

# New thermal mapping device dedicated to very high temperatures

[www.lisap.fr](http://www.lisap.fr)

## ➤ **OUTLINE**

- **Smart photoluminescent materials.**
- **Applications as thermal paints.**
- **New thermal mapping device principle.**
- **Examples of use in the Aerospace field.**
- **Conclusions**
- **References**

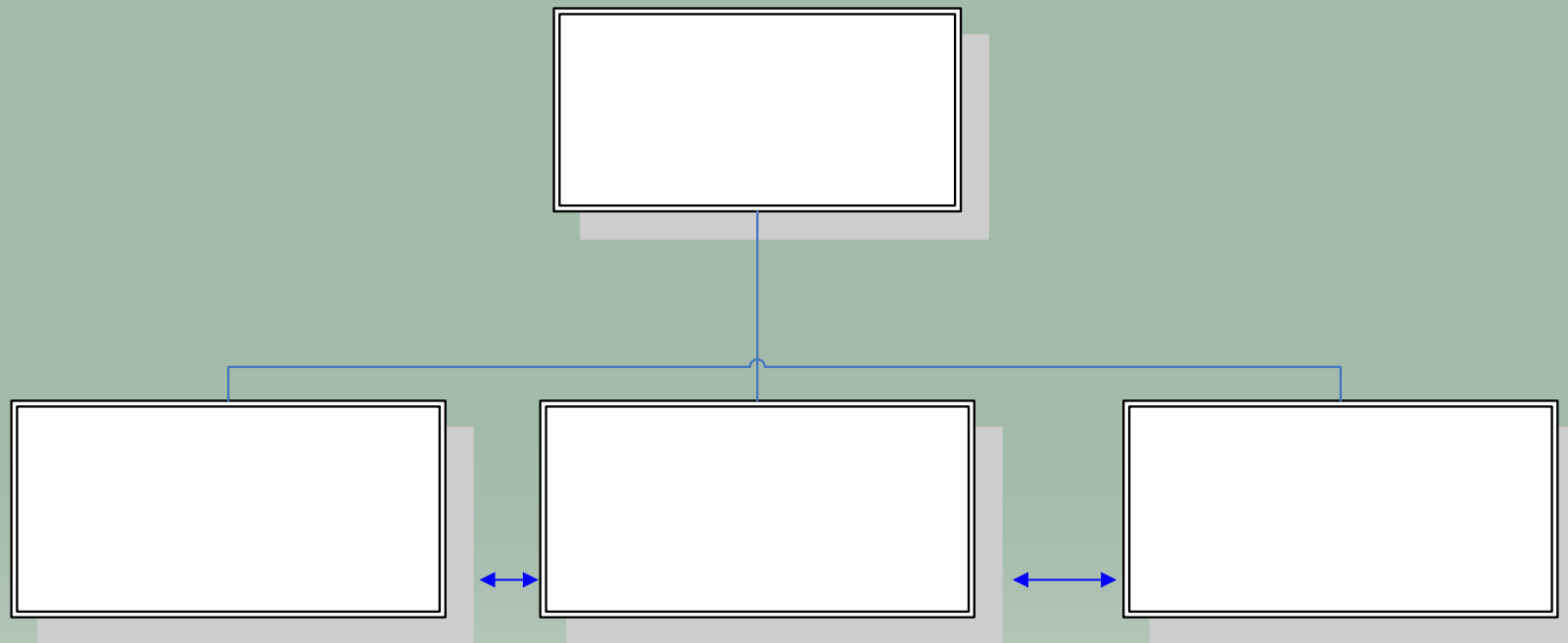


**Lauréat 2001**



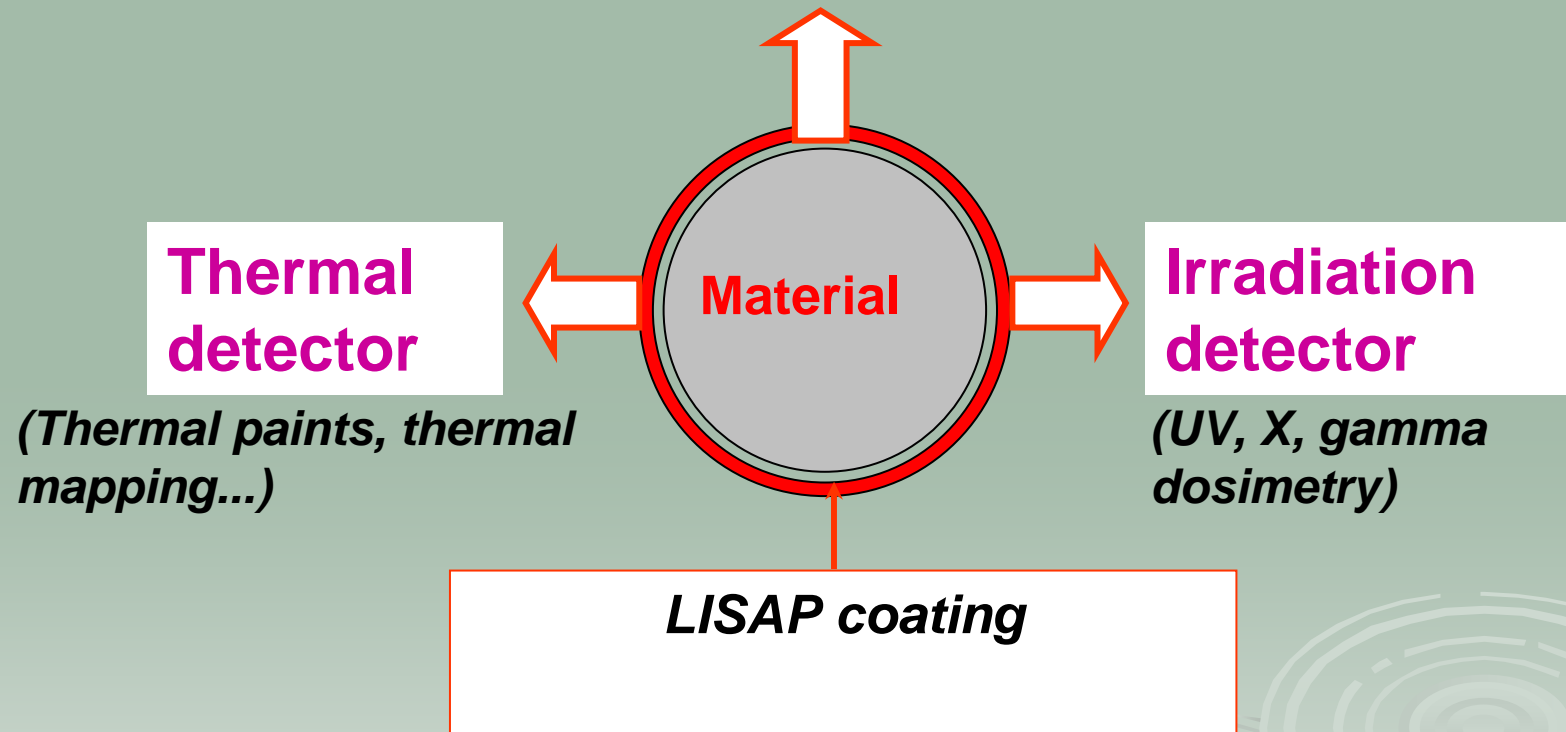
# Organization chart

(Luminescent Integrated Sensors Applied Protection)



