

Technology Driven
Not Operator
Dependent



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Not Operator
Dependent

Ultrasonic Inspection Services

IN SERVICE or OUT OF SERVICE TANK
SHELLS, PRESSURE VESSELS, SPHERES &
ROOF INSPECTION AS WELL AS SIMILAR
PLANT ITEMS



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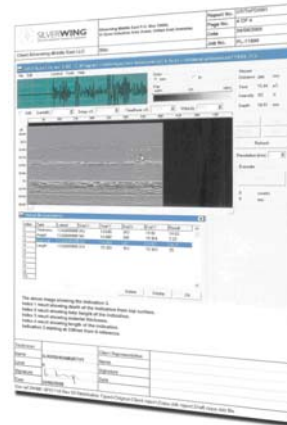
Ultrasonic Inspection Services

Thickness Gauging

Manual Ultrasonic Testing

Manual ultrasonic techniques, which include both 0° compression and angled shear wave techniques, are performed from the outside surface with little or no surface preparation. Manual ultrasonic techniques have excellent potential and are very cost effective when it comes to screening large surface areas and complex geometry's. The major limitation of manual ultrasonic technique is its inability to provide any imaging, either on line or as hard copy, of the indications detected.

Although it is possible to deploy the ToFD probes by means of fully automated manipulators, experience has proved that the most cost effective way of collecting the data on simple butt welds is by means of a manually propelled, single axis encoded scanner.

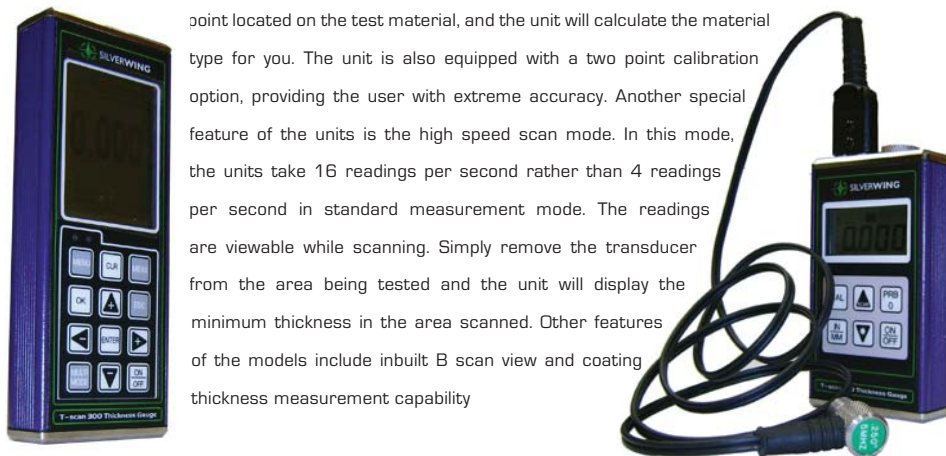


Corrosion Thickness Gauge Measurement

Manual Thickness Gauging with Data Loggers

The T-100, T-300 and T-300DL range of thickness gauges have the ability to field calibrate on the fly. The models offer extreme flexibility and accuracy to calibrate to a variety of materials instantly. Simply tell the unit one known thickness

point located on the test material, and the unit will calculate the material type for you. The unit is also equipped with a two point calibration option, providing the user with extreme accuracy. Another special feature of the units is the high speed scan mode. In this mode, the units take 16 readings per second rather than 4 readings per second in standard measurement mode. The readings are viewable while scanning. Simply remove the transducer from the area being tested and the unit will display the minimum thickness in the area scanned. Other features of the models include inbuilt B scan view and coating thickness measurement capability

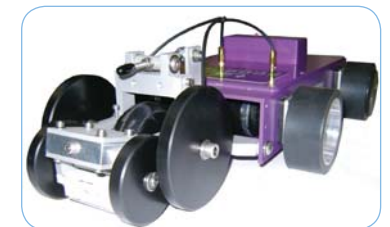


Auto Crawler Thickness Gauging

Silverwing have a range of tank or vessel auto crawler UT systems to remotely take thickness readings on suspected areas of hidden corrosion which would be expensive to monitor by traditional abseiling or via scaffolding access. These units are designed to be used with clients existing flaw detection or thickness gauging equipment to remotely take spot thickness readings. We have two types of unit available these being:

