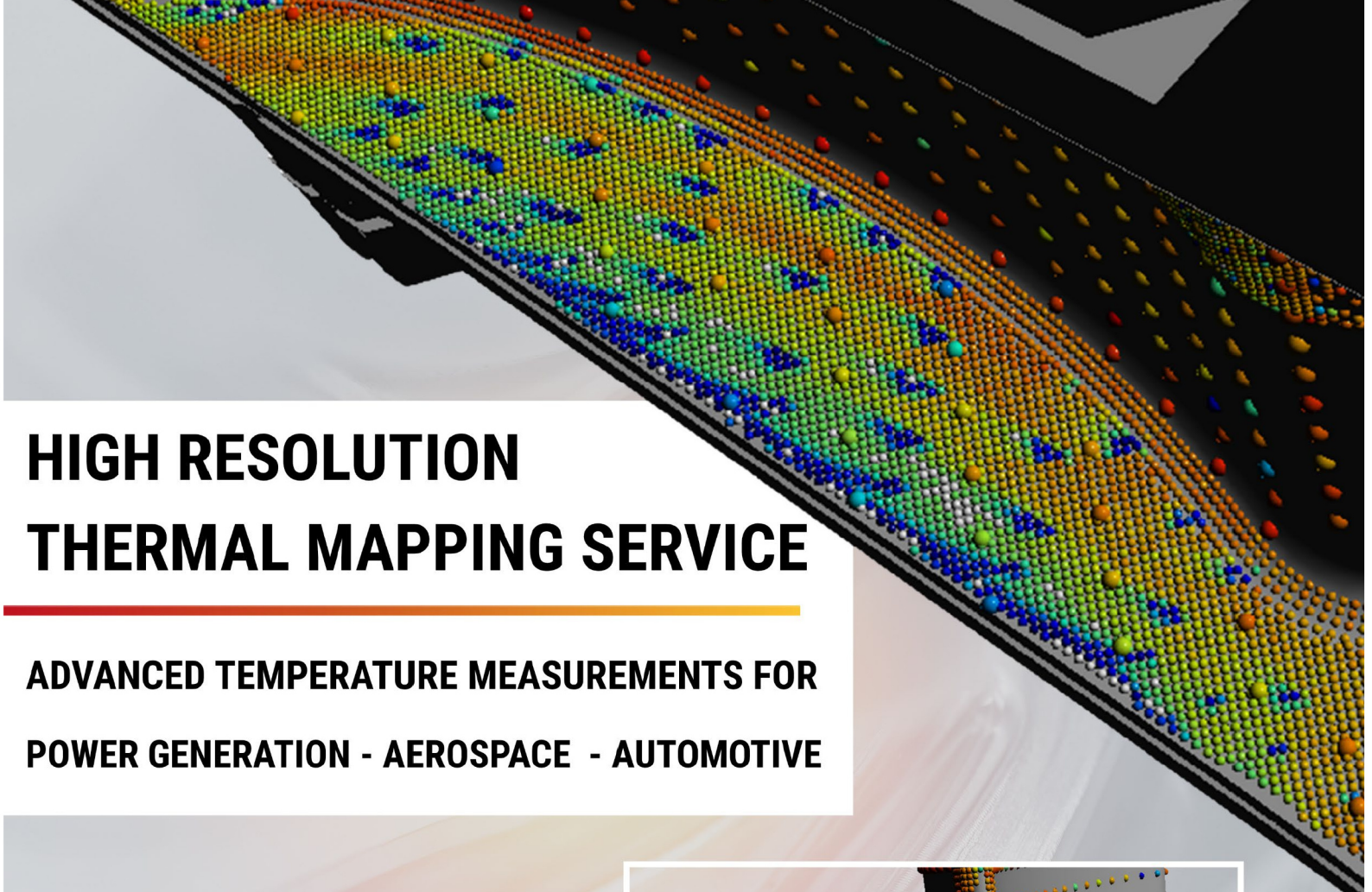
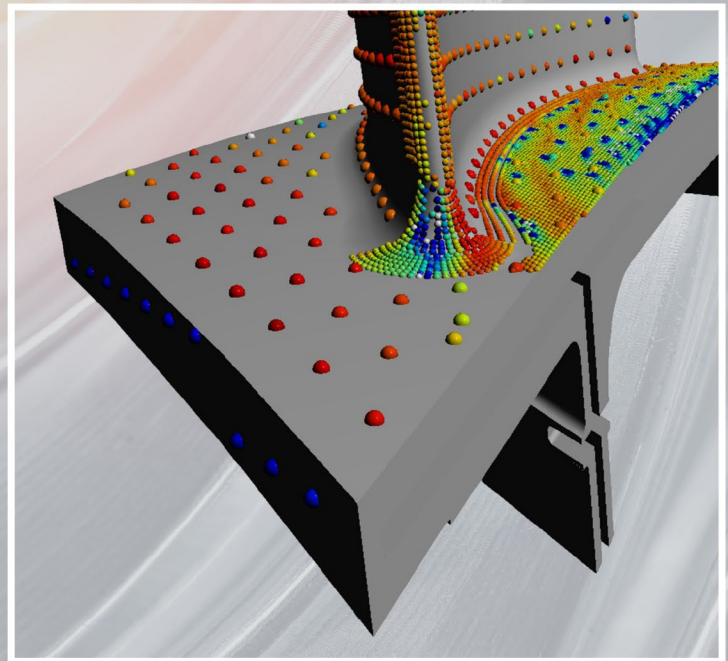