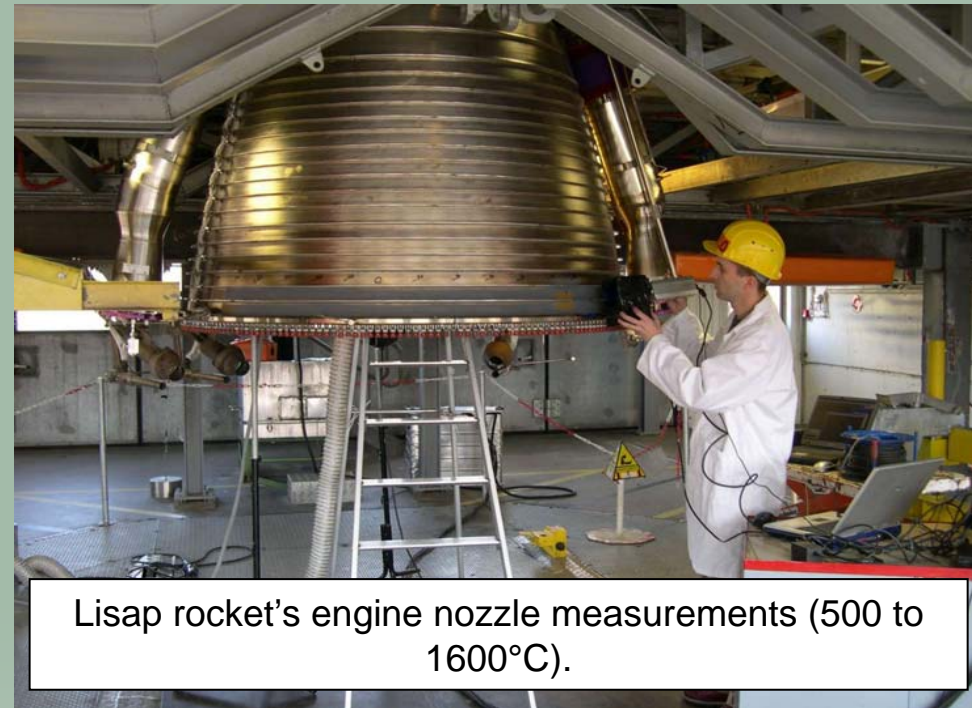
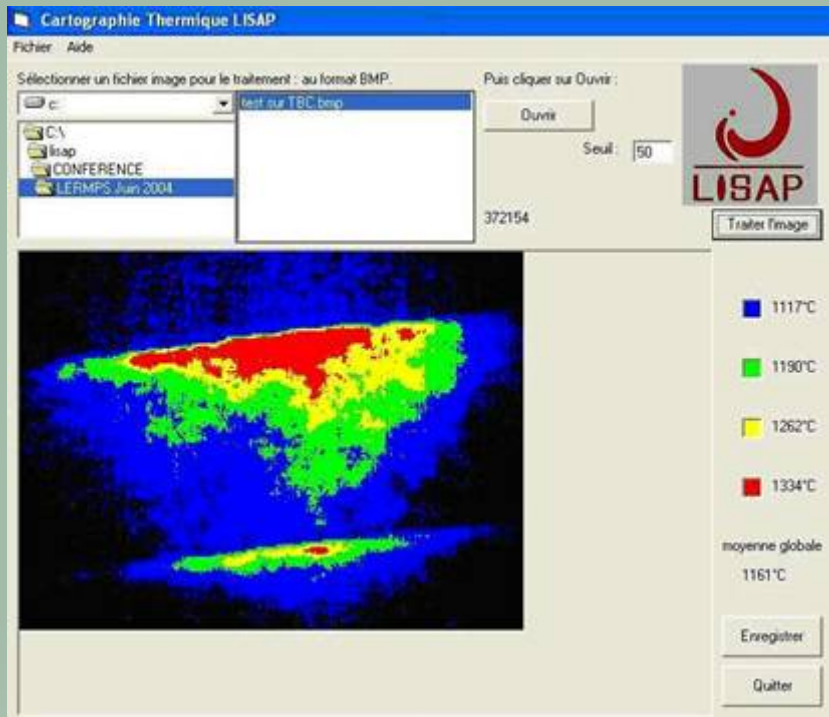
# LISAP photoluminescent materials

