MULTIPEL SCANNING

MULTIPEL SCANNING FOR NON-DESTRUCTIVE TESTING (NDT) IN REFINERIES

Dolphin Marine & Offshore is one of the leaders in the prevention of industrial and occupational hazards in Middel East and Europe. With its expertise to identify and assess hazards, the company plays an instrumental role in risk prevention for a variety of companies.

Material inspection, which mostly take place in the Netherlands, encompass a wide range of conventional and non-conventional NDT services and tools, such as conventional and phased array ultrasonic testing, time-of-flight diffraction (TOFD), Eddy current, robotics, electromagnetic acoustic transducer (EMAT), conventional and digital X-ray inspection, 3D laser measurements, alternating current field measurement (ACFM), thermography, Lixi Profiler, guided waves, Tube Testing, Pipeline inspections and surface inspection.

Case Study: On-site Corrosion Control on a Column Skirt

Multipel scanning for non-destructive testing (NDT)

Since 2015, Dolphin Marine & Offshore has been using the Multipelscan 170.1 scanner and data acquisition software with Pipeline checker, the software platform used to assess corrosion and mechanical damage in pipelines, refinery columns, and storage tanks.

"We made the decision to invest in Multipel Scanner and software as the solutions would allow us to perform all applications and tasks usually required in typical NDT environments with the flexibility that we needed. It is the best tool to effectively control pipelines, skirts or columns—even when access is difficult and no power supply is within reach.

Application

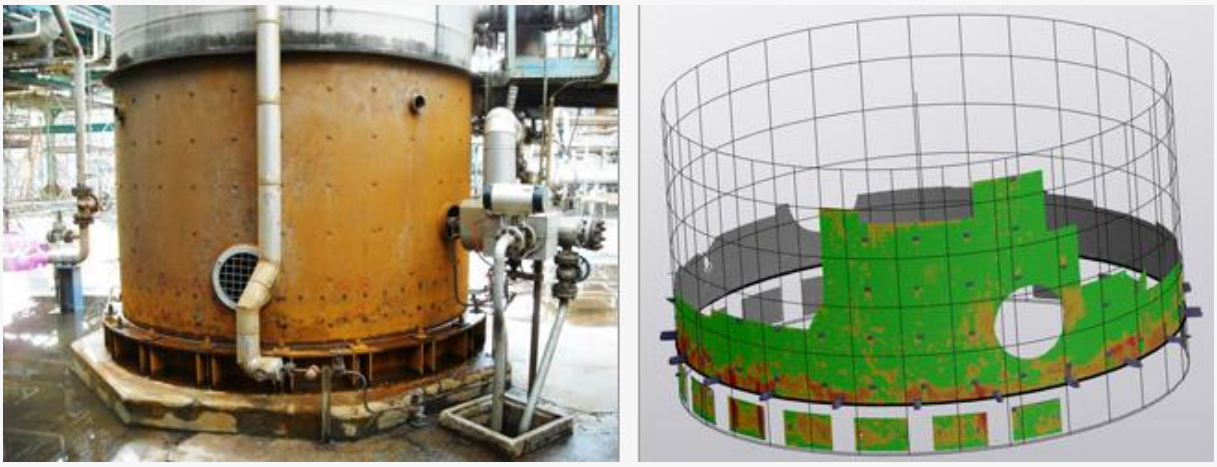
One of Dolphin Marine & Offshore recent NDT applications was to control the external corrosion of a column skirt in a refinery.

Column skirt after being fireproofed and sanded in preparation for corrosion inspection.

The skirt had a diameter of 3 m and the surface to inspect started at a height of 0.6 meters and ended at 2 m, with a nominal thickness of 10 mm. The skirt interior was covered with a concrete layer that prevented access to the opposite surface. The surface itself was complex and included many support plates, cavitations, manholes, insulation supports (about 50 on the control area), guards and mounting bolts. The objective was to control 100% of the accessible surface.

As the state of deterioration of the external surface was too advanced to proceed with a conventional ultrasonic control or to use a manual pit gauge, the Multipelscan and Pipeline check software allowed operators to scan the surface in 3D to assess the most damage around the skirt's circumference. Later, the results were presented in an official inspection report generated in Pipeline check.

