EMRP Call 2010 – Industry & Environment

Topic number: SRT-16i

Title: Metrology to assess the durability and function of engineered surfaces

Abstract

This Call for JRPs is to improve the assessment of novel surface engineering techniques. These techniques support the improvement of products, particularly industrial processing equipment, thus the techniques are often undertaken on-line, and in aggressive environments.

Improved metrology is required to address the long-term traceable assessment of low friction measurement, the loss of material due to surface damage, the temperature of the interface, and changes in the chemistry that take place at the contact interface.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP 2008, section on “innovative set ups for new industrial and societal needs “ p.37 and Length p.38.

This Call for JRPs addresses metrology needs in dimensional, temperature, chemical and mass areas and is also concerned with applications in manufacturing and processing.

Keywords

Surface Engineering, Durability, Industrial Production, Improved Products, Industrial Competitiveness

Background to the Metrological Challenges

Optimised surface engineering such as the development of complex composite coatings with multi-functional capability (i.e. low friction, high durability, and adequate performance in aggressive environments) can improve European competitiveness many in industrial sectors including; mechanical engineering, metal processing, mineral extraction, process engineering and production, automotive & aerospace industries, energy generation, and consumer products.

The importance of improving industrial effectiveness is recognised through numerous reports with some specific needs for improved tribological performance of surfaces including:

- More efficient and cost effective production machinery, e.g. forges, presses and cutting tools.
- Increased functionality and performance of products, e.g. internal combustion engines.
- Longer lifetimes for equipment used in mineral extraction industries (mining and oil and gas).
- Development of replacements for coatings that will be banned under impending REACH regulations such as hexavalent chromium, cadmium and silver.

The development of new complex composite coatings (for surface engineering solutions) is hampered by insufficient metrological tools and methods, such as:

- Measurement traceability of low friction forces (for new low friction coatings)
- Measurement of loss of material, which determines wear and durability
- Temperature measurement at surface interfaces (supporting friction measurements), where the contact size is often only about 20 μm across, and the access is often difficult

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- Measurement of changes in surface chemistry, at the tribological contact between the surfaces, if possible using real-time, in-situ spectroscopy
- The development of on-line monitoring techniques, to detect damage to tools and components through loss of material and increased friction

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them, in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP protocol.

The overall aim of the JRP is to develop step change improvements in the metrology of tribological contacts in industrial environments.

The specific objectives are:

1) traceable, self-calibrating, stable measurement techniques for determination of the long term performance of low friction coatings
2) techniques for measurement for small volumes and material loss from wear with sensitivity to achieve relative measurements of 0.1 μm or less over a period of several days
3) development of measurement methods for the measurement of the temperature of tribological contacts
4) methods for assessing chemical changes at tribological contacts.

Proposers shall give priority to work that meets documented industrial needs and that which supports transfer into industry e.g. by cooperation and/or by standardisation.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (e.g. letters of support) is encouraged.

Where a European Directive is referenced in the proposal, the relevant paragraphs of the Directive identifying the need for the project should be quoted and referenced. It is not sufficient to quote the entire Directive per se as the rationale for the metrology need. Proposals must also clearly link the identified need in the Directive with the expected outputs from the project.

You should also detail other Impacts of your proposed JRP as detailed in the document “Guidance for writing a JRP”

You should detail how your JRP results are going to:

- feed into the development of urgent standards through appropriate standards bodies
- transfer knowledge to the appropriate industrial sectors.

This potential impact of this project is huge, with losses of up to 2% of GDP of advanced countries attributed to losses due to friction and wear [10]. Very small savings as a result of improved metrological practice could significantly increase the competitiveness of European industry through reduced costs of production and lower raw materials costs.

Specific examples of impact include:

- in process industries and production technologies, increasing the lifetime of forge dies for aluminium forging, resulting in reduced downtime and lower material wastage.
- in the automotive industry the new metrology will facilitate the introduction of new low friction surface engineering technologies that will lead to increase fuel efficiency
- in the oil (mining) industry, increased lifetime of sea bed components

- in the food industry, the introduction of high durability coatings that eliminate health risk from contamination from processing equipment

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

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