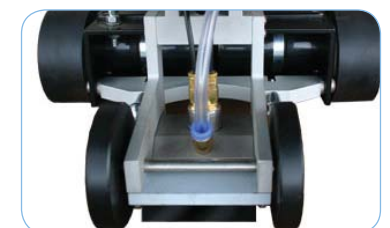
The Scorpion DCP remote access crawler uses a unique "Dry Coupled" wheel probe eliminating the need for traditional couplant. This allows the crawler to travel vertically, horizontally or even inverted whilst still fully functional. Compatible with almost any ultrasonic system, a 50 metre umbilical cable allows access to the furthest point of most structures without the need for scaffolding. Powered by the Sitemaster 30 battery pack, the system is capable of 8 hours continuous operation on a single charge.

- Unique dry coupled wheel transducer
- Remote operation with NO height restrictions
- 12VDC self contained system



The Scorpion BP remote access crawler comes supplied with an irrigated dual 5MHz transducer fed from a pressurised stainless steel reservoir. Compatible with almost any ultrasonic system, a 30 metre umbilical cable with water feed allows access to the top of the highest storage tank for remote access measurements. Powered by the Sitemaster 30 battery pack the system is capable of 8 hours continuous operation on a single charge.

- Pressurised water supply
- Remote operation with height restrictions
- 12VDC self contained system



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Manual Corrosion Profiling

Automated Corrosion Profiling

R-Scan Lite - B-Scan Imaging System



The R-Scan is a portable Digital B scan imaging system designed to capture data images to assist with corrosion profiling for the purpose of securing hard copy more accurate data and monitoring critical components where corrosion may have been previously identified using conventional NDT techniques and without knowing the corrosion profile as well as length.

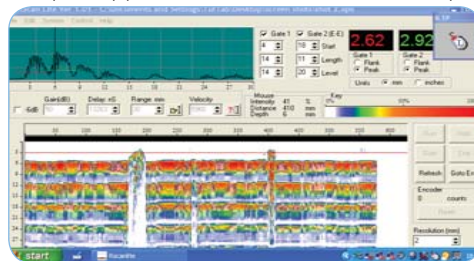
The system is manual and battery operated using a scanning head, UT interface unit and extremely durable personal computer as well as

interconnecting cables to provide real time digital display of any scan.

The UT scanner is extremely user friendly and easy on the hand in the same manner as a computer mouse. It uses a single axis encoder design using the Silverwing unique dry-coupled (rolling dual-element transducer) which also eliminates the use of conventional UT couplant. This also facilitates working the scanning head in an up side down position and scanning speeds of up to 200 mm/second to be achieved since generally there is no need to stop for couplant once the job has started.

The scanner is easily connected to the UT system and personal computer via simple interface cables providing Full B-Scan (with A-Scan) data acquisition capabilities. The personal computer is also very user friendly being MS Windows based which allows the report to be generated then cut and paste directly into clients or user reports, .The same personal computer and UT module may also be used with the Z- Scan Lite and ToFD Lite systems.

The R-Scan Lite operates with various surface geometries such as plates, pipe in excess of 50 mm diameter and up to very large diameter pipes as well as restricted and difficult to reach areas .In our opinion it also represents excellent value for money when compared with the time and cost of convention manual 10 mm Spot thickness gauging techniques that have been used historically in the past and where clients wish to minimise the risk of missing the hidden corrosion that maybe detrimental to the environment.