HIGH RESOLUTION THERMAL MAPPING SERVICE

ADVANCED TEMPERATURE MEASUREMENTS FOR
POWER GENERATION - AEROSPACE - AUTOMOTIVE



GT2024-126737



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SENSOR COATING SYSTEMS (SCS)

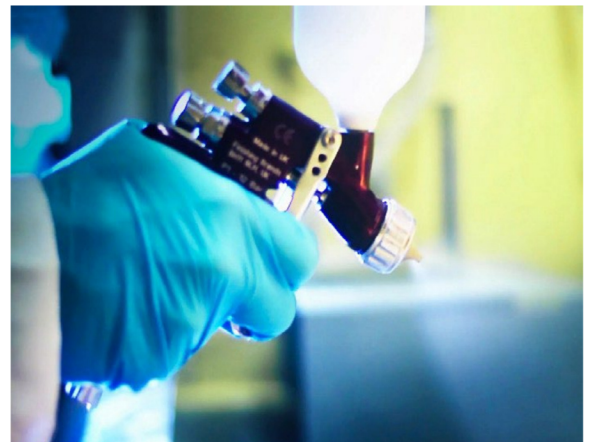
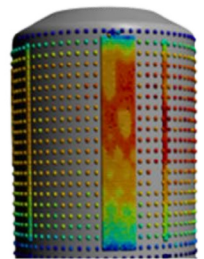
Thermal History Technology (THT)

Designing engines of the future requires a deep understanding of internal processes. Thermal properties drive next-generation engine innovation. SCS are pioneering efficient, cost-effective temperature sensing technology, replacing traditional methods.

The patented technology covers $150 \rightarrow >1600^{\circ}\text{C}$ ($302 \rightarrow >2912^{\circ}\text{F}$) with $\pm 5 - 10^{\circ}\text{C}$ ($41 - 50^{\circ}\text{F}$) precision, vital across many industries. In addition to thermal history sensors, SCS record measurements using a compact optical system. One OEM estimates savings of £1.5m to £3m per development program.

SCS'S AWARD-WINNING TECHNOLOGY IS REVOLUTIONISING DIGITAL THERMAL MAPPING

THE SERVICE PROCESS



Consultation for Bespoke Solution

1. Coating Deposition

Using advanced luminescent material technology
Extremely durable paints and coatings

2. Quality Control

Implementing rigorous quality control measures
ensures the excellence of the coatings

3. Engine Test or Heat Treatment

Highly adaptable to heat treatment needs.
Multi-cycle and long-term engine testing

4. Measurement

Cutting edge automation processes record
thousands of data points across entire
surface quickly and efficiently

5. Calibration & Analysis

Highly experienced analysts bring
temperature data to life, working to
contextualise unique requirements

Final:

Fully Digitised Temperature Map

SCS'S THERMAL HISTORY TECHNOLOGY HAS TWO MAIN EMBODIMENTS BASED ON LUMINESCENT MATERIALS

THERMAL HISTORY COATING (THC)

500 → >1600°C (932 → >2912°F)

A robust oxide ceramic coating, which changes microstructure irreversibly at high temperatures. THC is applied by Atmospheric Plasma Spray and can withstand thousands of hours of exposure in harsh environments.

THERMAL HISTORY PAINT (THP)

150 → 900°C (302 → 1652°F)

A combination of the robust sensor powder with a high-temperature, water-based binder. It offers reliable surface temperature profiling along with simple application using an air spray gun. It is suited for shorter term, lower temperature applications.

BENEFITS

- Accelerates industrial development; reduces costs
- Rapid in-situ measurements, non-invasive
- High resolution, automated temperature mapping onto component 3D model
- Full digitisation for effective data processing
- Record historical data, useful as a warranty tool

FEATURES

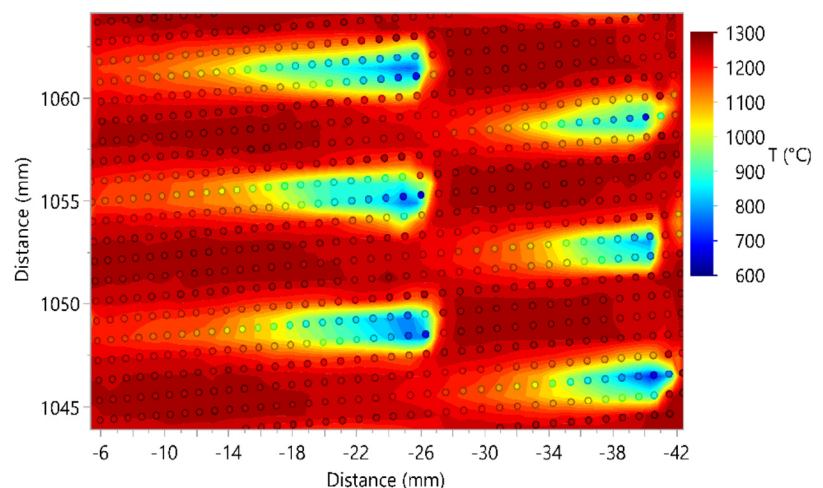
- Precise 3D temperature profiling
- Non-toxic & EU REACH compliant compared to thermochromic paints
- Non-destructive and non-intrusive
- High resolution, continuous temperature data
- High durability coating for harsh environments

