

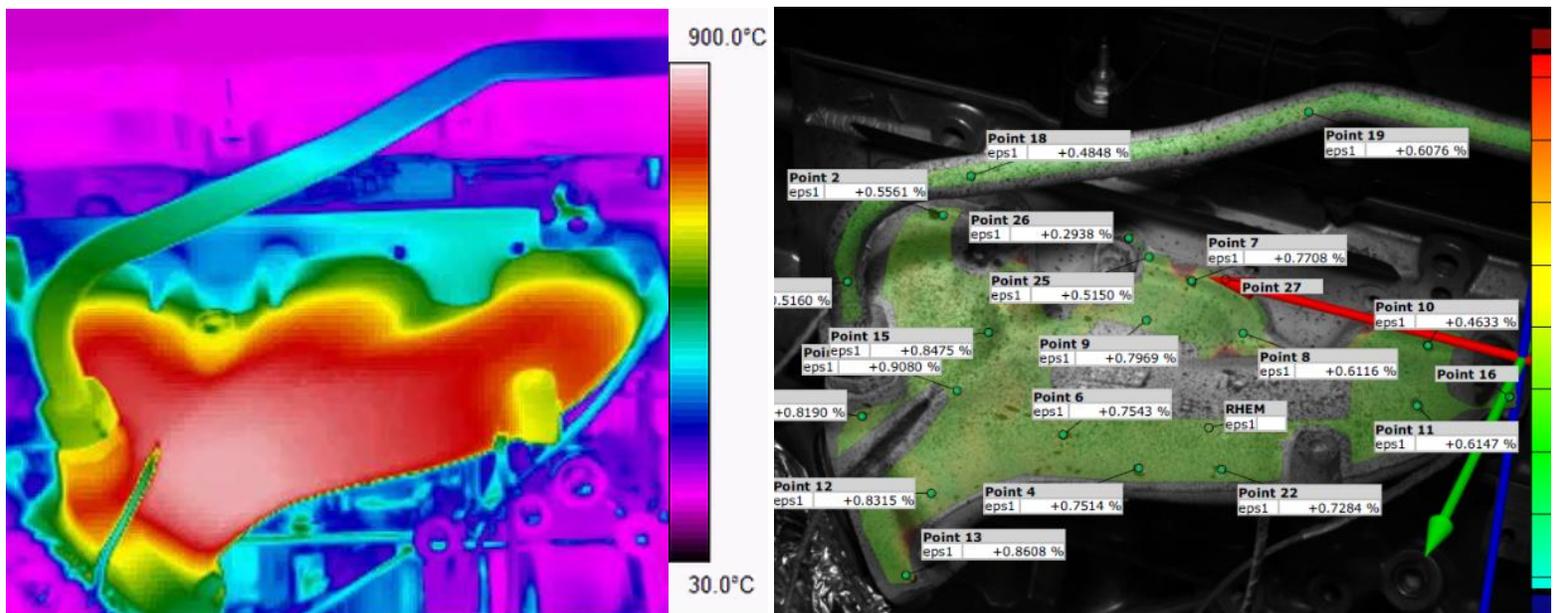
Industry 4.0

# ARAMIS 3D Thermography & NDE

InSitu NDE

ARAMIS Thermography

ARAMIS Thermography NDE



**See deep into your Structures and Processes**

Rapid, Non-Contact NDE.

The Power of Optical Metrology.

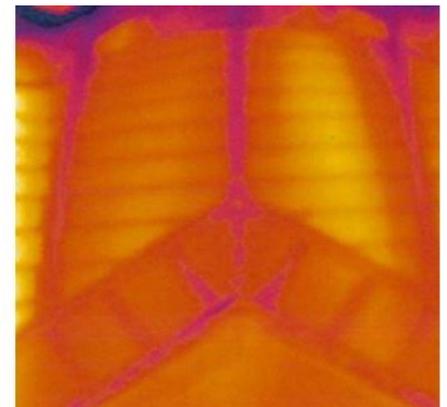
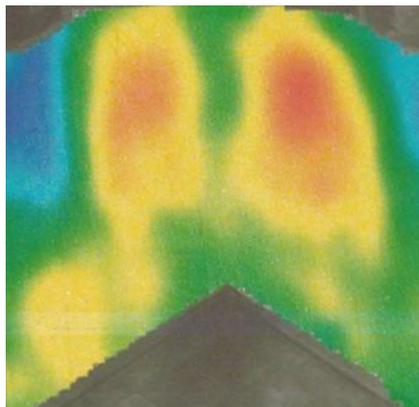
# ARAMIS Thermography™

ARAMIS Thermography is unique in its ability to read full-field temperatures in 3D coordinates. This provides broad capabilities in understanding your materials, structures and processes with cutting-edge data on material properties, process quality and structural health monitoring. Our goal is to provide our customers with cutting-edge capabilities with high measurement accuracy and highly efficient controls, and the wrap around training and services to support them.

