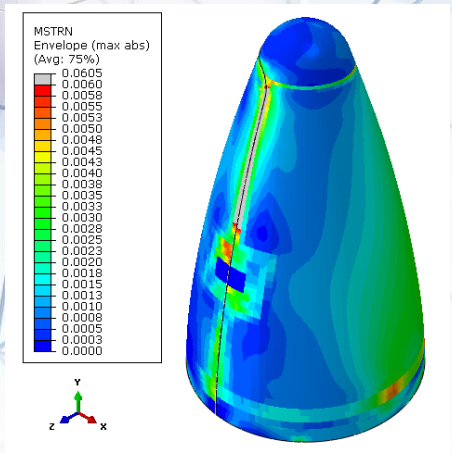
Today and Future Projects

VE-CTA Rocket Engine – Electric pump FED



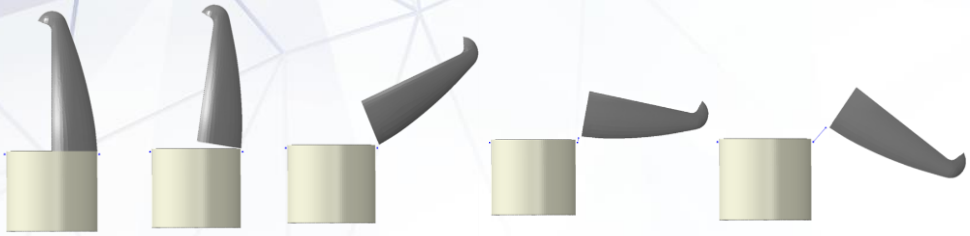
Fuel	Liquid Methane (LCH4)	--
Oxidant	Liquid Oxygen (LOX)	--
Feed System	Electropumps	
Absolute pressure inside combustion chamber	35	Kg/cm^2
Adapted Nozzle Exit Plane Absolute pressure (P_e)	0,01 (0,00101)	kg/cm^2 (MPa)
Mix ratio $(R = O/F)$	3,2	--
Thrust (adapted Nozzle)	3500	Kgf
Thrust (vacuum)	3602	kgf
Design altitude of nozzle (Adapted pressure)	31150 (0,01)	m (kg/cm^2)
Expansion ratio (optimum) (ε_e)	215,1	--
Burning Time (nominal)	400	Sec
Thrust chamber design type	Cooled until Patm + radiative	--
Thrust control	Throttling de TBD %	--
Injectors	Coaxial – swirl	--
Specific Impulse (I_{VAC})	391,5	seg
Total Mass flow (gases) $(\dot{m}_M)$	9,44	Kg/s
Fuel Total Mass Flow $(\dot{m}_{M-f})$	2,24	Kg/s
Fuel Average Density (ρ_f)	429,37	Kg/m^3
Fuel Total Volumetric Flow (Q_{M-f})	5,23 (0,00523)	litros (m^3/seg)
Oxidant Total Mass Flow $(\dot{m}_{M-ox})$	7,19	Kg/s
Oxidant Average Density (ρ_{ox})	1151,15	Kg/m^3
Oxidant Total Volumetric Flow (Q_{M-ox})	6,25 (0,00625)	liters (m^3/sec)
Thrust at sea level (F_{SL})	2595,67 (25,43)	kgf (kN)

