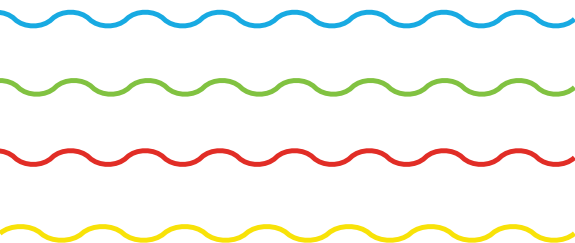


SCT

Stress
Concentration
Tomography



Speir Hunter Limited





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OVERVIEW

Speir Hunter Ltd, in partnership with the University of Leeds in the UK, has engineered the science of stress-magnetisation to create a remote pipeline inspection tool which is used by integrity engineers worldwide on both piggable and non-piggable lines. This groundbreaking technology is called Stress Concentration Tomography, commonly referred to as SCT™.

SCT™ is the only inspection technique in the world that can simultaneously map the lateral position and depth of cover of the pipeline whilst also providing comprehensive defect detection. Moreover, it provides additional deliverables that anticipate the increasing demand of pipeline regulatory authorities such as the location of casings and wrinkle bends.

STRESS CONCENTRATION TOMOGRAPHY

SCT™ exploits the measurable relationship between stress and magnetization: changes in localised stress on the pipeline wall cause predictable changes in the pipeline's natural magnetic field. The analysis of this remotely collected magnetic data is then used to determine the presence of defects, their location and their magnitude of stress.

INTRODUCING UNISCAN™...



UNISCAN™

is the hardware used to collect raw data for analysis. It is composed of:

- An array of sensitive magnetometers that collect data on the pipeline's natural magnetic field from a distance.
- A high-precision GNSS positioning system to stamp locational data onto magnetic data in real-time.
- Complex firmware to control electronic functionalities and to record magnetic locational data onto a USB stick for analysis in UNISCAN™ Tools.

UNISCAN™ TOOLS

is a software package that analyses the magnetic-locational data collected by UNISCAN™ and automatically generates integrity reports and pipeline route maps. It contains algorithms that:

- Detect the presence of defects, their location, and their magnitude of stress.
- Report 3D mapping information of the pipeline's route, depth of cover and lateral position.
- Filter out external sources of magnetic interference, such as pipeline CP currents and overhead power lines.



MUCH MORE THAN DEFECT DETECTION

In addition to defect detection, SCT™ reports a wide variety of pipeline configurations that are being increasingly demanded by pipeline regulatory bodies worldwide.

SCT™ DELIVERABLES

- 1 The number and location of defects in the pipe to sub-meter accuracy
- 2 The stress-level that each defect zone causes on the pipeline wall reported relative to Design Max Operating Hoop Stress, and material SMYS





3

Identification of girth welds and their position to sub-meter accuracy

4

Changes in pipeline wall thickness and diameter and their location to sub-meter accuracy

5

3D Mapping: pipeline depth of cover within 5% of actual depth and lateral position to cm accuracy

6

Wrinkle bend detection and location along with a prediction of their stress level

7

Casing detection and location to sub metre accuracy

8

Prediction of bending strain in geohazardous regions

COMPREHENSIVE DEFECT DETECTION

SCT™ directly measures the quantity of stress on a pipeline wall by analysing remotely collected magnetic data. This means that SCT™ can detect any type of defect occurring in a pipeline in any orientation, internal or external, and irrespective of the clock position of the defect. If it causes a localised increase in stress on the pipe wall then SCT™ will detect and report it to sub-meter accuracy.