**Wear and identification marker**  
*(Infringement, cables...)*



# Thermal mapping with LISAP thermal paints

- 500°C to 1600°C -

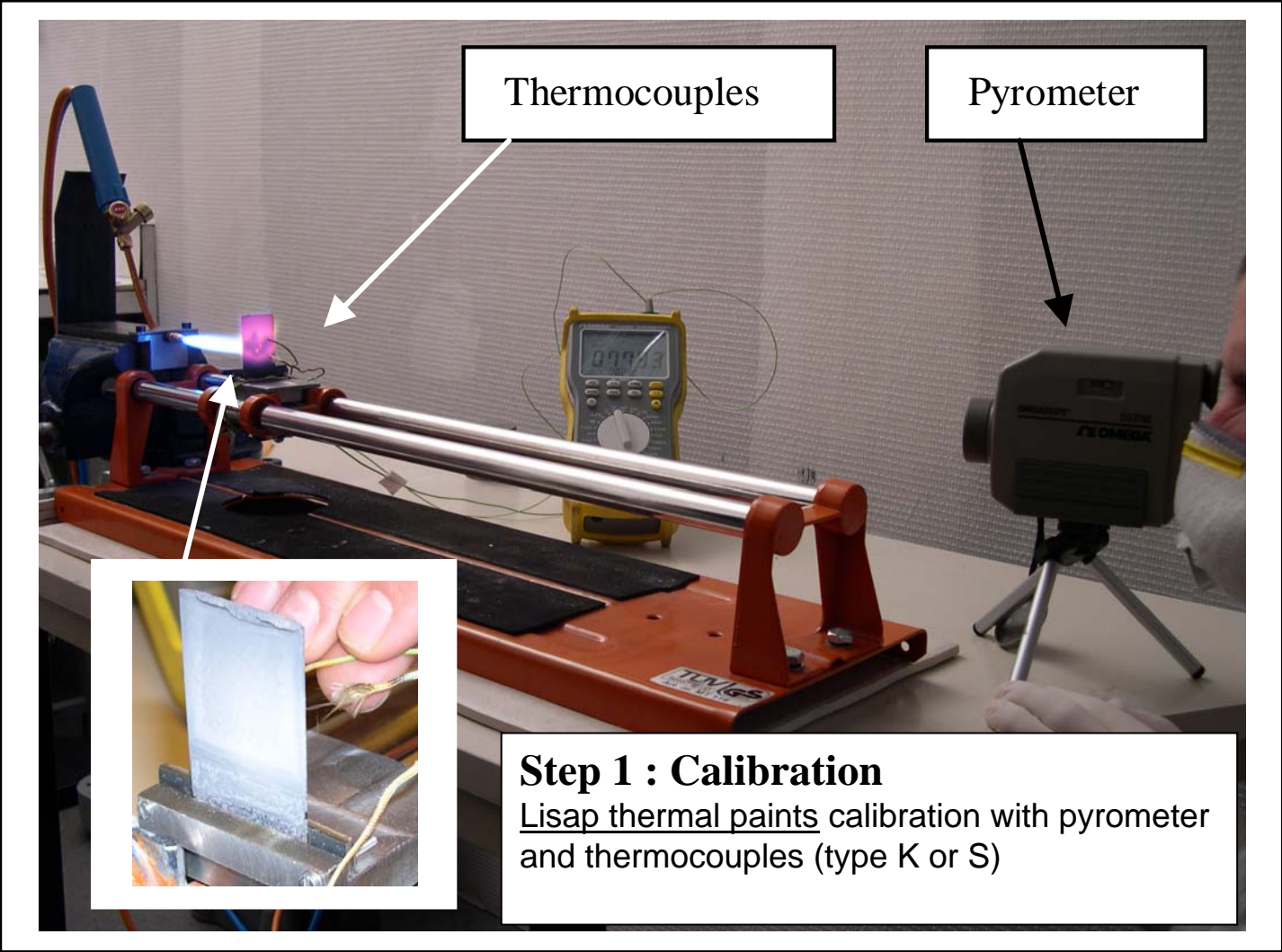


Lisap rocket's engine nozzle measurements (500 to 1600°C).