Today and Future Projects

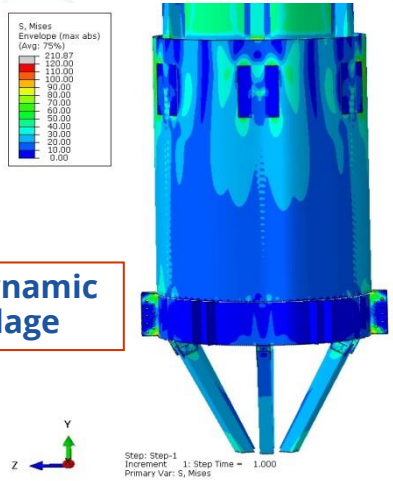


Fairing Structural Analysis

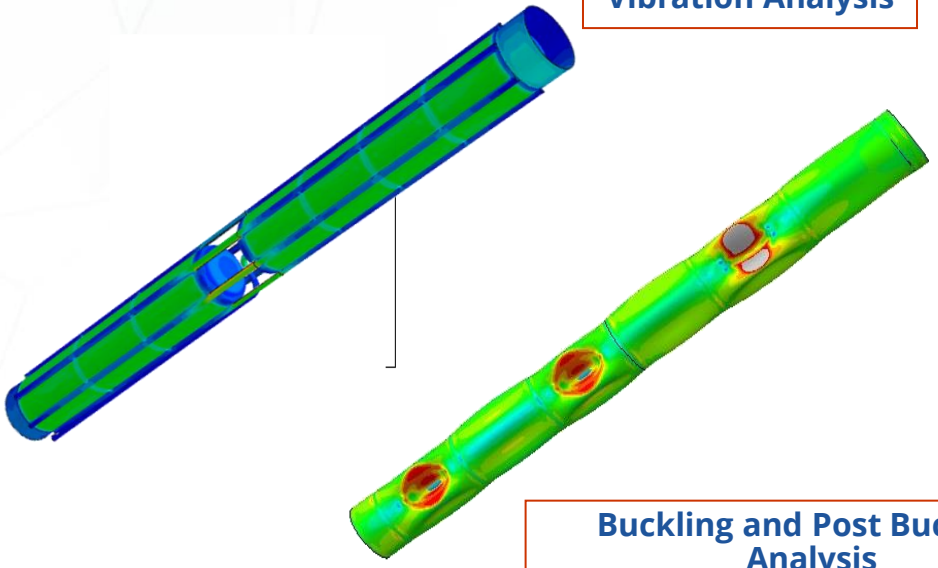
Fairing Separation Dynamic Analysis



Vibration Analysis



Non Linear And Dynamic Analysis of Fuselage



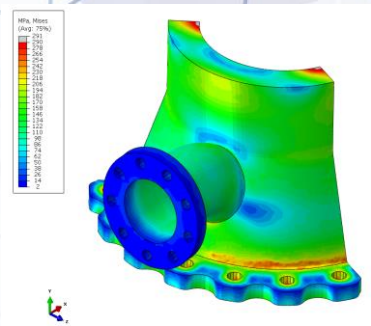
Buckling and Post Buckling Analysis

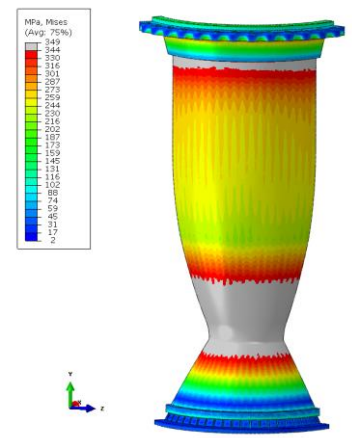
VE-CTA – Structural Analysis

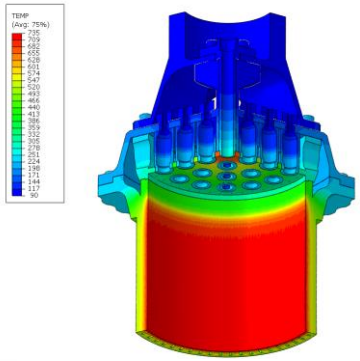
Today and Future Projects

VE-CTA – Rocket Engine Structural Analysis

Engine Structural and Thermal Analysis

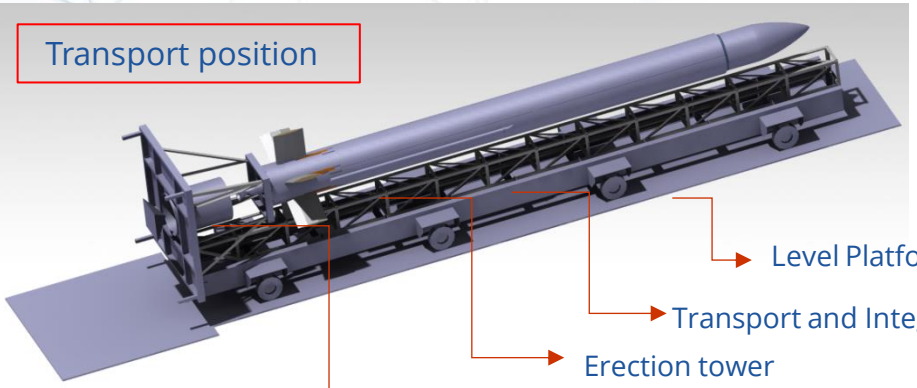




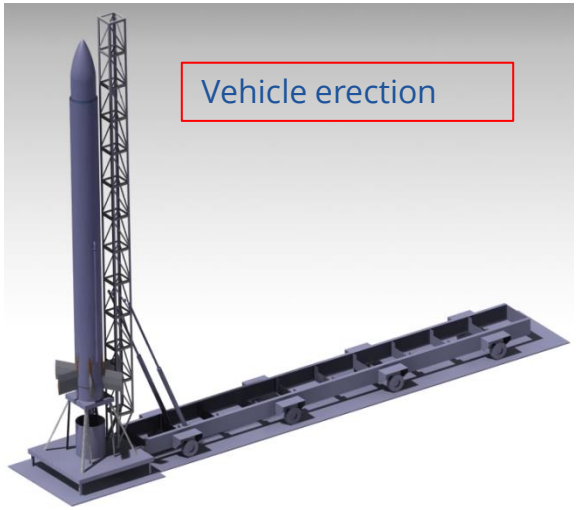


VE-CTA Integration and Launch Systems

Transport position

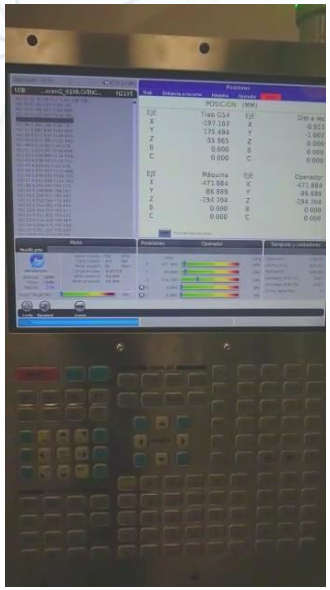


Vehicle erection



Today and Future Projects

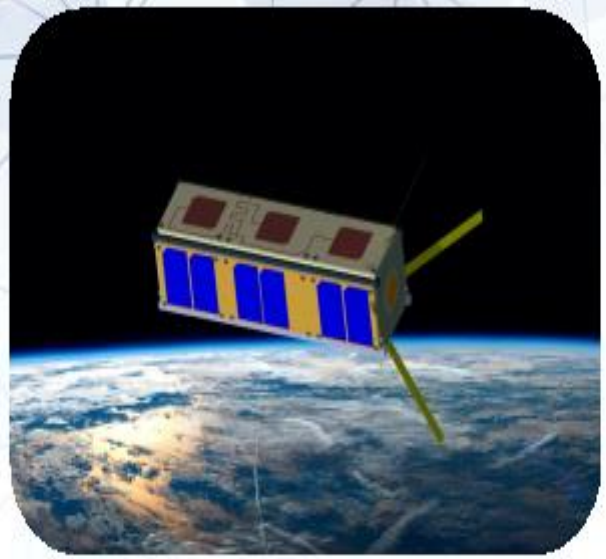
