
LPG SPHERE TANKS
ASSET INTEGRITY
KEEP PLANT ALIVE

HOW TO INSPECT SPHERE TANKS?

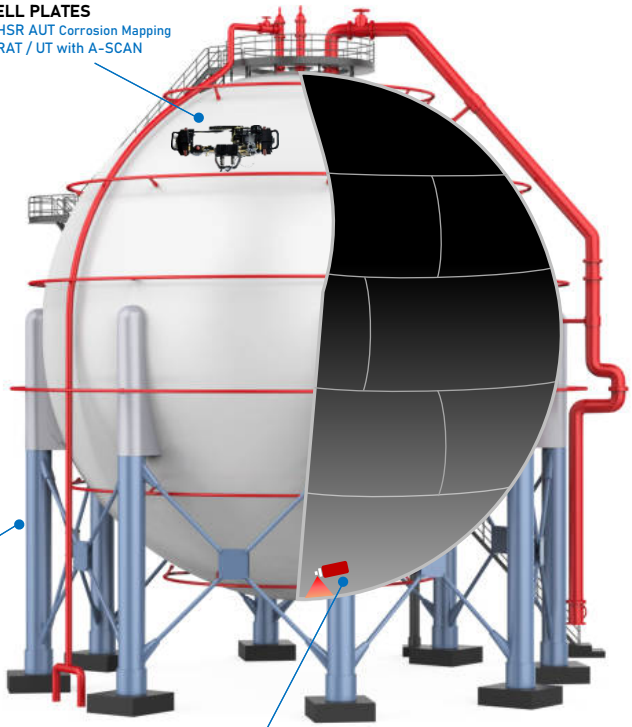
LPG Sphere Tanks Integrity

SHELL PLATES
- HSR AUT Corrosion Mapping
- RAT / UT with A-SCAN

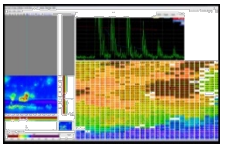
EXTERNAL INSPECTION
INSPECTION OVER INSULATION
- Pulsed Eddy Current
- Digital RT
- Acoustic Emission

INTERNAL INSPECTION
- Visual Test (VT)
- Penetrant Test (PT)
- Magnetic Test (MT)

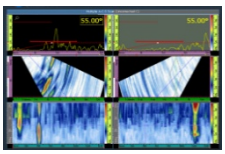
SUPPORTS INSPECTION
- Pulsed Eddy Current
- Guided Wave



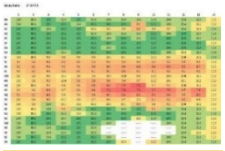
Welds & Surface Defects
- PT & MT Tests



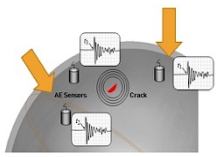
AUT Scan



PAUT Scan

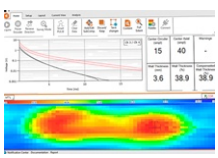


UT Grid Scan



Acoustic Emission

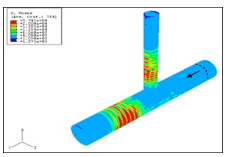
Thermal Imaging



ECT Scan

MT Test

PT Scan



LRUT Test

Spherical LPG Tanks Inspection

Spheres are typically used to store ambient temperature liquids and pressurized gases such as ammonia, propylene, LPG, butadiene, etc.

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Born in Ankara,Turkey in 1987, been living in Turkey/Hatay for many years. Graduated from Akdeniz University in 2010 as a Mechanical Engineer, and in 2012 completed master's degree in heat transfer & fluid mechanics at Mustafa Kemal University. Been working as a mechanical engineer in the sector for 13 years. Worked in the field of production and manufacturing for the first 3 years of his profession, and then for 2 years worked in project-based maintenance-repair and capacity increase works in Oil & LPG terminals. Been working at Milangaz for the last 8 years. Been working as LPG Operations Engineer for 5 years and as LPG Terminal Manager for 3 years.

The LPG spherical tank is a fixed-pressure vessel at normal temperature, with a single-layer tank structure, dedicated to storing liquefied petroleum gas, using steel plates for the vessel, with excellent performance, safety, and reliability. The spherical tank is quite important to the storage and production process. It can be eroded by the internal medium, and may defects such as corrosion, cracks, holes in the walls and welds.