Screen shot showing B Scan

Scorpion B Scan - Remote Access B-Scan Imaging System



The Scorpion B-scan is a rugged remote access crawler designed to allow cost Effective A and B-scan imaging on above ground ferro-magnetic structures without the need for costly scaffolding or rope access. The system uses a unique "Dry Coupled" wheel probe eliminating the need for

traditional couplant. This allows the crawler to travel vertically, horizontally or even inverted whilst still fully functional. Scorpion B scan auto UT inspection system to provide normally minimum 4 scans of the shell to minimise the risk of missing any unforeseen corrosion as well as eliminating the need to use scaffolding or rope access to perform manual UT thickness gauging inspection. The Scorpion B scan system will also provide the following additional benefits:

- Maximise the ability to detect corrosion by taking a continuous 10 mm dry coupled wheel probe scan from bottom to top assuming there are no obstructions such as wind girders, nozzles, etc
- Permanent hard and soft copy record of the results which can be retrieved at any future date with extremely accurate X and Y coordinate location of any corrosion for future data collection and RBI comparison.
- Eliminate the need to apply any grid lines matrix as per the requirement manual grid gauging technique.
- Eliminate the need to remove painted areas for inspection
- Quicker data collection and real time analysis of the inspection
- Computer generated report in lieu of totally manual reports.
- Reduced safety incident risk by minimising the use of scaffolding.



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Manual Corrosion Mapping

Automated Corrosion Mapping

Z-Scan - Manual C-Scan Imaging System

Silverwing Z-Scan Lite unit is a portable digital C scan imaging system designed to capture data images to assist with corrosion mapping for the purpose of securing hard copy more accurate data and monitoring critical components where corrosion may have been previously identified using conventional NDT techniques and without knowing the corrosion profile or area.



The system is manual and battery operated using a scanning head, UT interface unit and extremely durable personal computer as well as interconnecting cables to provide real time digital display of any scan.

The UT scanner is extremely user friendly and easy on the hand in the same manner as a computer mouse. It uses a dual axis encoder design to provide an accurate raster type capability using the Silverwing unique dry-coupled (rolling dual-element Transducer) which also eliminates the use of conventional UT couplant. The unit will provide X and Y location points for any corrosion that is identified this also facilitates scanning speeds of up to 200 mm/second to

achieved since generally there is no need to stop for couplant once the job has started. The scanner is easily connected to the UT system and personal computer via simple interface cables providing full C-Scan (with B-Scan) data acquisition capabilities and attainable resolutions as small as 0.25 mm. The personal computer is also very user friendly being MS Windows based which allows the report to be generated then cut and paste directly into clients or user reports, various options are available in the report such as a basic C scan image reports, palette colour selection, 3 D image as data point or wire mesh, Zoom on minimum thickness with subsequent 3D image in data point or wire mesh and animated wire mesh view. The same personal computer and UT module may also be used with the R-Scan Lite and ToFD Lite systems. The Z-Scan Lite operates with various surface geometries such as plates; large diameter pipe as well as inaccessible and difficult to reach areas and in our opinion represents excellent value for money when compared with the auto UT systems that may not be practical or where clients may not wish to make such a high value investment.

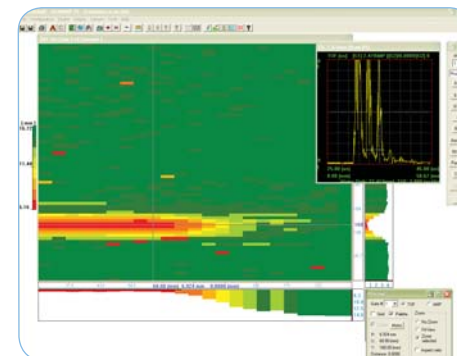


ScanmapVS giving 130 mm wide UT A, B and C scans

ScanmapVS auto UT inspection system to provide A, B and C scan reports as well as eliminating the need to use scaffolding or rope access to perform manual UT thickness gauging inspection. The ScanmapVS system will also provide the following additional benefits:



- Maximise the ability to detect corrosion by taking a 130 mm wide scan from bottom to top
- Permanent hard and soft copy record of the results which can be retrieved at any future date with extremely accurate X and Y coordinate location of any corrosion for future RBI comparison
- Eliminate the need to apply any grid lines matrix as per the requirement of clients specification.
- UT data is permanently stored to assist with future RLA and RBI forecasting and eliminates the risk of not being able to duplicate the inspected area at a future date



Screen shot showing A, B and C Scan

- Will also detect de-laminations
- Quicker data collection and real time analysis of the inspection
- Computer generated report in lieu of totally manual reports.
- Reduced safety incident risk by minimising the use of scaffolding and tank roof corrosion issues.