HAAS 5 Axis CNC Machine



VE-CTA Manufacturing

From 3D Virtual Mock Up to Real Manufacturing

Today and Future Projects



University Satellite Programme- Series of CubeSats

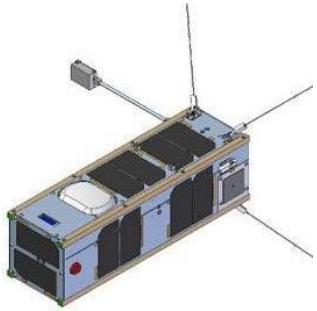
Current Mission:

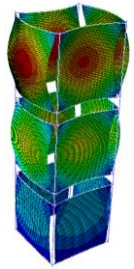
USAT 1 – GNSS Techniques Technology Demonstrator

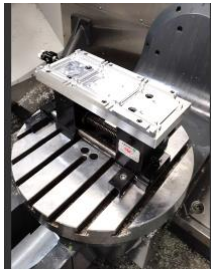
- Currently **under development** (Manufacturing and Testing)
- Estimated launch: **Q4 2023**

Future Missions:

1. Quantum Communications Technology Demonstrator
2. ADCS and Navigation for Lunar Missions Demonstrator
3. Missions in collaboration with local and international partners





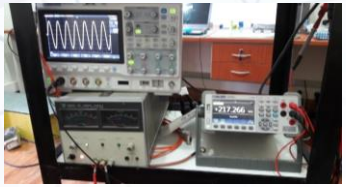


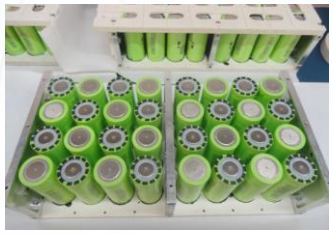
Today and Future Projects

Lithium Battery Development

CAPABILITIES:

