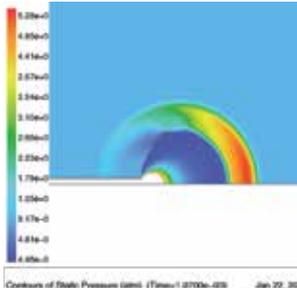




Specialized Master in **Pyrotechnics and Propulsion**

ISO 9001: 2000 certification
for all its activities.



Simulation de l'effet de souffle engendré par un canon.

Industry Partnerships:

- > CNES
- > Dassault Aviation
- > Davey Bickford
- > EADS Astrium
- > Gaz de France
- > INERIS
- > Lacroix
- > Livbag Autoliv
- > MBDA
- > Nexter
- > PyroAlliance
- > Roxel
- > SAFRAN - Snecma
Propulsion Solide
- > SNPE / SME
- > TDA
- > TNO

>Pyrotechnics and Propulsion ?

The aim of this course is knowledge of combustion, deflagration and detonation phenomena. These physical phenomena are characterized by high temperatures and pressure, reached in a short period of time.

The acquisition of high-level expertise enabling the integration of these phenomena into a complex, mechanical system and into specific manufacturing and application techniques, and practical use of substances which could generate such phenomena, are at the heart of this year of specialization.

>Fields of Application

The techniques studied, pyrotechnics and propulsion, are employed extensively in all sectors of industry:

- > **Aerospace** (rocket propulsion, satellites)
- > **Defense** (missiles, military explosives)
- > **Automotive** (airbags, seatbelt pretensioners)
- > **Public works** (mines, sites, quarries)
- > **Industrial hazard prevention** (depollution of sites, fires, explosions...)

>Course Objectives

The curriculum furthers engineer training through the acquisition of high level technical knowledge in the following fields:

- > compressible and reactive fluid mechanics
- > the dynamic behavior of materials
- > the chemistry of energetic materials
- > rocket propulsion
- > processing methods and numerical simulations
- > pyrotechnic regulations

>Exemples of Final Year Projects

AEROSPACE

- > Outline of an innovative propulsion architecture with application of NFH₂ formulation (SME)
- > Architectural studies of multiple motors (SNECMA Propulsion Solide)
- > Study of pressure fluctuations in a solid fuel engine (ONERA)

RESEARCH

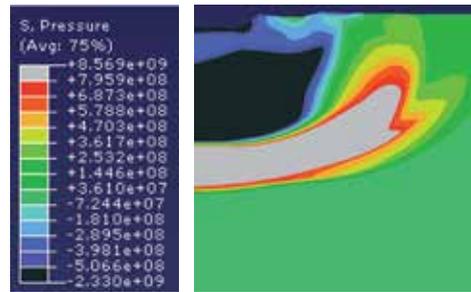
- > Interaction of a detonation wave in nitromethane with a gaseous cavity (CEA)
- > Study of the propagation of metastable deflagrations (Mc Gill University)

SAFETY AND PREVENTION

- > Compliance of the pyrotechnic safety study of the Lann Bihoué Naval Air Station
- > Application of a numerical simulation tool to fires in vertical or oblique volumes of underground rail networks (Laboratoire Central de la Préfecture de Police de Paris)

ARMAMENT AND DEFENSE

- > Characterization of percussion in pyrotechnic systems (ALSETEX)
- > Influence of the granulometry of aluminium on the explosive effects of enhanced blast explosives (Institut Saint Louis)

