Pressure Systems

GUIDELINES

Guidelines for Users and Competent Persons

Overview of the Inspection of Storage Tanks.

Document Reference: IMG02

Dated 25th August 2016

Content

1. Introduction

IMG01. The mechanical Integrity of Plant Containing Hazardous Substances. A guide to periodic examination and testing was published by SAFed in 2012. This document supplements the guidance in IMG01 for the periodic examination and testing of storage tanks.

Many different types and sizes of storage tank are used in industry for the storage of hazardous substances. The tank is the primary barrier against a loss of containment and therefore its mechanical integrity requires periodic reassessment.

This assessment is for the whole lifecycle, from original specification, design, and construction through its use to end of life.

This guidance refers to the regulatory framework of the UK. However, much of the content of good practice it contains may be relevant in other areas.

2. Scope

This guidance is aimed at Duty Holders and/or Competent Persons creating tank written schemes, and covers all storage tanks that provide the primary containment boundary to hazardous substances. It does not cover the maintenance or operation of the tanks.

Though aimed at hazardous products the guidance can be used for tanks containing non hazardous products.

Please see SAFed Guide IMG01 for specific information on the regulations that pertain to storage tanks.

If the tank contains or is likely to contain a relevant fluid it is a pressure system and is excluded from the scope of this document. It may need to be included within a written scheme of examination as required by the Pressure System Safety Regulations.

3. Types of Storage Tanks – Common Material Types

The vast majority of storage tanks in use come from the following three types, however there are many variations upon these main themes;

1. Metallic
2. Glass reinforced plastic
3. Thermoplastic

The nature of the contents must be confirmed as suitable for the material of construction.

3.1 Metallic

Metallic storage tanks are given more detailed consideration in SAFed guide “SAFed IMG02a – The Integrity Management of Metallic Storage Tanks” however it should be noted that the design/construction details of these tanks are many and varied and the inspection philosophy for each tank will be determined based on an assessment of its design capability.

3.2 GRP

GRP storage tanks are given more detailed consideration in SAFed guide “SAFed IMG02b – The Integrity Management of Glass Reinforced Plastic Storage Tanks” and HSE ‘PM 75: Glass reinforced plastic vessels and tanks’.

3.3 Thermoplastic (HDPE & Polypropylene).

Thermoplastic storage tanks are given more detailed consideration in SAFed guide "SAFed IMG02c – The Integrity Management of Thermoplastic Storage Tanks" and HSE 'PM 86: Thermoplastic Tank Integrity Management'

These storage tanks have generally been seen as 'fit and forget' by many in industry, however they are generally built for a specific life and hence require periodic assessment in order to confirm they continue to be safe to operate.

4. Initial Integrity Management

As part of the initial assessment of any storage tank the following data needs to be collated and assessed in order to determine fitness for service and the inspection philosophy,

4.1 Construction Standards

There are many standards in existence for storage tanks, however their use by manufacturers has not been consistent.

In many cases storage tanks have been built to no specific code, or the particular fabricator's custom and practice. Manufacturer's markings may also be missing. In cases such as these the 'competent person' drawing up a WSE will need to establish if the tank is fit for service., This will normally take the form of an assessment of the tank based on information obtained from a site survey including dimensional checks and thickness assessment. If the tank does not meet fitness for service requirements, remedial work may need to be undertaken or the tank replaced.

4.2 Historical Data

The data collected for most storage tanks will include the following where available:

- Location & identification.
- Main dimensions
- Year built/Installed
- Manufacturer
- Manufacturing standard
- Design life
- History (i.e. did it start in that location, what is its previous history)
- Materials of construction and whether lined / unlined
- Contents (current and previous, changes in temperature, specific gravity etc)
- Configuration (i.e. flat bottomed, on legs, supports)
- Previous reports of inspections / installation / new construction.
- Reports of any thickness surveys/NDT/pressure test.
- Type and extent of insulation fitted
- Facilities for tank heating
- Venting or Pressure Vacuum (PV) valve arrangements
- Any gas blanketing used
- Facilities for internal access
- Secondary containment, type, volume etc.

Whilst this list is not exhaustive it provides a comprehensive list of data on which a fitness for service and ongoing inspection philosophy would be based.

4.3 Maintenance Regime

Any records of maintenance of the storage tank should be provided as part of the assessment, this may include tank accessory maintenance, gasket/bolt replacement, painting records, assessment/results of previous inspections of the tank and similar tanks.
Additionally records of level controls, alarms, trips and remote operated shut off valve testing should be available.

4.4 Other factors.

Other features may affect the storage tank, examples are given below:

- Connecting pipework (loads/vibration etc.)
- Anchorage/holding down arrangements
- Pressure/vacuum relief devices
- Pump loads
- Maintenance functions
- Operational functions
- Inlets / outlets
- Impact from external forces
- Operational data, i.e. fatigue cycles
- Previous repairs or modifications

As part of the initial assessment, the storage tank data gathered has to be assessed by a competent person. The assessment needs to take into account all of the likely damage mechanisms that may affect the storage tank. Once this has been done a WSE can be created which will address these damage mechanisms. However it is common practice for the initial assessment to include a more detailed examination, i.e. a benchmark type examination, to confirm which damage mechanisms are present and their extent. When this examination has been completed the original WSE can be re-assessed for suitability.