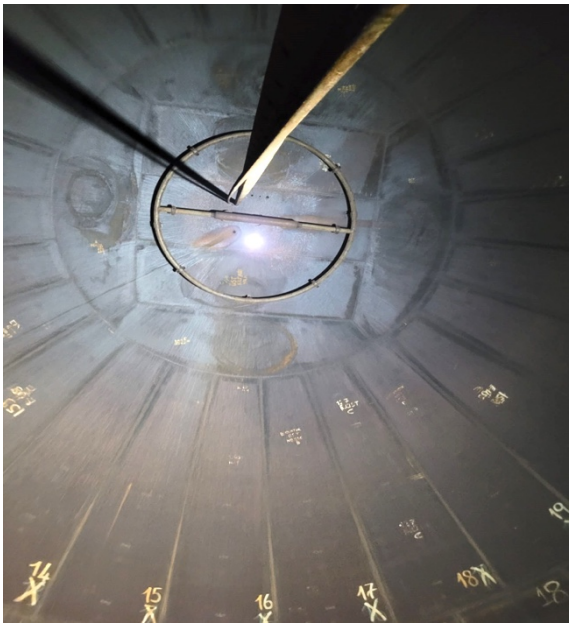
For these reasons, inspection of LPG tanks is very important. Also, Inspection is a necessary means to ensure the safe operation of the spherical tank.

Inspection is mainly conducted to identify wear and tear, and corrosion around components such as vessel connections, welded nozzles and seams, and areas near to welds, external controls, or fittings, and so on.

Spherical Tanks Internal Inspection

Unless justified by a RBI assessment, the period between internal or on-stream inspections shall not exceed one half the remaining life of the LPG vessel or 10 years, whichever is less.

LPG Tanks are designed to store LPG gas. Leaks or failure in tanks may lead to major accident on site. Inspection is done to identify this failures and leaks in LPG tank. Inspection involves measurements and testing. The inspection is done on non-destructive basis. To improve quality control inspection is most important. Inspection also ensures the safety or reliability of structures. During inspection it is necessary to do inspection using proper steps.



PREPARATION

Internal Inspection REQUIREMENTS

Internal inspections require the tank to be empty so that the internals of the tank can be checked to ensure that there is no corrosion, wastage, or damage due to the contents of the tanks. The thickness of the internal walls is also measured to test structural integrity.

To inspect the tank internally, the tank should be decommissioned, and an atmosphere should be created in which an inspection expert can work with safely.

These processes are generally called Gas free, but itself is not enough for safety.

In addition, there must be sufficient oxygen and no toxic vapors or substances inside.

Furthermore, there should be sufficient lighting inside the tank so that the inspection expert can visually inspect the welds with naked eye.

Conventional NDT used for internal Inspection!

Most common methods are Visual Testing, Magnetic Particle Testing, Penetrant Testing, Ultrasonic Testing, Radiographic Testing and Eddy Current. In these tests, defects such as corrosion, cracks, decrease in wall thickness or gaps in internal structures are identified in ferritic and austenitic steels, aluminum alloys, nickel, copper and titanium alloys during production or usage. Non-destructive testing methods can change depending on the procedure, size, thickness, and structure of the material.

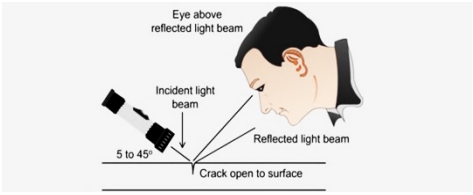
Visual Inspection.

VT is the fastest and cheapest method of Non-destructive testing. It's the first step of every inspection before any other Non-destructive test starts. When performing visual test with naked eye, equipment such as magnifying glass, light source, borescope, and mirror can also be used.

The condition of the surface is important to detect discontinuities such as cracks, porosities, and undercuts. Required cleanings must be finished before visual testing starts. surface cleaning is very important.

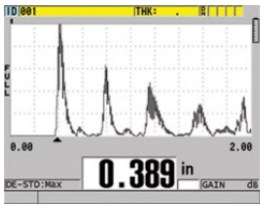
Visual Testing is perhaps the oldest and most widely used inspection technique. Often the eyes of the inspector are the only "equipment" used for the inspection. Visual İnspection is applicable to virtually any material, at any stage of manufacture, at any point in its service life. **To perform a successful direct visual examination, adequate lighting and good inspector eyesight is required.**

VT seems like an easy method, but it has its own inspection terms, and the experience of the staff is important. Test should be performed under enough light, minimum 500 lux, with an angle not lower than 30° and the distance between eye and the surface shouldn't be less than 300 mm.



Ultrasonic Testing

Wall Thickness & Metal Loses measurements using UT Thickness Gauges includes A-scan feature to able to detect corrosion failure and display reading in Digital & A-scan view.

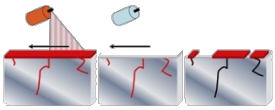


Magnetic Testing

MT is essentially a surface-type examination, although some imperfections just below the surface are detectable. This type of examination is limited to materials which can be magnetized (hence it is not appropriate for austenitic stainless steels). An area to be examined by magnetic particle examination can be completely examined or examined on a random sampling basis, as specified.