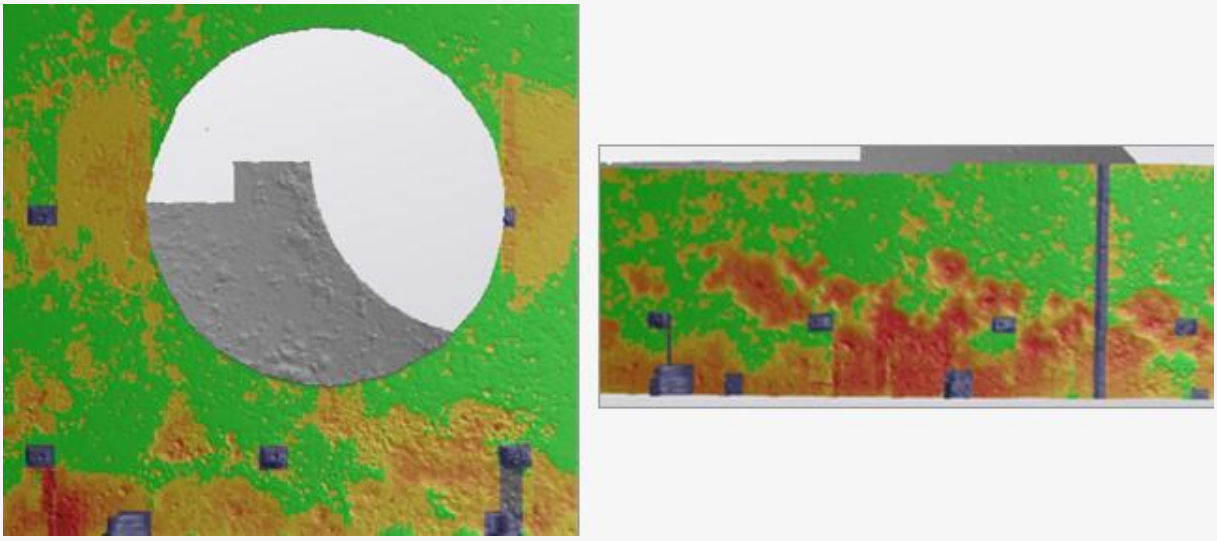
Methodology



Mapping of the column skirt after scanning. The scans highlight the corrosion (red areas) at the bottom of the skirt.

1. Once the surface is prepared (sanded and with its insulation removed) by on-site contractors, positioning targets are applied to it. Positioning targets allow the scanner to triangulate its position against the control surface during the 3D data acquisition process. Estimated time: 1 hour.
2. Reference arrow positioning allows the positioning of the indications in relation to X and Y references identified beforehand.
3. Positioning target acquisition and 3D surface scanning (approx. 20 m^2 with a resolution of 1.5 mm). Estimated time: 45 minutes.
4. Data recording and site cleaning and restoration after inspection. Estimated time: 30 minutes.
5. Data processing and preparation of the inspection report. Estimated time: 12 hours.

The above application and methodology are based on the control of a 20 m^2 surface carried out by Dolphin Marine & Offshore during a single intervention. This will enable the company to reduce data processing times in the future.



Detailed views of the manhole (left) and of a lower area of the column skirt (right).
The grey zones on the map indicate the insulation supports and presence of a welded joint. Pipecheck software also helps to accurately estimate each indicator or group of indicators revealed on the color map by providing the profiles of material losses and their associated depths.

ONSHORE & OFFSHORE TESTING

Dolphin Marine Offshore and Industrie BV offering world class onshore NDT facilities combined with our long standing expertise, We deliver a unique onshore NDT service portfolio. Dolphin operate 24/7, with a strong team of NDT technicians are available to advise you on the best method for your project also our teams of inhouse skilled engineers offer the following NDT techniques:

- Visual Inspection
- Magnetic Particle Inspection
- Dye Penetrant Inspection
- Ultrasonic Inspection
- Eddy Current Inspection
- Radiography (X-Ray and Gamma)
- PMI Testing
- OFFSHORE INSPECTION & NDT SOLUTIONS

Dolphin offers leading inspection and NDT offshore techniques to complement our extensive onsite services. We provide fully competent rope access trained personnel and equipment to meet clients' offshore inspection and NDT requirements as a standalone service or as part of a fully integrated package. Delivery offshore inspection and NDT solutions on hook up's and new installation projects, in-service inspections and decommissioning workscopes and we take the time to fully understand every client requirement. Dolphin's experience ensures we provide consultation on best methods, adding value and encouraging efficient use of resources while making sure we deliver the highest competence and safety standards.