CASE STUDIES

HIGH RESOLUTION AT HIGH TEMPERATURES

Complex engine cooling designs can be validated with unprecedented high resolution thermal mapping technology. Using THCs, minute cooling features and thermal gradients are made visible with sub-millimetre accuracy.

Digitised thermal mapping facilitates convenient comparison with existing heat transfer simulations; this enables the fine tuning of engine designs and the implementation of advanced high temperature materials.

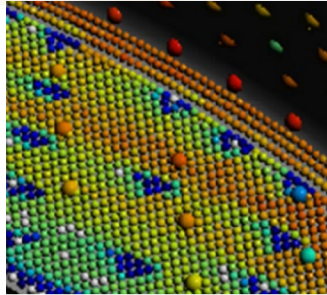


CASE STUDIES

SCS generates digital temperature maps which can be represented in 3D in different forms, e.g. contour maps or scatter point plots on CAD models.

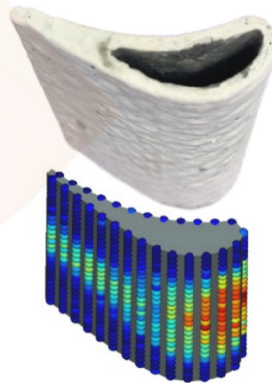
HIGH RESOLUTION MODEL VALIDATION

Unprecedented model validation through **unique high-resolution thermal mapping** was achieved with THCs on a stage 1 turbine vane. Over **16,000 measurement locations** high efficiency gas turbine **exposed for 72 hours**.⁴



HIGH TEMPERATURE CMC CAPABILITY

For NASA, **high temperature measurement** capability was demonstrated on a ceramic Matrix Composite (CMC) Airfoil from 1150 - 1500°C (2102 - 2732°F). Comprehensive surface thermal mapping is not possible with any other traditional technique under these conditions.²



LONG TERM MAINTENANCE APPLICATION

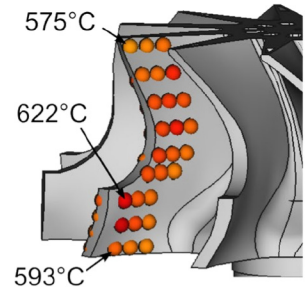
A **long term THP application** was conducted for the Energy and Power Research Institute (EPRI). **Measurements up to 450°C (842°F)** were recorded **after 7,200 hours of exposure**; demonstrating potential applications for component lifetime monitoring and **durability** testing.¹



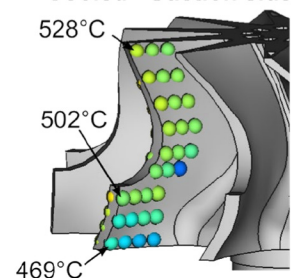
COMPLEX COMPONENTS

Hieta and Bath University successfully manufactured the first internally cooled **turbocharger wheel** with additive manufacturing but wanted to understand the effectiveness of the cooling. **SCS's paint was applied to a solid 'baseline' wheel and a hollow, cooled wheel** and both were tested in a turbocharger test rig. Temperature measurements were acquired from over 70 locations on each wheel. The results were in good agreement with the CFD simulations and had a repeatability of 8°C (46.4°F). The measurements enabled a **quantitative comparison of the temperature profile and hence the cooling effectiveness**.³

Baseline - Suction side



Cooled - Suction side



Publications

¹Rodriguez, S. A., et al. (2023). Feasibility of the Use of Thermal History Paints for Long Term Exposure of Low Temperature Life Critical Components. Proceedings of the ASME Turbo Expo, Turbomachinery Conference and Exposition, Boston, USA

²Ferran-Marqués, M., et al. (2021). Thermal History Coatings: Part II — Measurement Capability up to 1500°C. Proceedings of the ASME Turbo Expo, Turbomachinery Conference and Exposition, London, UK

³Zhang, Y., et al. (2018): Design of an Air-Cooled Radial Turbine: Part 2 — Experimental Measurements of Heat Transfer Volume 8: Microturbines, Turbochargers, and Small Turbomachines; Steam Turbines (ASME) p. V008T26A014.

⁴Hickey, J., et al (2024): Unique High-Resolution Temperature Mapping of Stage 1 Turbine Vane in a Long-Term Engine Test. Proceedings of ASME Turbo Expo, Turbomachinery Technical Conference and Exposition, London, UK.