

Metallurgy – Replication and Inspection

Remote Surface Measurement and Microscopic Examination

COMMISSIONING AND IN-SERVICE SUPPORT



Background

Rolls-Royce has developed a range of replication techniques utilising compounds developed in conjunction with the supplier to solve many complex and difficult inspection requirements. The replica's ability to provide high definition surface replication together with bespoke application and surface preparation equipment allows high quality surface examination in remote locations. These replicas can then be inspected in a laboratory providing a high quality examination in a low dose environment

Replication offers:

- The ability to inspect inaccessible surfaces indirectly by visual and microscopic techniques, including high magnification Scanning Electron Microscopy.
- The extraction of surface particles by the replica material also provides a means of analysing surface contaminants.
- The ability to record size measurements and defect location data in very high dose areas.
- A permanent record of the site of interest, allowing defect monitoring over time by comparison with previous replicas.

- In air or underwater application.
- Elastic material properties allowing replication of cavities and other undercut geometries.
- The ability to obtain microstructural information from metallurgically prepared surfaces.
- Resolution of surface textures to $<1\mu\text{m}$ whilst maintaining exposure to ionising radiation to levels that are ALARP.
- A range of replication media, (both putty and acetate) are available to suit different applications. Replication materials are available with a range of viscosities and curing rates. For remote application this allows transport time for the material to the inspection site, over long distances when required. Compensation may also be made for plant temperature.
- Rolls-Royce metallurgy have the capability to replicate – inspect remote surfaces underwater.
- **Remote Surface Replication**
- **Microscopic Examination**
- **High Definition to $<1\mu\text{m}$**
- **Accurate Dimensional Surveys**
- **EAC and SCC Detection Capability**
- **Permanent Record**
- **High Strength and Elasticity**
- **Recoverable from Complex and Tortuous Geometry**
- **Remote Grit Blasting, Chemical Etching and Polishing methods for Surface Preparation**

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Semi automated replication equipment for inspecting "blind hole" geometries



Manually operated replication and inspection equipment



Automated manipulator for remote replication of motor tubes.

Metallurgical inspection Capability

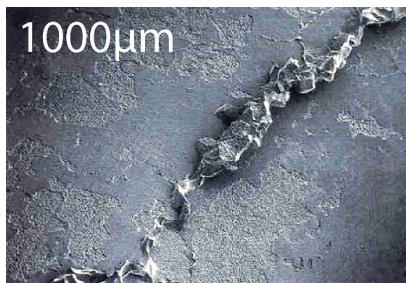
- SQUEP Metallurgists
- Macro and microscopic examination
- Remote Inspection Capabilities
- SEM and microanalysis examination

Typical Current Applications

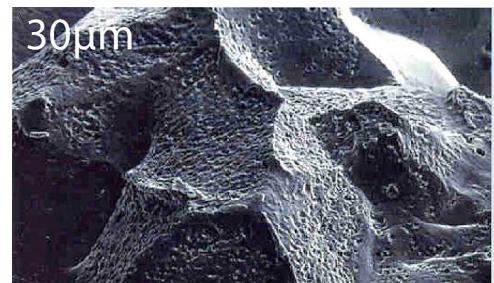
- Remote replication of boiler tube surfaces – stainless steel.
- Remote replication of Titanium heat exchanger welds – off shore platform.
- Internal surface replication of high temperature/pressure polymer manufacturing vessels.
- Internal surface bolt hole replication – valves, engines, con rods – marine applications.
- Inspection of cupro-nickel alloy heat exchanger tubes.
- Surface inspection of ships propulsor blades in the manufacturers workshop



1- Intergranular cracking in replicated surface



2 – Character fracture surface of replica. Detail of intergranular cracking shown in (1)



3 – Replica is amenable to high magnification examination and micro analysis by SEM. Detail of oxide on intergranular facets shown in (2)

7166/CS.03/Aug10