Our Offshore NDT capability includes the following:

- Visual Inspection
- External Close Visual Inspection and NDT measurements by RAT
- Magnetic Particle Inspection
- Dye Penetrant Inspection
- Radiography
- Ultrasonics
- Eddy Current Inspection
- Phased Array Inspection
- Time of Flight Diffraction
- REMOTE ACCESS CAISSON INSPECTION

With over 20 years inspection experience, Dolphin support clients to prevent failure by detecting early signs of possible defects and our expert field engineers deliver sound recommendations and reports for remedial work required. By proactively delivering internal inspection services, Dolphin provides an accurate picture of integrity, avoiding potential loss of structural integrity. We are committed to innovation and finding solutions for challenging inspection problems.

two single most common forms of **heat treatment Preheat** Preheat is the term associated with the application of heat to a metal component prior to and during welding. There are a number of reasons that preheat may be required, including reduction of residual stresses after the component has been welded, and minimising absorption of Hydrogen into the weld during welding. Preheat temperatures are generally relatively low, ranging typically from 50°C up to 250°C. Post Weld Heat Treatment Post Weld Heat Treatment (PWHT) is the term used to describe the heating of an entire weld to a temperature high enough to reduce the residual stresses within the weld. PWHT temperatures are typically in the range of 600 – 700°C. There are a variety of application methods for heat to weld geometries in order to achieve the desired temperature, ranging from locally applied electrical heaters, to larger gas fired furnaces. The method used is usually determined by the abrication geometry, size, access restrictions and site constraints.

Demonstration of Heat Treatment set up

PRODUCT DATASHEAT:

ULTRASOON MEASUREMENT

Reducing your energy costs is a difficult challenge faced by many industries in today's economy. But, it doesn't have to be.

Undetected air or steam leaks, bearing failures and electrical panel faults cost you real money. There's a way to cut these extra expenses from your energy bill.

Preserve the health of your assets with the SDT200 ultrasound detector. Hear air leaks, trend and monitor the condition of your bearings, safely inspect electrical panels and schedule repairs on your own terms, long before they shut you down – all with ultrasound technology.

IMPRESSION VIDEO

https://youtu.be/yNXihX8aVKQ

PRODUCT DATASHEAT:

Steam Systems Inspection

Keep Your Steam Clean, Safe And Energy-Efficient

Your steam traps contribute to product quality, energy conservation, component longevity and employee safety. Yet it is not uncommon to have as much as 50% of steam traps in a failed state.

As hot steam travels from your boiler to the point of use, some cooling is inevitable. The result is condensate and gases. The job of the steam trap is to isolate and remove these impurities from the live steam. Steam traps that function properly help maintain purity and efficiency throughout the system.

The best way to test steam trap function is to listen to them with an ultrasound solution. With ultrasonic detection you're able to hear:

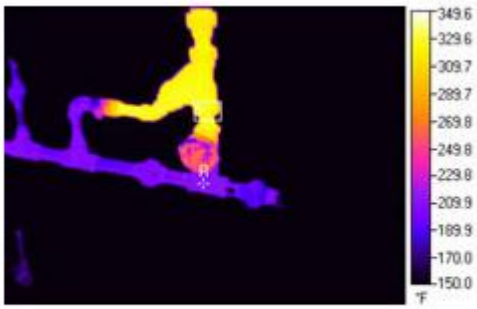
- The opening and closing of your steam trap
- Silence if the steam trap is stuck in the closed position

- Turbulent flow if the steam trap is stuck in the open position
- Mechanical clattering if the steam trap's valve is fluttering open and shut

IMPRESSION VIDEO

https://youtu.be/C7VB_gzWkgg

Working steam traps preserve pure, safe and energy-efficient steam. Rely upon the SDT270 and SDT200 ultrasound solutions to monitor the condition of steam traps and determine which ones need to be replaced.