LIST OF DEFECTS DETECTABLE BY SCT™

- 1 Internal or external corrosion
- 2 Weld defects and defects near to or on welds e.g. dents
- 3 SCC and micro cracks
- 4 Dents and mechanical damage
- 5 Lateral deformation and buckling caused by earth movement in geohazardous regions
- 6 Illegal hot tapping of pipeline transported material
- 7 Linear defects including cracks, delamination and exfoliation

COMMERCIAL BENEFITS

REMOTE PIPELINE INSPECTION

SCT™ is a **100% non-invasive** pipeline inspection technique: there is no need to modify the operating parameters in any way prior to, during or after inspection. This technical innovation translates directly into commercial benefit; maintaining normal operational parameters throughout the inspection process means normal revenues are maintained throughout the inspection process.



No need for calibration digs to verify the initial predictions of SCT™ or to adjust interpretation of magnetic signatures

No need to change operating pressure or flow rates

No need to physically alter a pipeline structure prior to inspection

No need to induce energy into the pipeline or to turn off CP currents prior to inspection



A FLEXIBLE AND DIVERSE TOOL

SCT™ has been designed as a cost-saving addition to existing methods of inspection and it can be used in a variety of ways. Weighing less than 8kg and requiring only a 2-man team to operate in the field, UNISCAN™ is rapidly mobilised and can be deployed in many different environmental conditions.

STAND ALONE TOOL

Some types of local pipeline wall weakness such as lateral deformation and buckling of the pipe caused by ground movement are not observable by any other form of NDT technique. SCT™ offers a solution to pipeline operators in geohazardous areas worldwide. Its 3D mapping features and stress-estimation capacity can reveal the exact location at which earth movement is leading to an imminent pipeline rupture.

MONITORING TOOL

By targeting specific sections to monitor known defects on a longer pipeline, SCT™ eliminates the need to initiate a full-length PIG run. This means less downtime and more savings.



MAPPING TOOL

Use SCT™ to deliver an accurate map of the pipeline route including its depth of cover. Especially useful in areas of soil erosion where deployed in this way it will help reduce the possibility of damage through mechanical impact from farming and excavation equipment. Also useful to an operator that has acquired pipelines whose records are not complete.

COMPLEMENT TO ECDA

SCT™ can be used as an additional tool in the ECDA process. Cross-comparing SCT™ results with DCVG results can reveal where coating defects have led to corrosion thus eliminating the need for unnecessary and expensive excavations.

COMPLEMENT TO ILI

SCT™ can be used as a screening tool to monitor the deterioration of specific defects on a pipeline. It can also be used to identify which areas of a pipe should be inspected by ILI, and which do not need ILI inspection. Moreover, Speir Hunter are currently developing a girth weld detection algorithm that can identify the precise above-ground location of girth welds to improve the accuracy of ILI excavations.

SCREENING TOOL

SCT™ can be used to scan a long length of pipeline and then to identify segments that need further investigation using high resolution tools. By zooming in on specific regions of a pipeline the need to inspect entire long lengths with high resolution tools is removed saving time and cost.

SOLUTION FOR PREDICTION OF STRAIN IN GEOHAZARDOUS REGIONS

Utilising magnetic data, SCT™ is capable of predicting strain in piggable and non-piggable pipes in geohazardous regions and can be deployed quickly, without disruption to operation.

The Uniscan™ System benefits from a non-contact, non-destructive and passive technology and collects data for assessing pipeline integrity, 3 dimensional mapping of a pipeline's position and location of girth welds.



Capable of detecting Stress Concentration Zones (SCZs) caused by:

Metal Loss

Cracking (including SCC and micro cracks)

Mechanical damage including dents

Sagging, bending and buckling caused by ground movement



3 Dimensional Mapping & illustration of a pipeline's position using a combination of survey grade GNSS technology and magnetic data



Estimates depth of burial with a reading every 2 to 6m



Detects Metallic Casings and Changes in wall thickness or diameter of pipe



Provides prediction of presence and degree of bending strain in geohazardous regions

TECHNICAL SPECIFICATIONS

SCOPE OF WORK

Diameter of surveyed pipelines	203mm – 1820mm
Pipe wall thickness	>3.0mm
Distance between Scanner and the pipeline (axial deviation, laying depth)	Optimal distance up to 12 times pipeline diameter