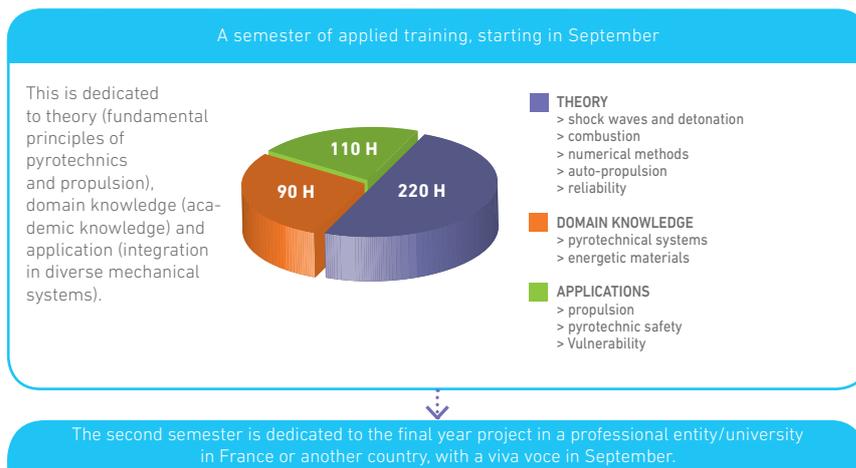


Simulation of laser impact propagation in a metal target.

Diploma accredited
by the Conférence
des Grandes Écoles

> Course comprising 2 semesters

100% of courses in French



Ensieta is a member
of the GTPS (Groupe de
Travail de Pyrotechnie)

Governmental and
Academic Partners

- > Académie Technique Militaire de Bucarest (Roumanie)
- > CEA
- > École Royale Militaire (Belgique)
- > ENSTA ParisTech
- > DGA Techniques terrestres
- > Groupe de travail de pyrotechnie (GTPS)
- > IRSN
- > Laboratoire central de la préfecture de police
- > Institut P'
- > Laboratoire LBMS
- > Pyrotechnie Saint Nicolas

> The only course of its type in France

Due to its military origins and thus extensive experience in the world of defence, ENSTA Bretagne can boast a long tradition of expertise in this field. You will profit from the expertise of the staff who are specialized in various areas of pyrotechnics. You will progress rapidly thanks to a pedagogical approach which combines theory and application.

> Admissions & enrolments

Entrance level: Master degree or equivalent.

Registration forms: Can be collected right from January. Completed files must be submitted strictly before April the 15th (Erasmus exchange students: May the 15th).

Selection: Based on written application and interviews.

Tuition fees: Individual candidate: €7.500 - Company or institution: €10.000

Requirements to pass the degree: The degree is awarded to students who have fulfilled all necessary examinations and their final thesis.

>>> Qualified teaching staff

All courses are given at ENSTA Bretagne either by research faculty members or by engineers who are specialists in their field of industry: SNPE, SNECMA, CEA, EADS, CNES...

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[670 STUDENTS]

[85 DOCTORAL FELLOWS]



>>> **ENSTA Bretagne**, trains high level engineers capable of designing complex industrial systems combining mechanics, electronics and IT, for the most innovative industrial sectors and the Ministry of Defense. Based in Brest since 1971, it offers training in marine sciences and technologies (naval architecture, offshore engineering, hydrography-oceanography, renewable marine energies), mechanical systems (vehicles, pyrotechnics), embedded systems (electronics, IT, automatics, robotics) and studies in humanities for engineers.

>>> **ENSTA Bretagne**, proposes several courses of study at engineer level and higher :

- Systems Engineering Course (5 year post 'A' Level course, post preparatory classes or on appropriate qualifications)
- Company-Linked Engineering Course in Mechanics and Electronics (5 year post 'A' Level, post BTS or DUT)
- Post Masters Degree (6 year post 'A' Level)
- Research Degrees : Research Masters (5 year post 'A' Level) and Doctorate (8 year post 'A' Level)
- Vocational Training (courses for professionals)

>>> **ENSTA Bretagne**, leads research activities, mainly based around Mechanics (Materials and Structures), IT (Informatics, Ocean Sensing and Mapping, Radar and Electro-Magnetic Sensing, Passive Acoustics) and Human and Social Sciences (educational Policies, professional Identity of Engineers). Through the sum of its activities in training and research, ENSTA Bretagne has links with a wide variety of partners : ENSTA Group, UEB (the Université Européen de Bretagne: European University of Brittany), GIS Europôle Mer, competitiveness clusters "Mer Bretagne", "ID4CAR", "Images et Réseaux", "EMC2", "Aéronautique et Espace" etc. Since 2007, ENSTA Bretagne has been certified ISO 9001 for all its activities.

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