Thermal Image - Trap appears okay

Digital Image of trap

Both the SDT270 and the SDT200 offer optional, onboard temperature measurement. Test temperature differential upstream and downstream of the trap, in conjunction with your ultrasound data, for a more thorough assessment of trap condition.

PRODUCT SHEAT:

Valve Condition Monitoring

Monitor Valve Leaks With Ultrasound

When your valves are closed, are they really closed?

How can you be sure? When a valve isn't completely closed it creates ultrasonic turbulence at the source of the leak. SDT's ultrasound solution hears that turbulence over the noise of the factory.

Whether it's internal or external leaks, or issues with flow regulation, valve leaks are a threat to your process.

Efficient processes depend on having valves that perform their function properly. Regular ultrasonic inspection quickly identifies which valves are leaking and which ones are closed.

PRODUCT DATASHEAT:

TankTest

Ultrasound Testing Of Underground Storage Tanks

Around the globe, preventing soil pollution from underground storage tanks has become a priority.

Many countries have introduced legislation to identify and assess the risks associated with soil or groundwater pollution from the underground storage of vehicle fuels, heating oil or other dangerous liquids. Rigorous, periodic tank tightness testing is imposed in order to guarantee an incident-free operation.

The SDT270 has proven itself to be the most accurate, reliable and comprehensive method of ultrasound tightness testing for underground storage tanks.

PRODUCT DATASHEAT:

Electrical Inspection

Safely Inspect Electrical Systems For Partial Discharge

When it comes to electrical systems, most failures are due to installation problems, water damage, insulation issues and poor workmanship.

Electrical failures pose a tremendous safety threat and have the ability to shut down operations entirely.

Electrical discharge is a constant threat to your safety – and the health of your electrical systems. Ultrasound solutions reveal electrical fault conditions such as partial discharge (corona), partial arcing (tracking) and arcing discharge inside metal clad switchgear, around substations, and in overhead transmission and distribution lines. Use SDT to hear what you cannot see.

PRODUCT SHEAT:

PULSED EDDY CURRENT

Eddy current arrays (ECA) are the natural extension of ECT. ECAs are composed of arrays of coils that activate in sequences intended to eliminate interference between them. The array slides on top of surfaces, offering an overall wider coverage and better sensitivity to defects than conventional ECT. ECA technology can detect surface-breaking defects and, to some extent, subsurface defects. ECA probes can also be shaped to match more “exotic” geometries, which enable single-pass scanning of geometries that traditionally pose serious challenges to other inspection technologies.

ECA technology is used as an alternative to other surface inspection technologies in such industries as the oil, gas, and petrochemical industry; the power generation and nuclear industries; the aerospace industry; and the heavy equipment and mining industries. ECAs also very successfully supplement ultrasonic testing (UT) and phased-array UT because these suffer from what is often referred to as a “dead zone” near the surface, making it difficult for them to detect near-surface defects.

Therefore, surface applications of ECA technology are numerous, ranging from weld inspection on pressure vessels and pipes, to corrosion mapping between wing longerons and skin, by way of dovetail inspection in turbines.

Use Eddyfi’s ECA solutions to detect and characterize such common defects as:

- Far-surface corrosion
- Subsurface defects such as cracks, voids, and porosity
- Surface-breaking defects such as cracks and pits
- Corrosion under insulation (CUI)

Here are some of the flagship surface applications where our ECA solutions — standard or custom — were used with great success to detect defects.

Welds

Welds are used almost everywhere and are subjected to various stresses, making them a focal point for inspection, as they are often critical to structural integrity and safety. Welds can develop surface-breaking cracks and other types of discontinuities that must be detected and characterized.

Eddyfi's ECA solutions are available for various types of weld materials (ferromagnetic or not), surface conditions (dirty, coated, abrasive), and weld shapes (different degrees of flexibility) to match the shape of the weld crown. Our ECA solutions can also cover all weld areas in a single pass — the heat-affected zone, the toe, and the cap.

The Sharck™ probe, incorporating tangential eddy current array (TECA™) technology, was specifically designed to inspect welds.