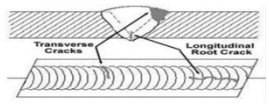
Penetrant Testing

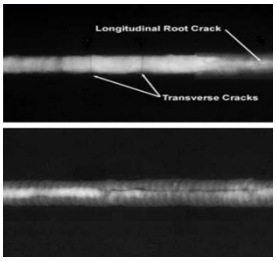
PT is a method to detect surface-connected defects. It is important to have a clean and smooth surface. After mechanical, chemical precleaning the surface must be dry and any dirt such as rust, oil, or paint should be cleaned from the surface as it will affect the process. The biggest advantage of this method is it has no restrictions about the material.



Radiography Testing

Random RT X-ray or gamma ray radiography may be used. The selection of the method should be dependent upon its adaptability to work being radiographed. When random radiography of welds is specified by the engineering design, it should be done on the number of welds designated. The engineering design shall specify the extent to which each examined weld should be radiographed. Random radiography may also be used for examination of piping components such as a valve or fitting to any extent specified by the engineering design.





Advanced NDT used for internal & external Inspection!

Most common methods are Phased Array UT, Automatic UT Corrosion Mapping, Acoustic Emission, Pulsed Eddy Current, Short Range guided wave. In these tests, you will have a permanent record and digital report for corrosion assessment. Defects such as corrosion, cracks, decrease in wall thickness or gaps in internal structures are identified in ferritic and austenitic steels, aluminum alloys, nickel, copper and titanium alloys during production or usage. Non-destructive testing methods can change depending on the procedure, size, thickness, and structure of the object need to inspect.

Ultrasonic Thickness Grids Measurement

UT Grid scan with spot digital reading & A-scan.

An ultrasonic thickness gauge works by precisely measuring how long it takes for a sound pulse that has been generated by a small probe called an ultrasonic transducer to travel through a test piece and reflect from the inside surface or far wall. From this measurement, the thickness of the test piece is calculated and displayed on a digital screen. The portability of the testing equipment allows for on-site inspection and results are instant. If a problem has been detected by the technique, additional non-destructive testing methods can be used to further investigate the findings.

Manual point thickness measurements using conventional ultrasound (UT) is a widely used technique for monitoring corrosion in many infrastructure applications. Depending upon the nature of the corrosion (e.g., localized, versus generalized and pitting), an inspector typically records the minimum thickness reading within a small area (usually 1 in.2). This however can lead to inconclusive inspection data due to minimal coverage of large areas, operator variability, lack of pitting or localized corrosion detection, and inadequate data reporting and analysis.

Automatic UT Mapping

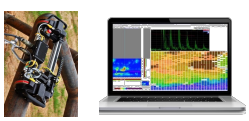
Ultrasonic technique using powered scanners.

AUT is using mechanical scanners with magnetic wheels to only adhering purposes to locate inherent defects within a given material. AUT is the term used to describe corrosion mapping inspections, pulse-echo weld inspection, Phased Array and Time of Flight Diffraction.

Typical Automated Corrosion mapping systems can inspect 20-30 sq. meters per standard workday. The benefit of using the automated imaging systems allows a picture (C-Scan Image) quickly identifies any significant reduction in wall thickness. These automated corrosion mapping scans can then be superimposed into development drawings of equipment and accurately indicate location of problem regions. The images on this page show some significant problems detected from field inspections.

Automated Corrosion Mapping Ultrasonic scans of materials, uses a range of colors to represent the thickness range of part being inspected, typically blue colors are used to represent nominal wall thickness with orange and red colors used to indicate significant wall reduction.

Mapping of pipelines for follow up of Smart Pig surveys and Long-Range UT (LRUT) programs allows accurate assessment of localized areas of concern. Due to the speed of modern systems considerable coverage can be completed daily. If you have a critical system and you require 100% coverage for process reliability, then this is the solution you require.



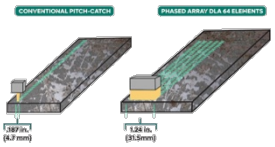
Phased Array UT

Inspect large surface areas quickly with high resolution.

Inspect large surface areas quickly with high resolution. Typically, a thickness reading is performed every 1 mm2, which represents 500 more sample points than conventional ultrasound. This high resolution makes it possible to detect small, localized indications, such as corrosion pits, and it enables the operator to profile the shape of the corroded area.

Intuitive and affordable phased array instruments are now commercially available. These devices are easy to setup so users can record and archive data for further analysis. Easy-to-read images make interpreting acquisition data straightforward. The data can then be used to perform corrosion assessments according to ASME B31G and other applicable standards.