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Automated Corrosion Mapping - Rapid Motion Scanner

Rapid Motion Scanner giving 300, 450P and 600 mm wide UT A, B and C scans



The RMS is a remote access C-scan imaging system. Utilising a combination ultrasonic pulser/receiver with a built in high speed A/D converter, sampling at 50MHz, the RMS 600 is capable of operating at a scanning speed of 500 mm per second. The control software has been written especially for the latest generation dual core notebooks which fully utilises the Microsoft Vista operating platform.

The data acquisition, analysis and reporting software comes as a combined suite and automatically stores the A-scan, C-scan image and thickness measurement whilst scanning at 500 mm per second with a maximum resolution of 2 mm x 2 mm.

Silverwing's rapid Motion Scanner (RMS) system is designed to give excellent corrosion mapping coverage of large surfaces such as pressure vessels.

The RMS system is very similar in capability to the ScanmapVS system except that it has a far greater surface coverage being able to achieve following performance criteria:

- The smallest defect is 2 mm diameter x 5 mm deep on a 35 mm thick plate.
- 1 x 1 mm resolution is scanning at 300 mm per second
- 2 x 2 mm resolution is scanning at 500 mm per second
- Gates based analysis is able to define top surface 0.1 mm (0.004") loss

Mechanical features

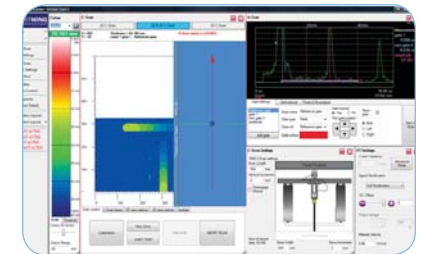
- 500mm / second scanning speed
- RMS 600 - Large Area Scanner
 - RMS 450P - Pipework and Vessel Scanner
 - RMS 300P - General Purpose Scanner
 - Scans 10" pipework to flat plate
 - Manual joystick control as well as computer programmable control



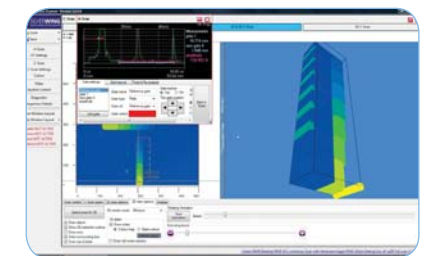
The data acquisition, analysis and reporting software comes as a combined suite and automatically stores the A-scan image, C-scan image and thickness measurement. Production rate of 1.7 sq metres per hour whilst scanning with a 2mm x 2mm resolution are standard making the RMS one of the fastest high resolution C-scan imaging system on the market today.

RMS Powerful, intuitive software suite software Key Features

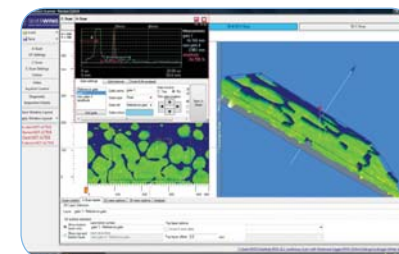
- Seamlessly integrated scanner control, data acquisition, analysis and reporting tools
- User friendly, modular interface
 - Quickly hide infrequently used controls
 - Restore hidden controls with one click
 - Save favourite screen layouts
- Real-time A-scan and C-Scan display during scan
- Multiple A-scan gates - Several gate types:
 - Peak
 - Flank
 - Fixed position (Can be used for top surface corrosion)
 - Amplitude
- Fully captured A-scan and gate configuration for accurate post inspection analysis
- Full scan replay with multiple gates:
 - Near side (external) defect sizing
 - Far side (internal) defect sizing
 - Composite analysis
- Save C-Scan data, with optional A-Scan and gates
- Export A-scan, B-scan, C-scan and 3D views as digital images
- Export C-Scan data as .CSV files for MS excel