Corrosion

Corrosion degrades the useful properties of materials and structures including strength and permeability, so it's critical to detect it. Corrosion can be concentrated, forming pits and cracks, and it can also extend across wide areas more or less uniformly on exposed surfaces. Some corrosion mechanisms are less visible and less predictable. Our ECA surface probes are designed to detect these various forms of corrosion.

Corrosion Under Insulation

CUI is one of the most difficult processes to prevent because no matter the precautions taken, water invariably seeps into the insulation and begins its dirty work—sometimes unseen until process leakage occurs. Historical data shows that about 60% of pipe leaks are caused by CUI. The price of this is astronomical. The Eddyfi Lyft solution is specifically designed to address this plague of an issue.

Turbines

Turbines are typically found in aircraft and power plants. Moving fluids act on turbine blades to impart rotational energy to the rotor. Gas, steam, and water turbines found in the power generation and nuclear industries usually have a casing around the blades containing and controlling the working fluid.

Turbines are therefore mission critical. Modern turbines are large, complex, and costly to shut down. Safety and life extension programs demand that turbines be inspected regularly. Eddyfi's ECA surface solutions are designed to perform fast and accurate inspections of various turbine components such as:

- Dovetails
- Blades (leading edge, gas path, root)
- Generator slots
- Retaining rings
- Rotor bores
- Boreholes

Technology Comparison for Surface Applications

When it comes to surface applications, the performance of any given inspection technique depends greatly on the specific conditions — mostly the types of materials and defects, but also surface conditions, cleanliness, etc. However, in most situations, the following are true:

	Liquid penetrant (PT)	Magnetic particles (MT)	ECT	ECA / TECA™
Effective on coatings/paints	No	Yes	Yes	Yes
Computerized record keeping	No	No	Partial	Yes
3D/Advanced imaging	No	No	No	Yes
User dependence	High	High	High	Low
Speed	Very low	Very low	Low	Very high
Cleaning	Yes	Yes	Application-specific	Application-specific
Post-inspection analysis	No	No	No	Yes
Chemicals/Consumables	Yes	Yes	No	No

PRODUCT SHEAT:

HEAT EXCHANGERS

Tubing applications are usually defined as the inspection of ferromagnetic or non-ferromagnetic tubes in a variety of assets such as shell-and-tube heat exchangers, steam generators, boilers, coolers, and condensers.

The tubes in such assets are usually small in diameter and very numerous (some bundles can contain as few as five tubes, while others as many as 50 000). The tubes in this fixed equipment are sometimes straight, sometimes bent, sometimes twisted, which requires a vast array of probes to inspect the tubes from the inside.

Inspecting such tubes is common in the oil, gas, and petrochemical industry, as well as in the power generation and nuclear industries. Timing is usually critical, as shutting down for inspection is usually costly, but more so when the shutdowns are unplanned. Inspections must therefore be highly productive, considering the large amount of tubes to be inspected.

The most common defects that asset owners and inspection companies look for in tubes are inner and outer-diameter pitting and corrosion, longitudinal cracks, circumferential cracks (especially at the tubesheet), erosion, fretting, and metal loss. It's usually important to find such defects **before** tubes begin leaking, because that causes pressure inside the equipment to drop, which leads to lower performance and even critical failure.

However, no single inspection technique is adequate for all tubing applications, all types of materials, and all defects. ECT is commonly used to inspect non-ferromagnetic tubes, RFT and MFL are used to inspect carbon steel and other ferromagnetic tubes, while IRIS ultrasonic testing is perfect for metal loss measurements on both types of tubes.

Ferrous Tubing

Ferrous tubes are common in the shell-and-tube heat exchangers of the oil, gas, and petrochemical industry, among others, where inspection companies use RFT, NFT, MFL, and IRIS in various combinations to detect corrosion, pitting, cracking, and erosion in the tubes to maintain efficiency. The generally poor cleanliness of tubes means that probes must be durable, reliable, and have short lead times.

This is exactly what Eddyfi probes offer. And, when our standard probes don't meet application requirements, we are fully equipped to custom-design and manufacture special probes.

Non-Ferrous Tubing

Non-ferrous metals, for example Inconel, are used to make tubes that are non-magnetic and offer a better resistance to corrosion and stress cracking. They are necessary in the power generation and nuclear industries due to the critical nature of the systems they are part of, such as steam generators in nuclear plants. They are also omnipresent in the balance of plants (BoP) of such industries.