SENSING

Passive magnetic technology

ACCURACY

Laterally Depth	Within 100mm ± 5% of the actual depth to a confidence of 95%
GNSS	Positioning Accuracy: Survey grade multi constellation GNSS system 15mm relative to fixed point without post correction (95% confidence) 15mm absolute after post correction
Location	Within +/- 1m as predicted by geocoordinates. This refers to the accuracy of the positioning of the geometric centre of the SCZ. Defects, single or multiple, causing the magnetic anomaly will be contained within the anomaly zone but their precise position and quantity is not defined

PROBABILITY OF DETECTION, MISSED, AND FALSE CALLS

Probability of Detection

Not less than 80% of verified inspection locations with a confidence level of 95% in conditions where no magnetic interference is experienced

Missed Calls

Not more than 20% of verified inspection locations with a confidence level of 95% in conditions where no magnetic interference is experienced

False Calls

Not more than 20% with a confidence level of 95% in conditions where there is no source of magnetic interference

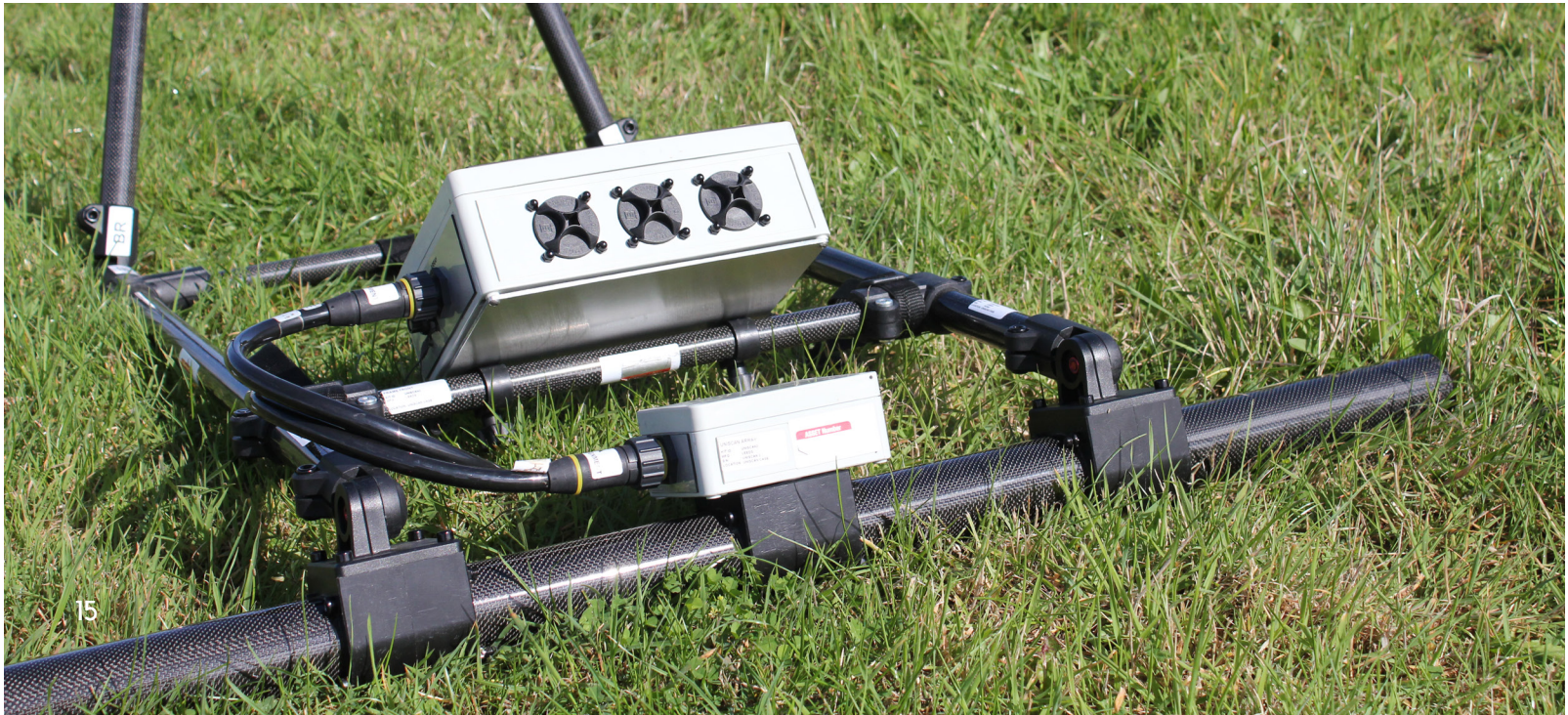
DATA

Memory USB

Durable industrial grade USB for data collection which will store > 200km of pipeline magnetic /GNSS data

Data Processing

Offline



PHYSICAL AND ENVIRONMENTAL

Environmental protection	IP-66
Batteries type	Lithium (GNSS): Ni-MH (UNISCAN)
Framework	Carbon Fibre
Continuous work	Not less than 12 hours
Operating Temperature	-25°C to 45°C
Max Survey Length	Unlimited
Operating Hoop Stress	>65MPa
Weight	7Kg (including GNSS Rover and batteries)
Sensory array dimensions	1100mm x 140mm x 120mm

STORAGE AND TRANSPORT

The Uniscan™ System is stored and transported in a protective 'Peli' case with the dimensions of 147 x 47.5 x 26.5 cm and weighs 26.8kg

INTRODUCING FSCT™...

A BRAND NEW TECHNOLOGY BROUGHT TO YOU BY SPEIRHUNTER LTD



INSPECTION SYSTEM FOR CORROSION UNDER INSULATION (CUI)