## Applications :

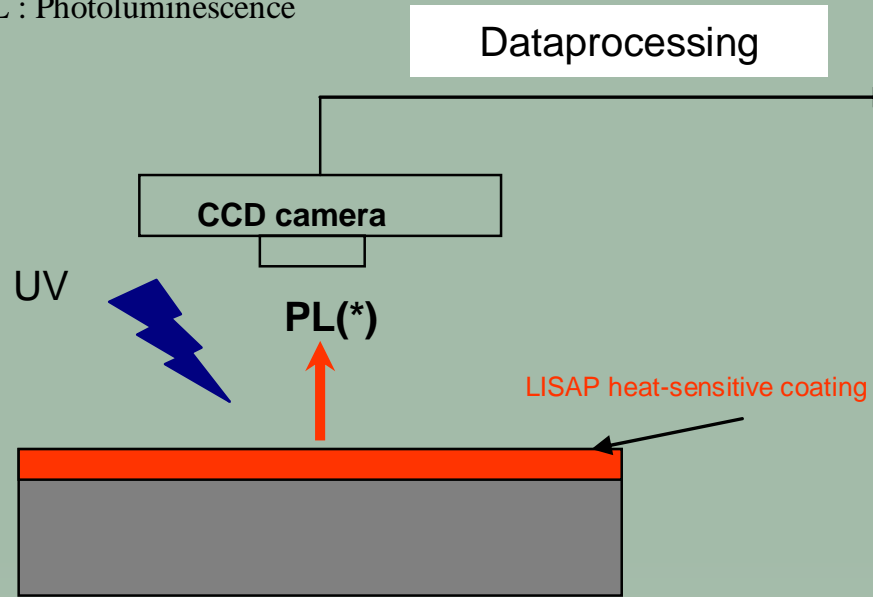
- Aerospace (launch vehicles, turbine blade, TBC, combustion chamber...)
- Industrial (glass and ceramics manufacturers...).
- Research and Development ( TIG, laser welding, High temperature materials...)

# Principle



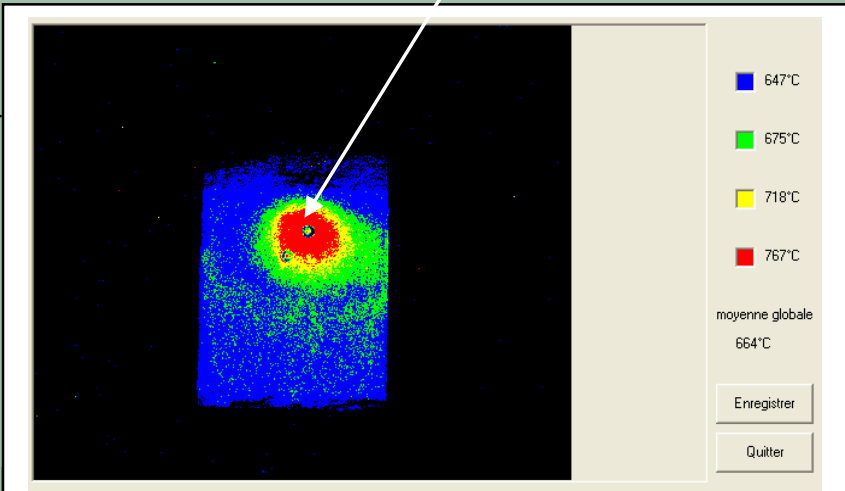
# Principle

(\* ) PL : Photoluminescence



**- Step 2 : Thermal mapping at room temperature**

Thermocouple position  
On the back side



**Thermal mapping following thermal cycle with Lisap software**

**Resolution :**  
**Ranges 600 to 1600°C (Low to High) : +/- 3°C to +/- 12°C (oxidizing conditions)**  
**Ranges 1100°C to 1500°C (High) : +/- 3°C (all environments)**