Eddy currents are used in these industries because they are perfectly suited to inspecting non-ferrous alloys. Our high-performance probes are designed to offer excellent signals while being very durable. You can therefore inspect large number of tubes rapidly and precisely.

Suitability According to Material

Suitability According to Material

Material/Tech		ECT	ECA	IRIS	RFT	NFT	NFA	MFL	PSEC
Non-ferromagnetic	Tube	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴
	Finned tube	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴
Low ferromagnetic	Tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢
	Finned tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢
Ferromagnetic	Tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢
	Integral finned tube	🔴	🔴	🟡	🟢	🟢	🟢	🟢	🟢
	Aluminum finned tube	🔴	🔴	🟢	🔴	🟢	🟢	🟢	🟢

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Detection Capabilities According to Defect Type

Defect/Tech	ECT	ECA	IRIS	RFT	NFT	NFA	MFL	PSEC
ID pitting	🟢	🟢	🟢	🟡	🟡	🟢	🟢	🟢
OD pitting	🟢	🟢	🟢	🟡	🔴	🔴	🟡	🟡
Axial cracking	🟡	🟢	🔴	🟡	🟡	🟡	🔴	🟡
Circumferential cracking	🟡	🟢	🔴	🔴	🔴	🟡	🟡	🟡
ID corrosion	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
OD corrosion	🟢	🟢	🟢	🟢	🔴	🔴	🟡	🟡
At tubesheet	🟡	🟢	🟢	🟡	🔴	🔴	🟡	🟡

🟢 Excellent 🟡 Acceptable, but limited 🔴 Not suitable

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Sizing Capabilities According to Defect Type

Defect/Tech	ECT	ECA	IRIS	RFT	NFT	NFA	MFL	PSEC
ID pitting	Good	Excellent	Excellent	Good	Not suitable	Excellent	Not suitable	Not suitable
OD pitting	Excellent	Excellent	Excellent	Good	Not suitable	Not suitable	Not suitable	Not suitable
Axial cracking	Good	Excellent	Not suitable	Not suitable	Not suitable	Good	Not suitable	Not suitable
Circumferential cracking	Not suitable	Excellent	Not suitable	Not suitable	Not suitable	Good	Not suitable	Not suitable
ID corrosion	Good	Excellent	Excellent	Excellent	Not suitable	Excellent	Not suitable	Not suitable
OD corrosion	Excellent	Excellent	Excellent	Excellent	Not suitable	Not suitable	Not suitable	Not suitable
At tubesheet	Good	Good	Excellent	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable

Excellent Good Not suitable

PRODUCT SHEAT:

FIBER OPTIC STRAIN SENSORS

With over 25 years' experience in the field, Dolpin Marine Offshore en Industrie BV is an expert provider of intrusive and non-intrusive Monitoring Solutions to the global Oil & Gas industry.

Dolphin provides fibre optic strain sensors and acquisition systems for monitoring strain, focusing on corrosion and bending. The fibre optic Strain Gauge is the latest Strain Monitoring technology. The fibre optic Strain Gauge is both robust and completely immune to EMI Noise. It offers a flexible solution for Operators seeking a versatile solution to their Strain Monitoring requirements and can be installed on almost **any pipeline** or structure across a wide range of industries. The system can be used for corrosion monitoring when in a coil configuration and pipeline movement in linear configuration. It can be deployed in high temperature areas up to 250°C and is epoxy bonded to the structure of interest to ensure secure and repeatable measurements can be obtained. Strain Monitoring – Fibre Optic Strain Gauge The data produced during the measurement process is logged and automatically uploaded to a server where it is processed into calculated data, such as microstrain.

Once installed, the logger can be configured to automatically send the data securely to the online web portal where it is analysed and displayed in a user friendly interface, designed to suit client requirements.

Fundamental Principles

Optical detection

Precise measurement of sensor length

Analogous to strain gauge

Changes in length are microscopic

Longer gauge length gives higher sensitivity

Both thermal and mechanical strain Installing fibre optic Strain Gauges on critical areas increases safety, equipment life and reduces the cost of repetitive site visits due to remote monitoring.