CUI is recognized globally by petrochemical industry operators and regulators as their primary integrity issue costing an estimated \$5.5 trillion each year in inspection, repair and maintenance (IRM). In addition CUI is one of the major causes of accidents in the oil and gas industry resulting in an uncontrolled release of hazardous substances creating loss of production and risk to life. The issue is becoming progressively worse as plant and equipment ages deteriorating to the stage where it is common for operators to have concerns in safely removing the insulation or coating for pipework inspection when the plant is in operation.

- 1 Removal of insulation is not required
- 2 Wireless transmission from probe to mobile device
- 3 CUI identified in real time
- 4 Easily portable lightweight hand held probe collects magnetic data
- 5 Fast and accurate inspection process
- 6 Minimal equipment



FSCT is a **non-intrusive** NDT system which provides an effective detection of CUI without the need to disrupt the insulation already in place. It is an **external, non contact and passive inspection technology** which uses a hand held instrument to scan over the insulation or coating, collecting magnetic data and giving results in real time on a tablet, mobile phone or laptop through a blue tooth connection. An audio visual alarm alerts the operator when corrosion is detected and the location can then be marked so that a high resolution NDT tool, for example radiography, can be deployed to assess accurately the extent of damage. This combination of tools facilitates a **rapid inspection, fast detection, accurate positioning and an assessment of the severity of corrosion** that is present **saving inspection time and dramatically reducing costs**. Alternatively, coating can be removed at locations where corrosion is indicated and assessed visually to decide if repair is necessary. Patents pending.

Please enquire for more details.

UK CONTACT

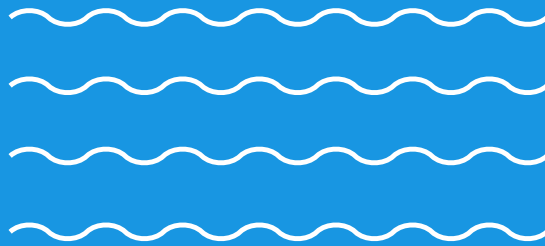
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