- Design, Integration, Manufacturing and Test of Lithium Batteries for military and Aerospatial use.
- Structural and Thermal Design
- Electrical testing
- Environmental Tests (Vibration and Thermo Vaccum)
- Welding Procces





OUR EXPERIENCE: (AEROSPACE USE):

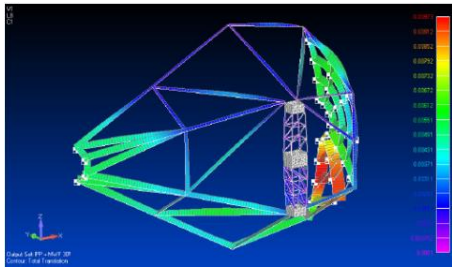
- SAC-C, SAC-D, Satellites
- SAOCOM Satellite (in progress)
- Tronador II Launcher Project
- Design, manufacturing and batteries tunning
- Experimental Vehicles VEx 1ª, VEx 1B and VEx 5A
- Automotive Use battery Manufacturing and design (2 Buses for Universitary use among others)

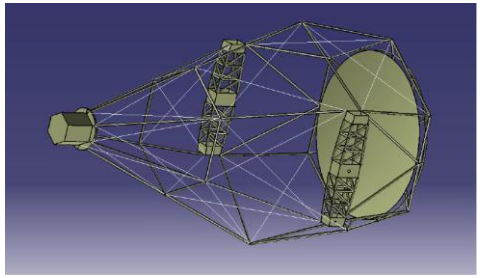
Other Projests and Activities

EU Collaborations:

"CTA (Cherenkov Telescope Array)"

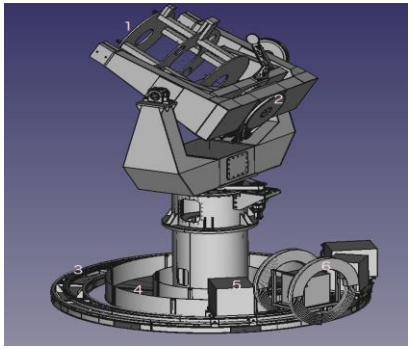
Structural and Mechanical Design of 6 meters in diameter of Telescope Mount for the astronomy detection of Gamma Rays





QUBIC EXPERIMENT Collaboration

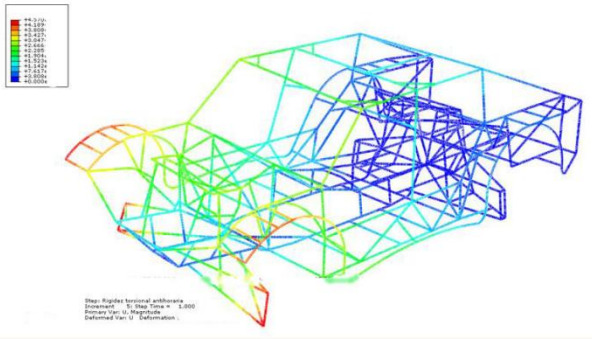
Structural and Mechanical Design of QUBIC Telescope Mount for the astronomy Deep Space observation



Other Projests and Activities

Argentinian Army Vehicle "GAUCHO"

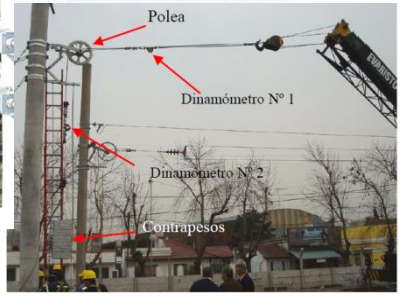
- ✓**Advice for Structural and Mechanical review**
- ✓**Execution of Mechanical Tests for the approval of parts**
- ✓**Participation in the Advisory Commission of the Ministries of Defense**