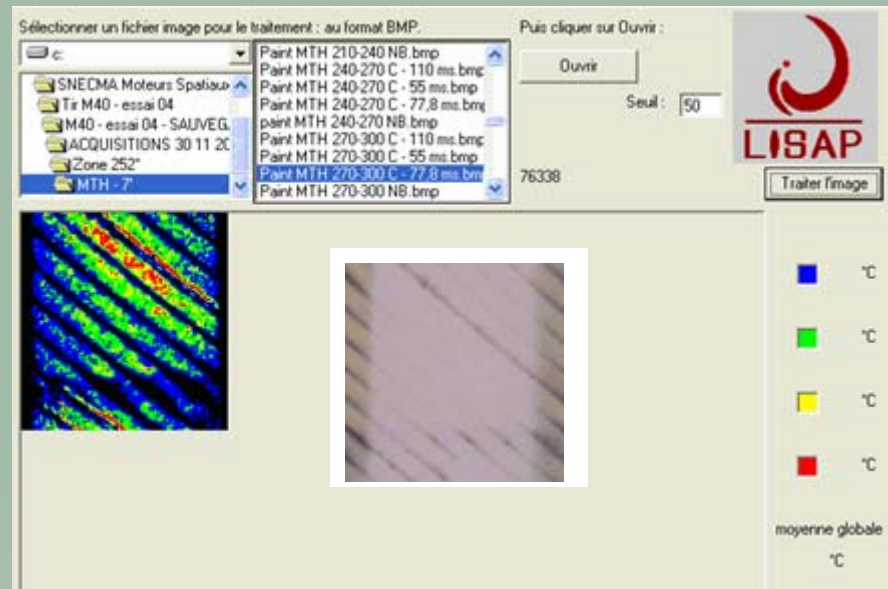
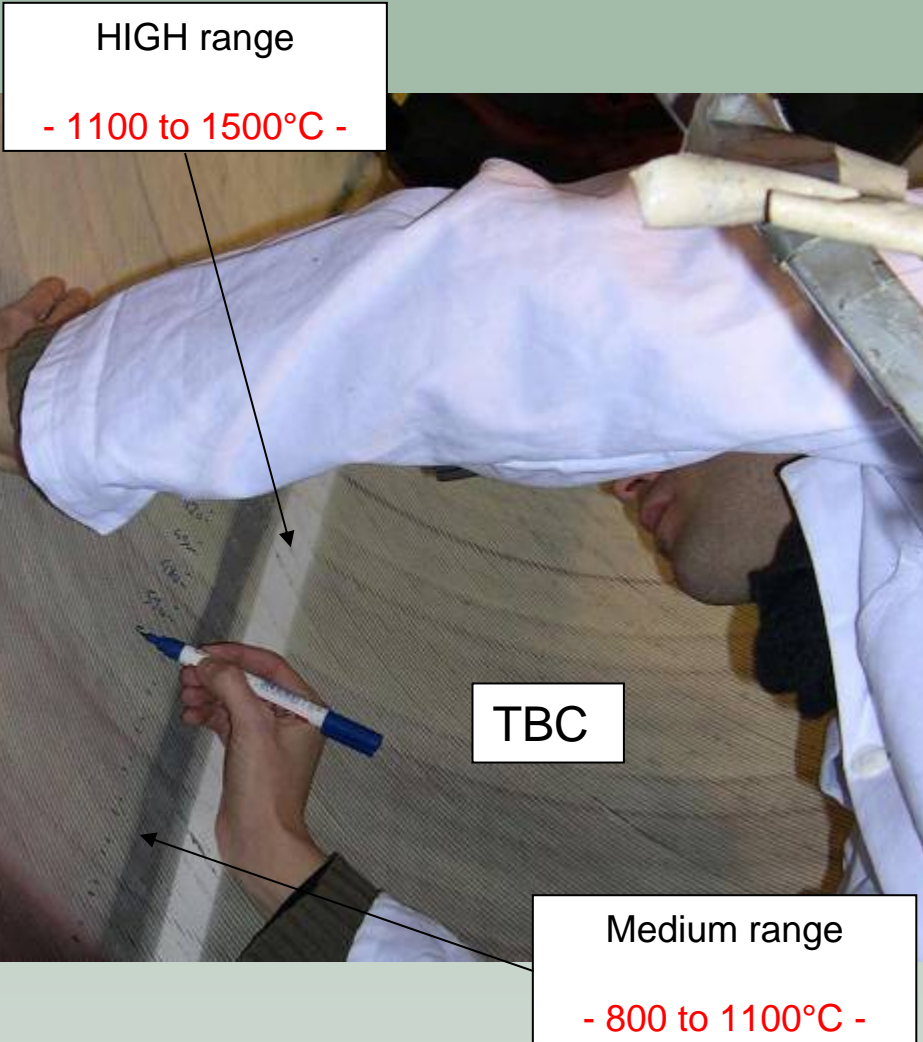
## *Main points*