Multiplexing, sometimes called an electronic or linear scan, is used to perform corrosion monitoring. The sensor consists of a long-phased array probe, 25 –100 mm (1 – 4 in.) with between 32 and 128 elements. A small group of elements, defined as the active aperture, is activated to generate an ultrasonic beam propagating normal to the interface. This group of elements is then indexed using electronic multiplexing, creating a true physical movement of the ultrasonic beam under the array with an index as small as 1 mm (0.040”). The electronic indexing is performed so fast that a 4-inch (100 mm) line length is covered by the ultrasonic beams in milliseconds. The travel time of these beams is used to determine the component’s thickness at each acquisition point.



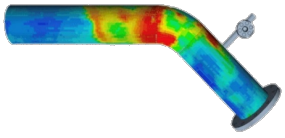
Pulsed Eddy Current

Inspection over Insulation to determine the condition of pipes and monitor corrosion.

PEC technology does not require direct contact with a test object nor specific surface cleaning, making inspection fast and easy even at high temperatures and on offshore wells. Inspections can be conducted, and corrosion can be monitored during operation to allow for planned maintenance and repairs to be scheduled and carried out at times optimal for your business.

Pulsed Eddy Current readings conducted many times at the same location can be reliably reproduced regardless of casing, coatings, or insulation. PEC technology provides results with a plus/minus 10% accuracy for corrosion detection and a plus/minus 0.2% accuracy rate for corrosion monitoring. Moreover, Pulsed Eddy Current inspections can be successfully and easily carried out at temperatures ranging from -100° C to 500° C (-150°F to 932°F).

Pulsed Eddy Current technology is based on electromagnetics and provides average wall thickness values over the probe footprint area. It measures and compares the percentage variation in average wall thickness throughout an object. Pulsed Eddy Current can be effectively applied for corrosion detection and monitoring on pipes and vessels made of carbon steel or low-alloy steel without contacting the steel surface itself. PEC technology allows measurements to be made through insulation, concrete, or corrosion barriers.

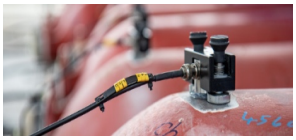


Acoustic Emission

When a material with defects is subjected to mechanical stress or load, it releases energy. This energy travels in the shape of high-frequency stress waves. These waves or fluctuations are obtained with the utilization of sensors which in turn transforms the energy into voltage. This voltage is electronically overstated with the utilization of timing circuits and later refined as acoustic emission signal data.

AE refers to the generation of transient elastic waves produced by a sudden redistribution of stress in a material. When a structure is subject to an external stimulus (change in pressure, load, or temperature), localized sources trigger the release of energy, in the form of stress waves, which propagate to the surface and are recorded by sensors. With the right equipment and setup, motions on the order of picometers (10 – 12 m) can be identified. Sources of AE vary from natural events like earthquakes and rock bursts melting, twining, and phase transformations in metals. In composites, matrix cracking and fiber breakage and debonding contribute to acoustic emissions. AE’s have also been measured and recorded in polymers, wood, and concrete, among other materials.

Need more, read Edition# 3



Spherical Tanks Supports Inspection

Many foundation structures in refineries such as skirts of process columns and the supports of spherical storage tanks are covered with a layer of fireproofing for safety reasons. Small cracks or holes in fireproofing may cause ingress of water, resulting in corrosion underneath the covering. The deterioration process cannot be detected by Visual Inspection alone. Failing to adequate condition monitoring tools, the deterioration process may eventually cause the foundation to collapse with disastrous results.

Corrosion Under Fireproofing (CUF) is nothing different than Corrosion Under Insulation (CUI).

Pulsed Eddy Current (PEC)

Pulsed Eddy Current (PEC) is an advanced electromagnetic inspection technology used in detecting flaws and corrosion in ferrous materials typically hidden under layers of coating, fireproofing, or insulation.

Why Pulsed Eddy Current for Corrosion Under Insulation & Fireproofing?

- No need to remove insulation, cladding, asbestos, fireproofing, concrete, coating over test materials, thus eliminating the operating asset's downtime.
- PECT can be applied at high temperatures up to 550°C of metal under insulation.
- Measurement accuracy of ±10% of measured wall thickness
- PEC testing can be performed on insulated layers up to 250mm thick.
- Test over corrosion scabs or blisters. No need of surface preparation thus cost saving for the plant owner
- PEC is an Inservice inspection which is not affected by flow of fluids within the subject equipment, thus no shutdown required.
- Battery powered instrument, thus perfect for remote locations.
- PEC is a fast-screening tool.

Standards guiding PEC Inspection

ISO 20669