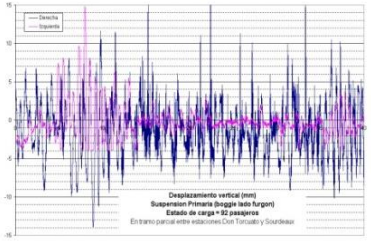
ACTIVITIES ON RAILWAY COMPONENTS

Railway sleepers tests

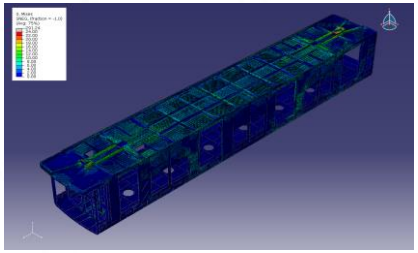
Mechanical tests

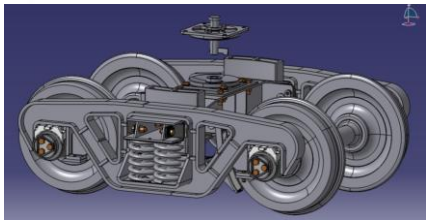


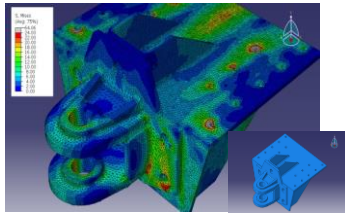
Flamability Tests.



Dynamic analysis of structures







Structural Analysis of train components

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ACTIVE AND PASSIVE SAFETY COMPONENTS CERTIFICATION

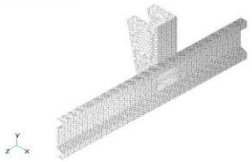
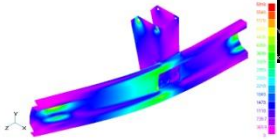
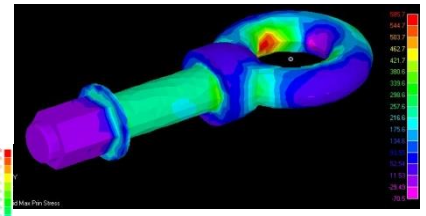
Evaluation of active and passive vehicle safety systems

- Brake Systems
- Bolts/Eyelets
- Hitching Plates







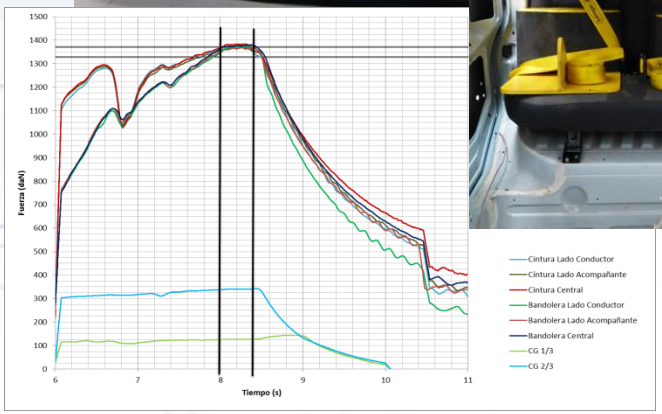





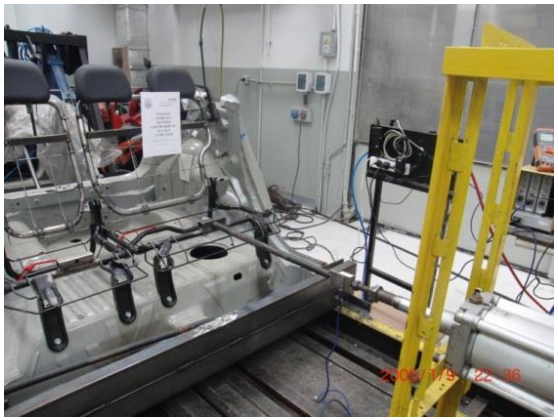
Tests performed under Argentinian and International Laws and Standards:

- ❑ **Ley 24449 Ley de Transito**
- ❑ **Decreto 779/95 Reglamentario de la Ley de Transito**
- ❑ **Normas IRAM**
- ❑ **Reglamentos de Naciones Unidas (UNECE), entre otras.**

ACTIVE AND PASSIVE SAFETY COMPONENTS CERTIFICATION

Testing and Evaluation of seat belts and car seats





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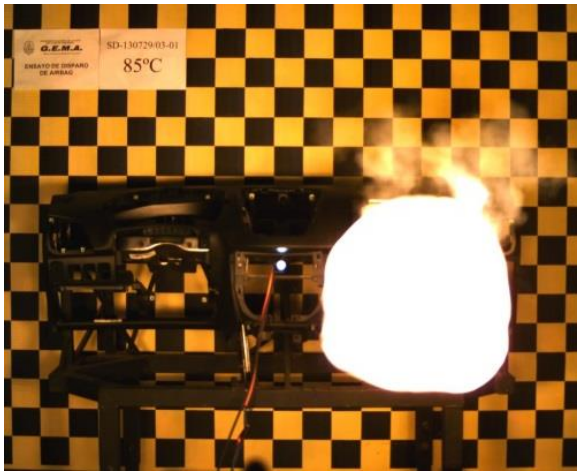
Grupo de Ensayos Mecánicos Aplicados