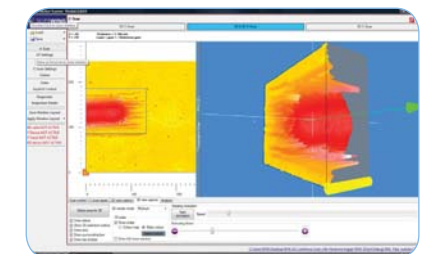
Inspection Window



Test plate with 3D Image



Hydrogen Blistering



2D and 3D C-scan Image

Ultrasonic Inspection Services

Automated Corrosion Mapping & Weld Defect Detection

Computerised ultrasonic inspection imaging techniques.

Silverwing offers a number of automated computerised ultrasonic inspection imaging techniques including Corrosion Mapping, ToFD, Phased Array and PipeWIZARD Phased Array (for Girth Weld Pipeline Inspection). The main advantage of these techniques are they provide detailed images and dimensional information of defects. This not only provides excellent information for critical defect analysis but, as all data is stored to magnetic or optical medium, it also provides a fingerprint against which future propagation can be measured. Typical scan presentations include plan view, "C" scan and cross sectional "B" and "D" scan views.

By combining our specialist technician skills with and the dedicated and trusted features of this equipment we are able to provide a Comprehensive range of UT inspection services to easily identify some of the common and unusual issues such as:

HYDROGEN DAMAGE

Hydrogen damage in steels has been identified as a major concern for equipment in hydrogen service since the 1940's. The Nelson Curve, developed by the American Petroleum Institute (API) uses data collected from almost all of the major oil companies to determine the probability of the presence of Hydrogen damage. Utilizing data such as material type, age, operating temperature-pressure and service, a curve is created which defines the safe operating limits in pressure-temperature space for various steels.

Hydrogen Attack

High Temperature Hydrogen Attack (HTHA)

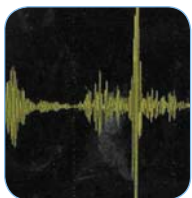
At high temperatures and pressures, atomic hydrogen diffuses rapidly into the walls of pressure vessels. Atomic hydrogen and carbon then form methane, the pressure of the methane causes cavity growth along the grain boundaries which reduces strength and ductility.

A number of techniques are employed to detect and confirm the presence of HTHA.

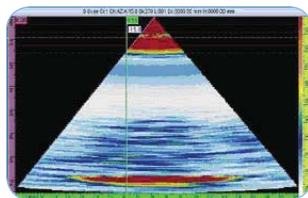
- Backscatter Technique
- Velocity Ratio
- Spectrum Analysis

Backscatter Technique

Suspect areas are scanned and the ultrasonic signal shape is observed for evidence of "scatter" from the grains as seen below.



Backscatter using manual equipment



Backscatter using Phased Array Equipment

Velocity Ratio

Once Backscatter has been observed, Velocity Ratio shall be employed to further establish the presence of HTHA. This technique relies on the ratio between transit times of 2 specialized probes. Special viscous couplant is used to transmit the ultrasonic energy. Using the same spot location, first the longitudinal velocity and then the shear velocity is measured. If the ratio of VS/VL is above 0.55 this is an indication of HTHA.

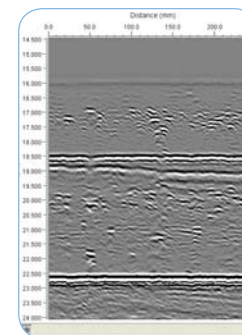
Spectrum Analysis

The final step in confirming the presence of HTHA is to perform spectrum analysis of the ultrasonic pulse. The attenuation of the pulse is measured; more attenuation will occur if HTHA is present.