Thermography is the optical measurement of temperature. ARAMIS provides precision 3D measurements of parts in CAD coordinates. Combined, ARAMIS Thermography uniquely provides thermal data in 3D coordinates. Optical Strain measurement uses the changes in temperature during a test, to correct the total strain measurements for thermal expansion, to measure the true mechanical strains. We developed this originally with AFRL for studying the engine washed Aft Deck of the B-2 Stealth Aircraft. Now, every industry uses the technology.



The biggest uses of ARAMIS Thermography are for automotive and aerospace engine testing, or operations like welding, where temperature differentials play a huge part in the material and structural response. But, every time that you are stressing a material or structure, it is heating up locally where there is stress, changing your material properties and measurements. ARAMIS Thermography allows you to measure accurately under all of these conditions.

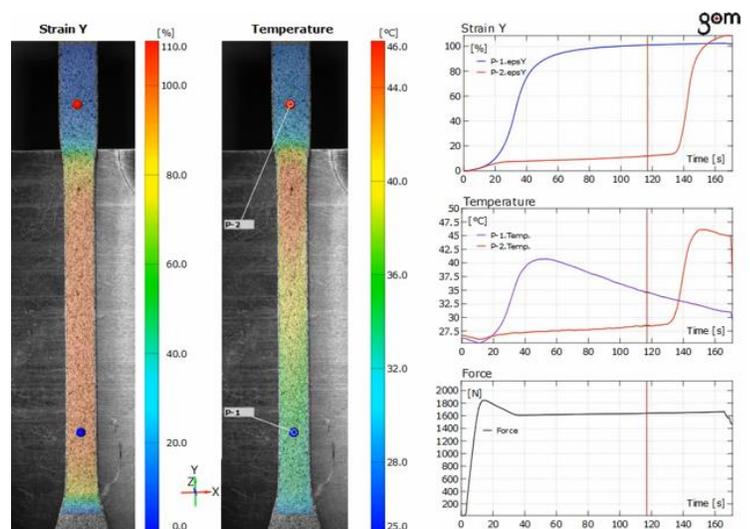


# Material Testing

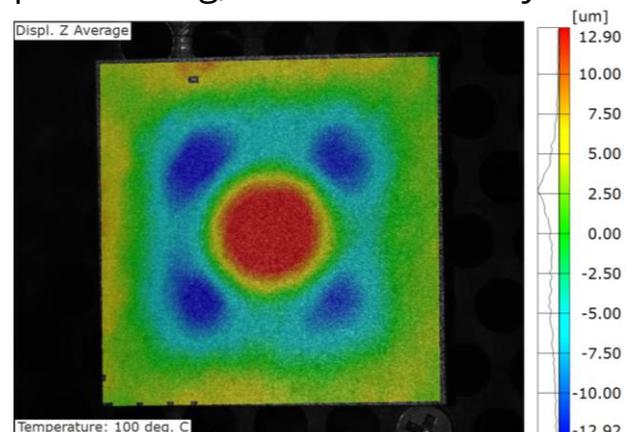
ARAMIS Optical Strain holistically tests your entire sample, allowing ARAMIS to measure local material variations and even microscopic material properties variations. ARAMIS is also rated as a Class 0.5 extensometer and can make all of your standard tests, quickly and easily.

ARAMIS Thermography corrects strain for the local thermal expansion during a test. Thermal changes and 3D necking can significantly affect your material properties. ARAMIS 3D-DIC with thermography corrects for these effects, providing highly accurate materials properties. NASA used ARAMIS to measure difficult material properties of epoxy resin, and then applied the same methods to their composites and metals, finding better, more consistent data for each.

**Material Testing** with Optical Strain provides full-field displacement and strain data, down to a single non-contact Class A extensometer. Testing is fast and easy with predefined templates. Thermography option allows for strain correction for stress induced thermal expansion. ARAMIS interfaces with all test frames or provides material properties directly.



**Thermal Expansion** with ARAMIS Thermography allows the thermal expansion measurement of any material even in a complex setting, like an assembly or circuit board. For precise thermal expansion measurement, we use a ARAMIS Thermal Chamber to get a precise measurement of the  $\alpha$  curve for any material or for microelectronic packages. ARAMIS Thermography allows this same measurement of complex parts or on a hot plate.

