

Pressure Equipment Inspections in the Iron and Steel Industry



Introduction

- Pressure vessels are critical components used in various industries, including oil and gas, chemical, aerospace, and energy, among others. These vessels are designed to hold gasses or liquids at pressures significantly higher than the ambient pressure.
- However, pressure vessel failures can lead to disastrous consequences, including leaks, ruptures, fires, and explosions, posing serious risks to human safety and the environment.
- Pressure Equipment inspection is a crucial component of overarching asset integrity initiatives. In modern industries, the emphasis on maintenance is highly valued as it serves as a preventive measure against unforeseen accidents. Regular inspections ensure safety, efficiency, and compliance with regulatory requirements as well as industry standards.

Examples of Pressure Equipment

Mobile air compressors



What is classified as a Pressure vessel in South Africa as per our Pressure Equipment Regulations

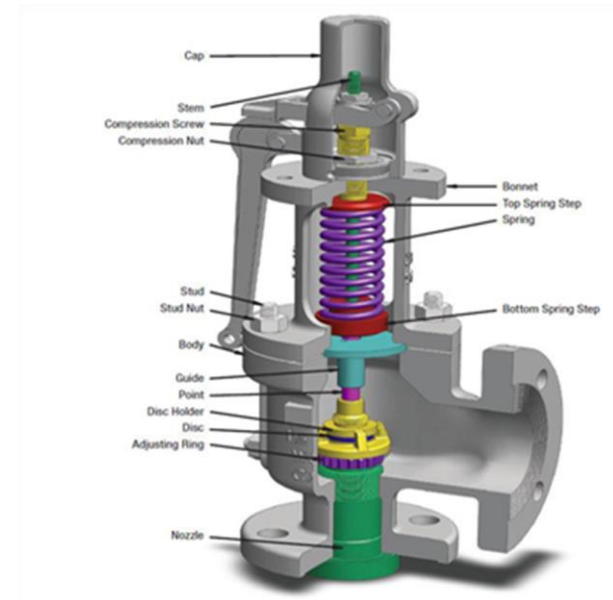
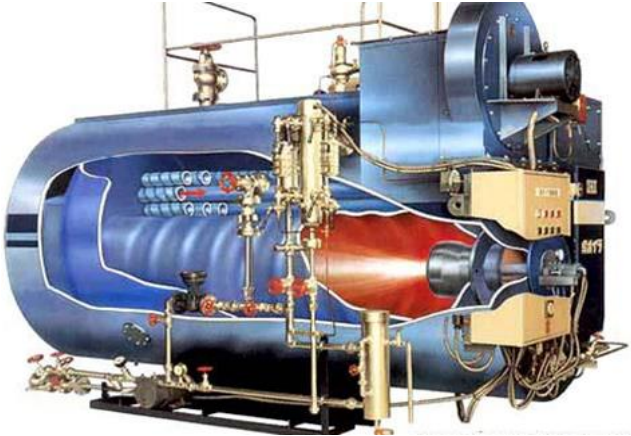
- **pressure equipment**” means a steam generator, pressure vessel, piping, pressure accessory and safety accessory, transportable gas container, and fire extinguisher and includes, but is not limited to an accumulator, a hot-water geyser and hyperbaric chambers;
- **pressure accessory**” means devices with an operational function having pressure-bearinghousing;

Some examples include but are not limited to: pressure gauges, bladder and piston type accumulators, level gauges, valves, strainers, bellows, flow meter, magnetic level indicators and instruments.

- **“pressure vessel”** means a housing designed and manufactured to contain a fluid under a design pressure equal to or greater than 50 kPa;

Includes storage vessels, beer kegs, plate heat exchangers, mobile pressure vessels, road tankers, rail tankers, intermediate bulk containers (ICB's), ISO containers, accumulators other than bladder or piston type, multi element gas containers, fired heaters, hermetic compressors, etc. but excludes transportable gas containers and fire extinguishers which have their own definitions.

Examples:



REGULATION 3 – GENERAL REQUIREMENTS

- (1) Any person who manufactures, imports, sells, offers or supplies any pressure equipment described in these Regulations for use in the Republic shall ensure that such equipment complies with these Regulations.
- (2) Any person who erects or installs any pressure equipment for use in the Republic shall ensure, as far as is reasonably practicable, that it is erected or installed in a safe manner and without risk to health and safety when properly used,
- (3) All pressure equipment for use in the Republic shall be categorized and submitted to the applicable conformance assessments of SANS 347 in addition to the requirements of the relevant health and safety standard incorporated into these Regulations under section 44 of the Act.

REGULATION 4 - DUTIES OF MANUFACTURERS

- (1) The manufacturer shall have an obligation to ensure that all equipment designed and manufactured for use in the Republic shall be conformity assessed and subjected to the requirements set out in SANS 347.
- (2) Subject to the requirements set out in the relevant health and safety standard incorporated into this Regulation under section 44 of the Act, the manufacturer shall ensure that the pressure equipment as manufactured, modified, inspected, tested or repaired is safe and without risks to health when properly used.
- (3) Subject to the requirements of this regulation a manufacturer shall issue a certificate of manufacture for all pressure equipment supplied, with a verification signature by an approved inspection authority when so required.

REGULATION 5 - DUTIES OF IMPORTERS AND SUPPLIERS

- (1) Importers and suppliers shall ensure that pressure equipment sold complies with the requirements of this Regulation.
- (2) The importer shall assume the liability of the manufacturer in terms of this Regulation.

REGULATION 6 - DUTIES OF USERS

- (1) The user shall ensure that the pressure equipment is operated and maintained within its design and operating parameters.

REGULATION 7 – APPROVAL AND DUTIES OF APPROVED INSPECTION AUTHORITY

- (1) Only an organisation holding an approval certificate from the chief inspector shall perform the duties of an approved inspection authority within the scope of accreditation.