COMPONENTS TESTING (Safety)

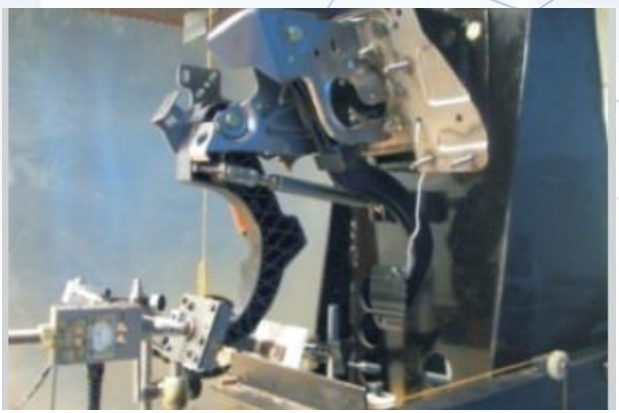
Airbag Testing Laboratory 200 m2

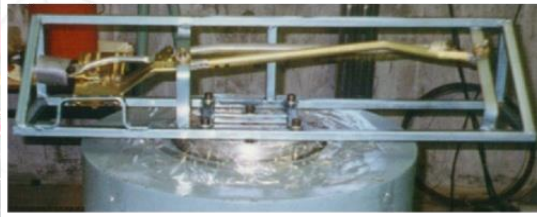
Airbag Firing Tests at Room Temperature, -35ºC and +85ºC

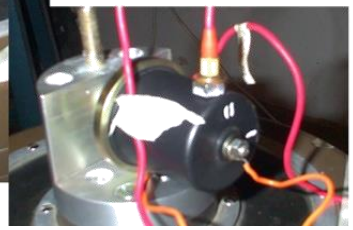


DIFFERENT COMPONENTS MECHANICAL AND THERMAL TESTING

Mechanical tests for components validation



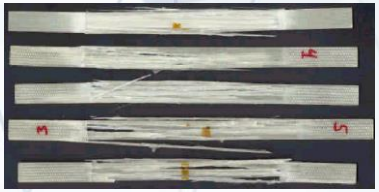




DIFFERENT COMPONENTS MECHANICAL AND THERMAL TESTING

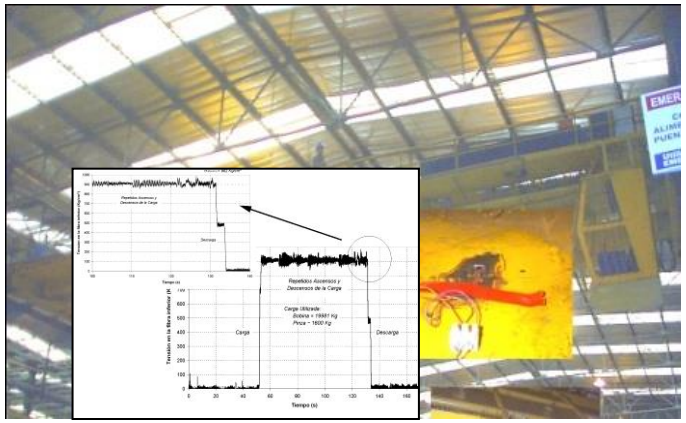
Tests for the determination of Physical Properties on different types of components and materials

- -Tensile tests
- -Compression Tests
- -Flexion Tests
- -Cutting Tests
- -Hardness Tests
- -Torsion tests
- -Fatigue tests
- -Flammability Tests





Measurements of Accelerations, Displacements and Deformations (On Site or in Laboratory)

THANK YOU FOR YOUR ATTENTION

CTA (*Aerospace Technology Center*)

UID G.E.M.A. [Research And Development Unit - Applied Mechanics Testing Group]

UID GFC [Research And Development Unit – Computational Fluid Dynamic Group]

UID LaCLyFA [Research And Development Unit – Boundary Layer Laboratory]

http://www.gema.ing.unlp.edu.ar

http://www.cta.ing.unlp.edu.ar

La Plata – Buenos Aires - Argentina

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DEPARTAMENTO DE AERONÁUTICA

FACULTAD DE INGENIERIA

UNIVERSIDAD NACIONAL DE LA PLATA