- Compatibility with severe conditions  
(high temperature, non accessible area , EM fields )
- Surface thermal mapping (levels and gradients)
- Thin film coating around 50  $\mu\text{m}$ .
- Memorization of reached temperature.
- All environment measurements (oxidizing, reducing, vacuum atmosphere).
- No pollutant.
- Thermal Barrier Coating effect.

- LISAP™ coating + NDT LISAP™

- Contracting-in : Temperature, wear, radiation exposure measurements.

# TBC thermal mapping inside rocket's engine nozzle (Vulcain 1 and 2)

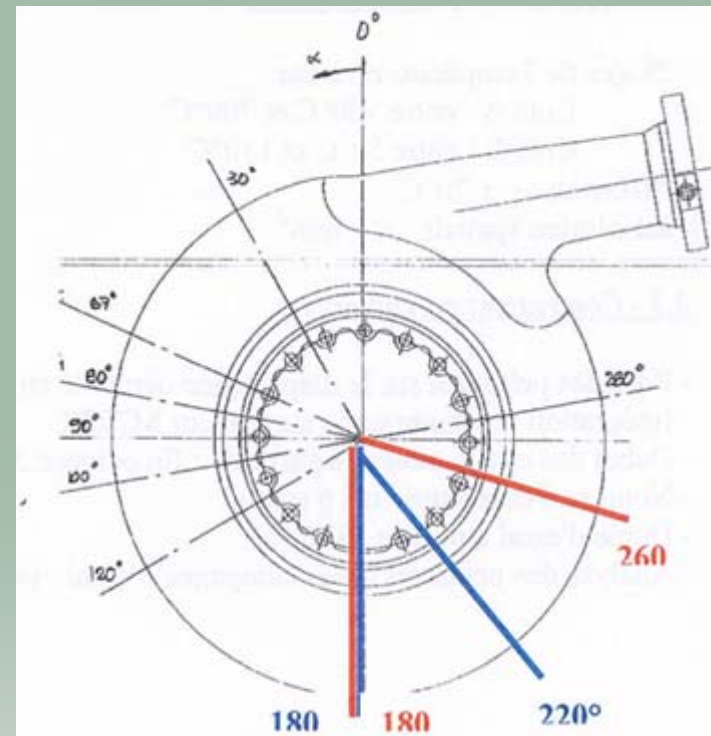


# Hydrogen Turbine (TPH) (Vulcain 1)

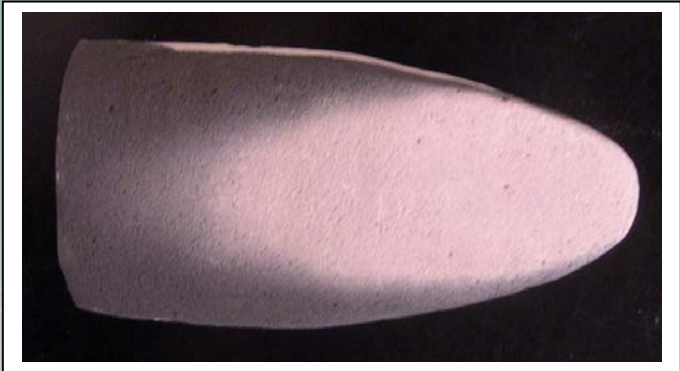
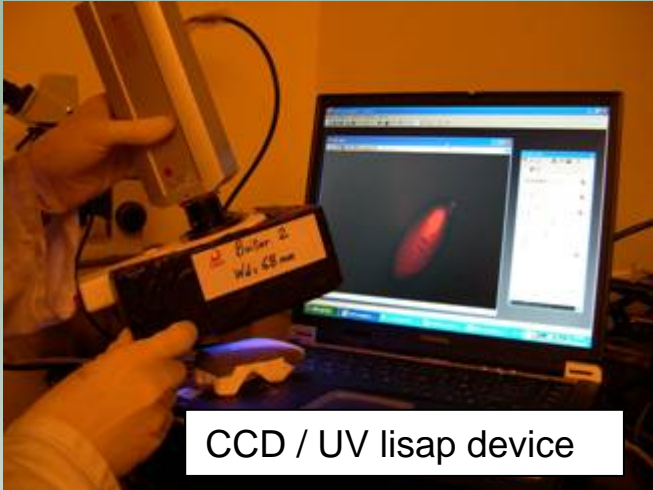
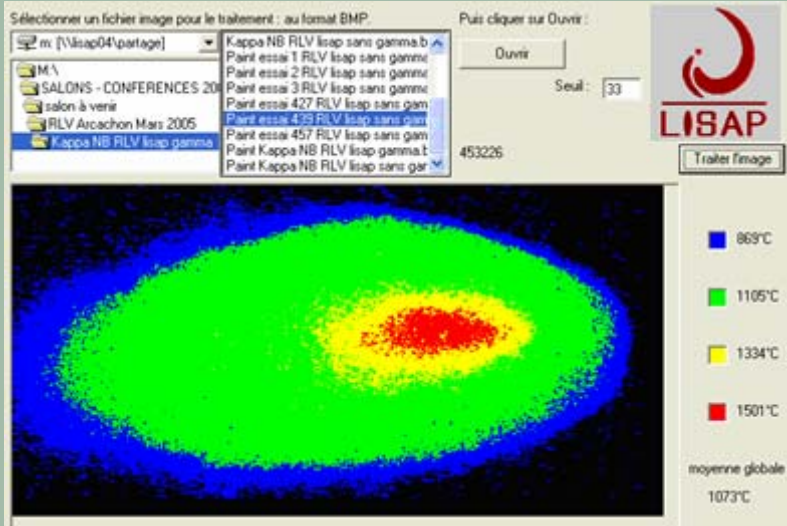


Low range

- 500 to 1100°C -



# Firing test on RLV model Low to high range covering paint (scale 1/100)



## Main conclusions

Lisap thermal paints can be used on **inaccessible zones**, or during firing tests, in oxidizing / **reducing atmosphere**, under **vacuum conditions**, or under electromagnetic disturbances.

Thermal mapping with Lisap thermal paints enables a **code calculation validation**.

Lisap thermosensitive thin film is able to detect **hot spots** (control and maintenance).



# REFERENCES

**Snecma Moteurs Vernon** : thermal mapping inside rocket's engine nozzle (Vulcain 1 and 2), and hydrogen turbine (Vulcain 1).

**Snecma Moteurs Villaroche** : thermal mapping on afterburning nozzle segment.

**Turbomeca** : Nickel alloy turbine blade.

**Onera / MBDA** : thermal mapping on ramjet engine parts.

## Contacts

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