REGULATIONS 11 – INSPECTION AND TEST

- steam generators or pressure vessels, including pressure and safety accessories, after they are installed or re-installed and before they are commissioned, to be subjected to a witnessed internal and external inspection of a hydraulic pressure test to 1,25 times the design pressure by an approved inspection authority
- every pressure vessel and steam generator, to be subjected to an internal and external inspection and a hydraulic test to a pressure of 1,25 times the design pressure by an approved inspection authority for in-service inspection appointed by the user in writing, at intervals not exceeding 36 months:

In addition

- every fire-tube steam generator to be subjected to an external inspection every 12 months and a witnessed hydraulic test and crack detection of critical welds every 36 months, by an approved inspection authority for in-service inspection appointed by the user in writing;
- all piping and pipelines to be inspected and tested in accordance with the relevant in service health and safety standard:

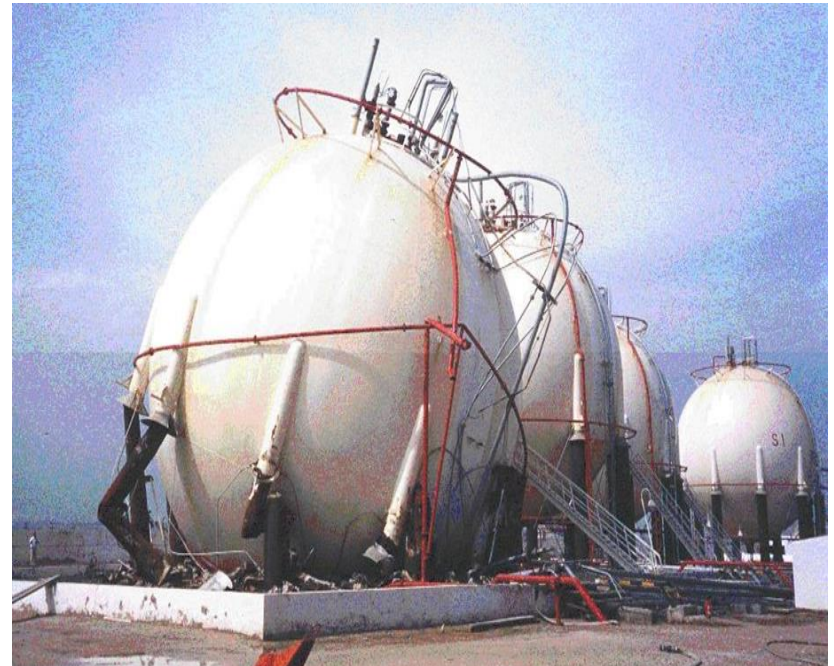
Inspection Methods

- Visual Inspection Internal and External
- Non-Destructive Testing (NDT) is crucial for the early detection of flaws or defects in pressure vessels. Common NDT methods include Ultrasonic Testing (UT) and Magnetic Particle Inspection (MPI) for identifying surface and subsurface cracks, Radiographic Testing (RT) for internal flaw detection, and Liquid Penetrant Testing (PT) for identifying surface discontinuities. Accurate and reliable NDT requires skilled personnel and well-maintained equipment. Proper training and certification of NDT personnel ensure proficiency in conducting inspections and interpreting test results.
- Wall Thickness Measurements
- Pressure Tests(Hydrostatic or Pneumatic)
- Non intrusive Inspections.
- Drones/ROV's

Common Issues Found

Inspections often reveal:

- Corrosion and Erosion
- Cracks and Fractures
- Deformation
- Leaks and Pressure Loss
- Welding Defects
- Internal Deposits and Fouling
- Cyclic Failures
- Process related failures



What Happens when a defect is found?

- Where an inspection or test carried out in terms of sub regulations (1)(c), (d) and (e) reveals any weakness or defect whereby the safety of persons may be endangered, the weakness or defect shall be reported forthwith to the user by the person carrying out the inspection or test and the user shall forthwith cease the use of the pressure equipment until such weakness or defect has been rectified to the satisfaction of the person who carried out the inspection and the approved inspection authority concerned in cases of modifications or repairs, as the case may be, or the steam generator, pressure vessel or storage vessel has been re-rated to the satisfaction of the approved inspection authority.

REGULATIONS 14 - RECORDS

- (1) Every user of pressure equipment shall keep a record, which shall be open for inspection by an inspector, in which the certificate of manufacture, and the results, after manufacturing, of all inspections, tests, modifications and repairs shall be recorded.
- *The user shall keep all records for the operating life of the equipment. Such records shall typically cover repairs, modifications and In-service inspection test records as well as all related documents such as deferments, pressure test dispensation, NDT reports and not just manufacturing related records. Further clarification is that the user is not necessarily the owner.*
- *The records of the original manufacturing of the pressure equipment shall be kept by the manufacturer for a minimum of 12 years; enabling a technical review of the construction of the equipment should a failure or a dispute arise. Typical documentation should include, but not limited to, design calculations, approved manufacturing drawings, approved fabrication records, pressure test certificate, Certificate of manufacture as well as a copy of the marking.*

Conclusion

- Pressure vessel failures can have devastating consequences, endangering human lives, and causing extensive damage to the environment and property. Understanding the common causes of failures and implementing preventive techniques is crucial in ensuring the safe operation of pressure vessels across various industries.
- By complying with recognized Codes and Standards, performing Fitness for Service Assessments, utilising advanced fatigue improvement techniques, conducting regular NDT inspections, and fostering collaboration within the industry, we can proactively prevent pressure vessel failures and safeguard the well-being of workers .Regular inspections are essential for maintaining safety, preventing failures, and ensuring regulatory compliance.