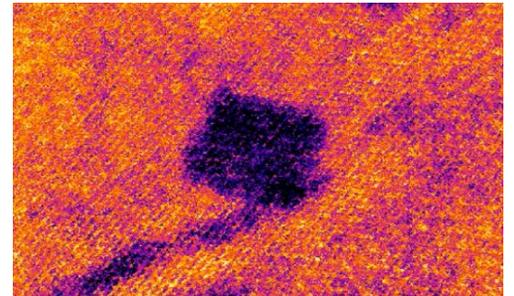


# Composites InSitu NDE

Real-time In-Situ NDE for manual and robot lay-up can make the composite builds highly more efficient and allow them to be cost efficient to be ramped up to high volume builds streamlining the manufacturing process, and moving towards making perfect parts continuously. InSitu NDE automation is the key.

## CoolScan NDE™

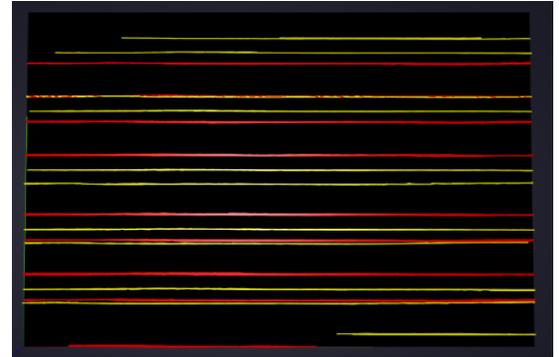
CoolScan NDE for manual composite lay-up allows for the real-time validation of quality during the builds and allows the operator to see defects, FOD, bridging and voids in the structure that they can fix, prior to curing. This allows perfect parts to be made and validated, before NDT.



InSitu NDE CoolScan: FOD & Bridging

## AFP InSitu NDE™

Automated Fiber Placement (AFP) composite builds can be greatly improved with real-time quality monitoring InSitu NDE, reducing post layup inspections, providing real-time monitoring of all of the toes of each composite tape layup pass, measuring toe lap, gaps and twist, as well as bond quality, FOD, bridging and voids. These data threads and reports are automatically collected, analyzed and organized into the Trillion Digital-Twin.



InSitu NDE "X-Ray" view shows all defects at every layer to tolerance.

## Thermography NDT

ARAMIS Thermography NDT provides the post cure NDT inspection for composites, as well as thinner, lighter materials that other NDT systems have difficulty, such as hat sections and impact damage.

Tol (mm)	Max (mm)
2.00	2.64
2.00	2.50
2.00	2.50
2.00	2.28
2.00	1.78
2.00	1.50

Digital-Thread Automated Report

# Welding Quality

ARAMIS Thermography is ideal for weld inspections due to its holistic measure of the complexity of the entire weld, seeing the 3D shape, 3D distortions, strains (during and induced residual) and temperature profile. ARAMIS Thermography NDT can also be used to study the quality of the weld.

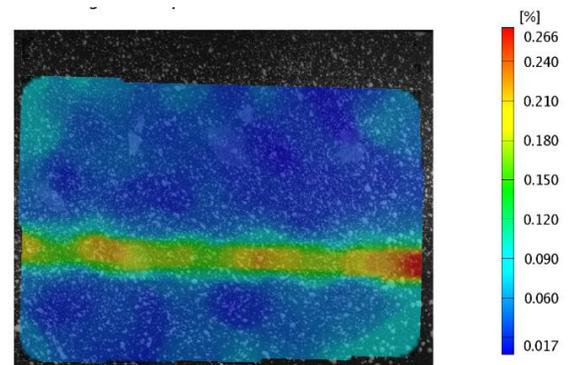
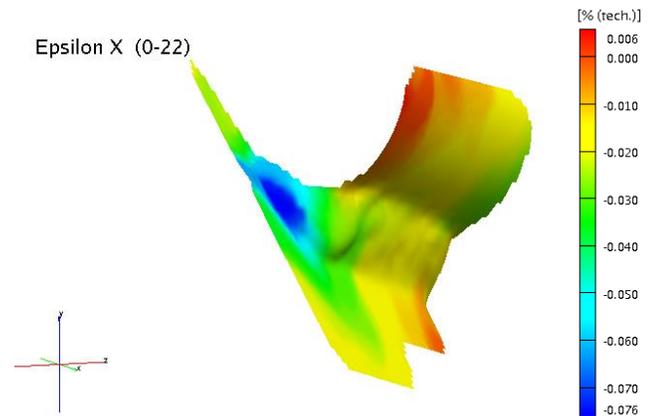
**Weld Strains** (During, Residual and NDT) Real-time and induced residual strains of the weld and the base material, allow you to understand the effect of the weld, is there a stress concentration? is heat treating required? During load or pressure tests, is the load being carried evenly across the weld?

