METROSION

Metrology to Enable High Temperature Erosion Testing

EURAMET
European Association of National Metrology Institutes

Challenge

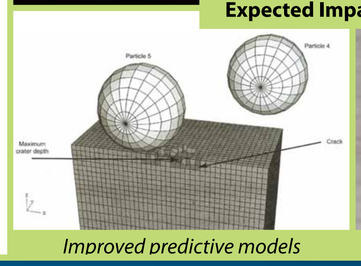
Assessment and development of new material solutions for resistance to high temperature solid particle erosion are currently **largely empirical**. For a step change improvement in the design and performance of new solutions, development of **robust**, **accurate metrology** is required to enable the measurement of:

- *volume* of wear by *in-situ* sensors capable of measuring depth of damage to 1 µm over a 10 mm area.
- change in *mass* of samples to an accuracy of 1 µg.
- velocity of high temperature erodent particles and their velocity distribution accurate to 1 ms^{-1}.
- mean and distribution of the erosive particles *size* and *shape*.
- *temperature* of high velocity particles and supporting gas stream up to 1000 °C to an accuracy of 5 °C.
- ultimately enabling *modelling* to achieve a life prediction capability.

More efficient power generation

Improved coatings for aerospace

Expected Impact of Project

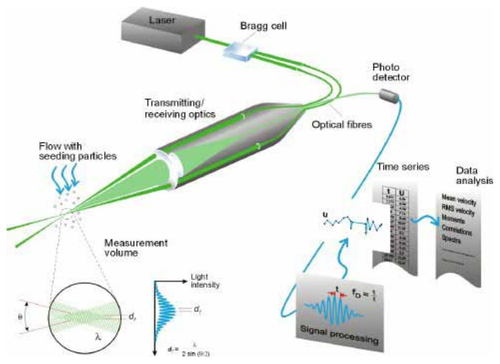


Improved predictive models

Erosion resistant materials

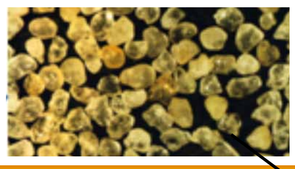
How will this project address this need?

WP2 – Development of new test systems at NPL and BAM incorporating the latest measurement technology.
- Test systems at Cranfield and RSE also updated.
- Effect of test parameters explored, basis of an interlaboratory exercise.
- Modelling of the erosion process will be an essential activity to enable predictive capability

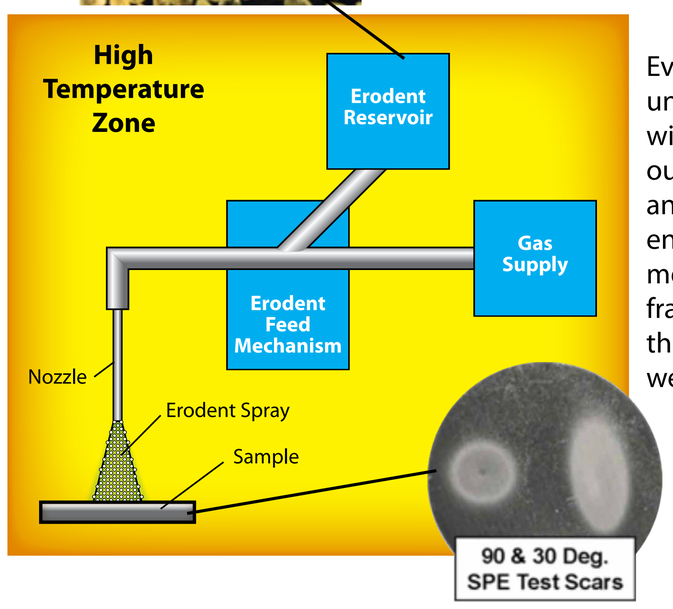


WP4 – Measurement of the environmental parameters of the test including velocity and velocity distribution, temperature and flow of the carrier gas.

WP1 – Supply of carefully selected and characterised materials.

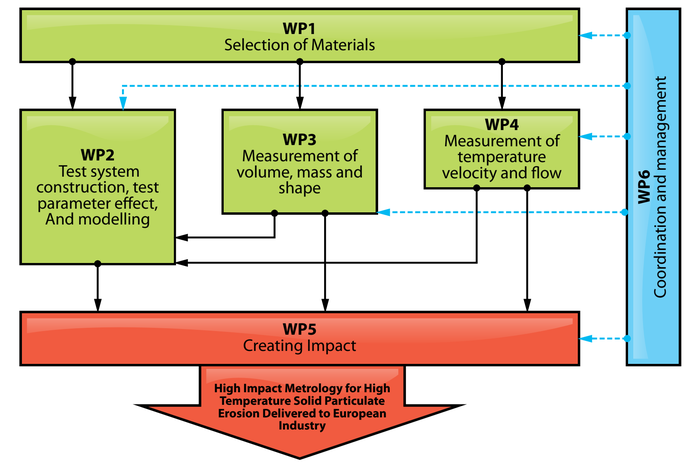


WP3 – Evaluation of the size, size distribution and shape or erodent particles.



Evaluation of uncertainties will be carried out in WP2 and WP4 to ensure that the metrological framework for the HTSPE is well defined.

WP3 – Accurate measurement of wear volume and mass. New non-contact *in-situ* techniques.



Expected impact of project

- More **efficient** generation of power by the introduction of **new coatings and materials** to give **increased operating temperatures**.
- The development of **new materials** with improved erosion resistance.
- More **efficient and damage tolerant** aero engines.
- **Improved lifetime** for drills for oil/gas excavation, and for materials moving plant in heavy industry such as metals production.

Creating impact

A very strong set of industry partnerships is already in place which offers a direct route to successful adoption of the outputs of this project. To reach as broad a European audience as possible key mechanisms that will be used include:

- Web portal for dissemination of guides, presentations and case studies.
- Conference presentations targeted to reach major industry sectors.
- Publication of scientific papers and technical articles.
- Training workshops.
- Exchange of staff and visits to industry.
- Dissemination through coordination activities such as E-Surf! and VAMAS.
- An industrial focus group to aid exploitation, such as: through training course developed; through the REG partners to the tool making industry; marketing any devices developed.

Consortium

Key to the success of this project is the strong industry engagement already in place.

- Industrial partners will guide the direction of the project based on their experience as manufacturers facing major technical challenges.

The core research partners and their roles are:

- NPL and BAM will design and construct new erosion test systems for innovative in situ measurement of damage.
- PTB provide traceable characterisation of dimensional and mechanical surface properties, for measurement of erodent particle by XCT.
- DTU and CMI provide expertise of particle velocity and flow measurements, and non-contact optical methods for temperature and thermal properties.
- Cranfield and RSE will evaluate current state of the art apparatus and will be involved in the intercomparison exercise. They ensure that the new metrology developed in the JRP is relevant and usable by the end stakeholders.
- BAM, RSE and NPL will develop complementary approaches to the modelling the erosion process that will achieve the objective of providing a predictive modelling capability for erosion.

NPL National Physical Laboratory · BAM Federal Institute for Materials Research and Testing · DTU · RSE Ricerca Sistema Energetico · MONITOR Coatings Limited · DOOSAN · SPECIAL METALS · PTB · CMI · Cranfield University · ALSTOM · SIEMENS · TECVAC

JRP 0115
Job number/OCT2012