5. Inspection Methodologies

The WSE may include some or all of the requirements below:

5.1 Visual Examination

The primary technique for examination of storage tanks is a thorough visual examination, checking for the damage mechanisms noted on the WSE.

5.2 Non-Destructive Testing (NDT)

In addition to the visual examination the WSE may require specific NDT in certain areas of a storage tank, in order to identify a specific damage mechanism, this may include:

- Comprehensive thickness survey of shell/base/head. (corrosion)
- Crack detection of seams/shell to base weld. (fatigue/stress corrosion cracking (SCC))
- Nozzle welds. (fatigue/SCC)

Non-destructive testing is continually developing; suitable techniques should be used for the damage mechanism considered and this would need consideration at the time of assessment / deployment. For new techniques it is essential that the system has been validated as fit for purpose.

The use of Non Invasive Inspection techniques should be validated as suitable for purpose. Further guidance is available in DNV-RP-G103 Non-Intrusive Inspection.

5.3 Pressure testing

For most open vented storage tanks it is usually only possible to apply a static head test as a leak type test. For tanks with a design top pressure it is possible to apply a top pressure above the normal operating conditions. The Specific Gravity (SG) of the content in relation to the test medium, and the height of the tank should be taken into account.

5.4 Lined vessels

Lined vessels require additional consideration to ensure the integrity of the lining. A breach in the lining may cause rapid deterioration of the tank. Typical Testing Techniques:

- Holiday (Spark) testing.
- Conductivity testing.

6. Repairs and modifications

The initial integrity assessment will need to consider whether there has been any repairs or modifications carried out to the tank since it first went into service. This can be achieved through visual examination and/or a review of operator records, where they exist. Repairs and modification have the potential to significantly affect the integrity of the tank and therefore should be assessed for suitability.

Consideration should be given to repairs and modifications when drafting the written scheme of examination. It should outline where and to what extent the competent person needs to be involved in such work.

6.1 Structural parts

Any work carried out on the primary containment envelope of the tank and any supporting structure should be documented to the extent that its suitability can be evaluated. Where the work involved welding then the quality of the welding should be evaluated through welding qualification records and/or non-destructive testing where appropriate. New openings in the shell should be considered for the adequacy of any associated opening reinforcement. New pipework connecting to the tank should be adequately supported so as to minimise the load on the tank. Tanks that have changed use should be considered for suitability for the new fluid contained. It should be noted that it is rarely feasible or practicable to carry out repairs on non-metallic tanks.

6.2 Fixtures and fittings

Any repairs or modifications to items attaching to the tank which are critical to the safe operation should be assessed. This includes, but not limited to: access ladders and walkways, vents, pressure/vacuum relief devices, fluid level alarms and indicators. Ideally valves and instruments should be replaced on a like for like basis but in some cases it may be appropriate to replace with more state of the art equipment. In either case the new equipment needs to be confirmed as suitable for the application.

7. Relevant Publications.

- SAFed IMG01 – The mechanical Integrity of Plant Containing Hazardous Substances.
- SAFed IMG02a – The Integrity Management of Metallic Storage Tanks.
- SAFed IMG02b – The Integrity Management of GRP Storage Tanks.
- SAFed IMG02c – The Integrity Management of Plastic Storage Tanks.
- EEMUA 159: Users' Guide to the Inspection, Maintenance and Repair of Above ground Vertical Cylindrical Steel Storage Tanks.
- HSE PM 86: Thermoplastic Tank Integrity management.
- HSE PM 75: Glass reinforced plastic vessels and tanks.
- API 650: Welded Tanks for Oil Storage.
- BS EN 13575:2004 Thermoplastic tanks made from blow or rotationally moulded polyethylene. Tanks for the above ground storage of chemicals. Requirements and test methods.
- BS EN 12573-1:2000 Welded static non-pressurised thermoplastic tanks. Part 1 General principles.
- BS EN 12573-2:2000 Welded static non-pressurised thermoplastic tanks. Part 2 Calculation of vertical cylindrical tanks.
- BS EN 12573-3: 2000 Welded static non-pressurised thermoplastic tanks. Part 3 Design and calculation for single skin rectangular tanks.
- BS EN 12573-4:2000 Welded static non-pressurised thermoplastic tanks. Part 4 Design and calculation of flanged joints.
- BS EN 1778:2000 Characteristic values for welded thermoplastics constructions. Determination of allowable stresses and moduli for design of thermoplastics equipment.
- BS EN 13341:2005 Thermoplastics static tanks for above ground storage of domestic heating oils, kerosene and diesel fuels. Blow moulded polyethylene, rotationally moulded polyethylene and polyamide 6 by anionic polymerisation tanks. Requirements and test methods.
- BS EN 13067:2003 Plastics welding personnel. Qualification testing of welders. Thermoplastics welded assemblies.
- BS 4994:1987 Specification for design and construction of vessels and tanks in reinforced plastic.
- BS EN 976-1:1997 Underground storage tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels. Requirements and test methods for single wall tanks.
- BS EN 976-2:1997 Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels. Transport, handling, storage and installation of single wall tanks.
- BS EN 977:1998 Underground tanks of glass-reinforced plastics (GRP). Method for one side exposure to fluid.
- BS EN 978:1997 Underground tanks of glass-reinforced plastics (GRP). Determination of factor a and factor b.