**Weld Distortions** ARAMIS measuring 3D shape of the weld, also measures the distortions of the base materials to CAD, all in real-time.

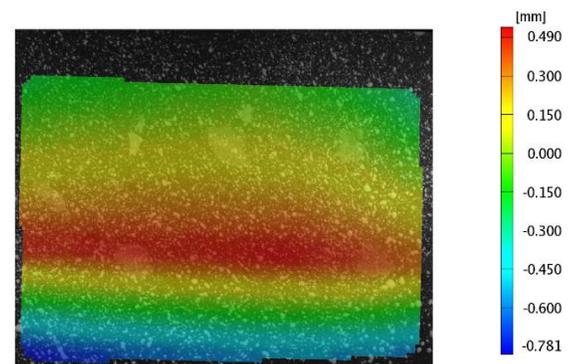
**Stur Welding** ARAMIS Optical Strain measurement of Stur Welding, shows the flow of the material into the weld, in real-time or before and after, and shows the quality of load transfer during testing.

**Real-time ARAMIS Thermography** allows you to confirm the strain and temperature distributions during welding, in-situ validating weld quality.

**Fatigue Testing / Fracture** ARAMIS detects strain concentrations and fracture anywhere across the nonhomogeneous weld, with real-time detection and notification.

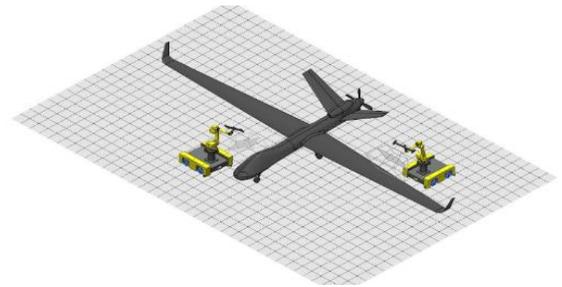


Weld strains during welding (above) and post weld distortions (below).



# Structural Health Monitoring

**Trilion Smart Paint** pattern allows Optical Structural Health Monitoring (SHM) using ARAMIS Thermography NDE for non-contact, weightless and power-free Structural Health Monitoring of the entire aircraft structure. ARAMIS Optical Strain measures the Smart Paint of each point for 3D shape, 3D displacement and surface strain, over time, allowing it to see slight transitional changes in the composite or metallic structures.



**Trilion Smart Paint provides trillions of strain gages over the surface of the aircraft, allowing for complete robotic inspection of the aircraft and comparison to Digital-Thread history of each point.**

**ARAMIS Optical Strain** can see Barely Visible Damage (BVD) even prior to any delamination damage, as a surface displacement and strain. Integrated ARAMIS Thermography NDE can then be used to detect the extent of local delamination from impact or structural damage. ARAMIS Optical Strain can also detect the strains induced by internal structural failure. Trilion Analytics are able to identify problem areas, determine the severity versus FEA, and provide recommendations for repair requirements and predictive maintenance. Providing a high level of safety for the aircraft.

**ARAMIS Thermography NDE** allows each measurement to be in CAD coordinates and to be compared with the entire inspection history as a Digital-Thread for changes in structure, strain or response. Defects detected are compared to the FEA Digital-Twin and their repair planned, as immediate – flight critical, or programmed for future repair.

**Trilion Digital-Twin** contains all of the data about your aircraft, collected from manufacturing and operation, organized in a 3D coordinate graphical format, for easy to top-down visualization of the entire aircraft build and SHM. The Trilion Digital-Twin publications provide transparent manufacturing documentation and control, to full show that your manufacturing is in control.

# All-in-One Solution

**Trilion Quality Systems** has been an industry leader in Optical Metrology Systems for over 20 years, developing and supporting unique applications throughout North America. Optical metrology brings long-awaited advanced Factory 4.0 capabilities to the manufacturing industry.

**Trilion Engineering Services** is the perfect solution for companies who have a complicated application need measurement method development, or professional measurements. Our experienced level 3 engineers and precision system to get professional results every time.

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*A manufacturing revolution, reducing costs and improving quality!*

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## **ARAMIS Optical Strain is the tool of choice for industry leaders!**

Trilion customers are industry leaders, and their operations are the best proof of the importance of this optical metrology in manufacturing.





For more information, visit:  
[trilion.com/thermography](http://trilion.com/thermography)

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