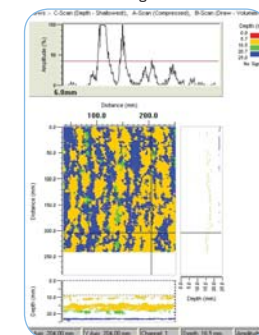
Low Temperature Hydrogen Attack (LTHA)

Unlike HTHA, Low Temperature Hydrogen Attack (LTHA) occurs at much lower operating temperatures and affects a wider range of material types. LTHA is classified into several different defect types:

- Hydrogen Blistering (HB) - Caused by the accumulation of molecular hydrogen close to the internal surface of the material. Over time, these concentrations of hydrogen expand creating laminar type fissures or blisters. Blistering occurs parallel to the steel surfaces.
- Hydrogen Induced Cracking (HIC) - Hydrogen Blisters can link up in the through-thickness direction without an apparent influence of external stress phenomena. This is known as stepwise cracking
- Stress-Oriented Hydrogen Induced Cracking (SOHIC) - Similar to the Hydrogen-Induced Cracking (HIC) mechanism, SOHIC occurs by the accumulation of hydrogen atoms at imperfections, non-metallic inclusions. But, the fissures stack themselves up in the through-wall direction because of the influence of stress. SOHIC typically occurs in the heat-affected-zones of welds as a result of residual stresses due to welding, and at areas of high applied stress or areas of stress concentration.
- Sulphide Stress Corrosion Cracking (SSCC) - With SSCC, the hydrogen atoms remain dissolved in the steel, are highly mobile and in susceptible steels and under the influence of stress produce brittle cracking.



ToFD image of Hydrogen Blistering



C-Scan image of Hydrogen Blistering

Ultrasonic Inspection Services

Tube Testing

Silverwing offers a full range of Specialist tube inspection services of heat exchanger tubes, boiler tubes, condensers, distillers and the like, only generally using the multi functional state of art equipments as manufactured by RD Tech TC 5700 and 5800 equipments or their equivalents. The equipment has the capabilities to offer all the necessary inspection techniques from one unit covering:

Internal Rotary Inspection (IRIS)

Material of Tube Inspection

- Ferrous & Non ferrous materials

Advantages of IRIS

- Very accurate technique.
- Three dimensional picture of the defect giving the defect profile in addition to its area is obtained.
- Interpretation of results is easier
- Ferromagnetic and non-ferromagnetic tubes can be inspected.

Limitations of IRIS

- It is a slowest technique.
- Tubes must be very clean. Tubes must be cleaned virtually down to bare metal for a successful IRIS inspection.
- Water must be introduced into the tube to act as a couplant.
- Only volumetric defects will be detected. It is not, therefore, sensitive to cracking.
- Due to the effects of 'probe ringing' there is a dead zone

Tube Inspection Rates

- Inspection Speed of 75 mm/sec
- Typically 60-80 tubes inspected per 12 hours

Eddy Current Testing (ECT)

Material of Tube inspection

- Non-ferromagnetic tubing
- Austenitic SS; brasses; 90/10 and 70/30
- CuNi; Cu; Inconel & Titanium.

Advantages of Eddy Current Testing

- Fairly accurate Technique
- Very sensitive technique

Limitations of Eddy Current Testing

- Circumferential Defects
- To detect defect inside tube sheets

Tube inspection Rates

- Inspection speed of 2.0m/sec
- Typically 700 tubes per 12 hour shift

Remote Field Eddy Current (RFET)

Material of Tube inspection

- Ferromagnetic Materials

Advantages

- Equal sensitivity is obtained to internal and external defects.
- Relatively insensitive to the presence of scale deposits.
- Probes can be made flexible
- Very thick wall tubes can be inspected in the case of generalized wall loss the circumferential extent of the defect can be determined.
- An experienced analyst can achieve reasonably accurate depth measurements

Limitations of RFET

- Not sensitive to small diameter defects
- Support plate indications cannot be separated
- Data Analysis Fairly complex Sensitive to external features such as fins.
- Internal and external defects difficult to distinguish

Tube Inspection Rates:

- Relatively slow as compared to ECT Inspection speeds 300 mm/sec
- Typically 400-500 tubes per 12 hour shift

All reports are supported with Carto software, the reports generated are both in "A" scan as well as in "C" scan presentations.

SWME also offers this inspection service together with consultancy on degradation of the tubes and remedial measures for same.

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