

# TECHNICAL GUIDANCE

Asset Testing and Inspection Standards  
Fuel Ethanol Production Facilities

January 15, 2016



## OVERVIEW

The Occupational Safety and Health Administration’s (OSHA’s) Process Safety Management (PSM) regulation, 29 CFR 1910.119, is required of operations that process or store a listed Highly Hazardous Chemical (HHC) and/or gases or liquids in excess of 10,000 pounds in one location that has a flashpoint below 100° F.

Some fuel ethanol production facilities utilize Anhydrous Ammonia (NH<sub>3</sub>) which is a listed Highly Hazardous Chemical (HHC) and all fuel ethanol production facilities have liquids on site in one location at a flash point below 100° F as pure ethanol’s flash point is 61.88° F. Most commercial scale fuel ethanol production facilities have flammable liquids of 10,000 pounds (Approximately 1,200 gallons) or more on site in one location making this standard in its entirety applicable to fuel ethanol production facilities.

As such, fuel ethanol production facilities are required to have a Mechanical Integrity program. OSHA states, “The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment. Inspections and tests shall be performed on process equipment. Inspection and testing procedures shall follow recognized and generally accepted good engineering practices. The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.” Not only is it a requirement, but a robust Mechanical Integrity system will add years to the life of critical equipment and will also ensure that the equipment is available and functional when needed.

The equipment on your Mechanical Integrity list should be site specific, documented, and kept current with the fuel ethanol production facility’s Management of Change (MOC) system.

## APPLICABILITY

OSHA’s PSM regulation does not clearly define the equipment and its testing and inspection requirements, but rather it requires fuel ethanol production facility owners to document that their equipment complies with Recognized and Generally Accepted Good Engineering Practices, known by the acronym RAGAGEP. To do that you must determine the design standards and codes for your PSM covered processing equipment. Typically, ethanol production facilities were designed to and should be inspected to the following standards and codes:

Equipment	Recognized and Generally Accepted Good Engineering Practices (RAGAGEP)	
	Design Standard	Testing & Inspection Standard
Pressure Vessels	ASME Vessel - Section 8, Division 1	API 510 - Pressure Vessels
Process Piping	ASME Piping - B31.3	API 570 - Process Piping
Above Ground Storage Tanks	API 650 - Above Ground Storage Tanks	API 653 - Above Ground Storage Tanks

## INSPECTION INTERVALS

API 510 Pressure Vessel Inspection Code		
Interval	Inspection Type	Typical Inspection(s)
5 Years	External	VT - Visual Testing UT - Ultrasonic Testing PT - Penetrant Testing MT - Magnetic Particle Testing
10 Years	Internal	VT - Visual Testing UT - Ultrasonic Testing PT - Penetrant Testing MT - Magnetic Particle Testing ET - Eddy Current Testing

- Unless justified by a Risk Based Inspection (RBI), each aboveground vessel shall be given a visual external inspection at an interval that does not exceed the lesser of five years or the required internal on-stream inspection. It is preferred to perform this inspection while the vessel is in operation. The interval is established by the inspector or engineer in accordance with the owner/user’s quality assurance program.
- Unless justified by a Risk Based Inspection (RBI) assessment, the period between internal or on-stream inspections shall not exceed one half the remaining life of the vessel or ten years, whichever is less. Whenever the remaining life is less than four years, the inspection interval may be the full remaining life up to a maximum of two years. The interval is established by the inspector or engineer in accordance with the owner/user’s quality assurance program.

API 570 Piping Inspection Code		
Type of Circuit	Ultrasonic Testing (UT) External	Visual Testing (VT) External*
Class 1	5 Years	5 Years
Class 2	10 Years	5 Years
Class 3	10 Years	10 Years
Class 4	Optional	10 Years

\*Any suspect areas identified by a thorough visual inspection should have a follow up Magnetic Particle Testing (MT) or Penetrant Testing (PT) if determined to be necessary by the API 570 Inspector.

- **Class 1** - This classification includes services with the highest potential of resulting in an immediate emergency if a leak were to occur. Such as emergency may be a risk to safety or the environment.
- **Class 2** - This classification includes the majority of the unit process piping and selected off-site piping. ERI Solutions, Inc. recommends that baseline thickness be taken to establish future testing intervals.
- **Class 3** - This classification includes services that are flammable but do not significantly vaporize when they leak and are not located in high-activity areas. ERI Solutions, Inc. recommends that baseline thickness be taken to establish future testing intervals.
- **Class 4** - This classification includes services that are essentially nonflammable and nontoxic. ERI Solutions, Inc. recommends any of these lines that transport a corrosive material or are pertinent to continued operations or could cause a life-safety issue if ruptured, be spot checked.

API 653 Above Ground Storage Tanks Inspection Code		
Interval	Inspection Type	Typical Inspection(s)
5 Years	External	VT - Visual Testing UT - Ultrasonic Testing PT - Penetrant Testing MT - Magnetic Particle Testing
10 Years	Internal	VT - Visual Testing UT - Ultrasonic Testing PT - Penetrant Testing MT - Magnetic Particle Testing MFL - Magnetic Flux Leakage

- All tanks shall be given a visual external inspection by an authorized inspector. This inspection shall be called the external inspection and must be conducted at least every 5 years or remaining shell life based on established corrosion rate divided by 4. Tanks may be in operation during this inspection.
- The interval from initial service date until the first internal inspection shall not exceed 10 years unless a tank has one or more of the leak prevention, detection, corrosion mitigation or containment safeguards.

## INSPECTION TYPES

The use of various inspection methods is necessary in order to identify the integrity of different components and different type of asset integrity issues. The following table provides a brief description of why each testing method is utilized.

Inspection Name	Inspection Description
VT - Visual Testing	A visual inspection conducted by a trained and certified individual, typically done to inspect metallurgical deformities and weld defects either directly or remotely, aided or unaided.
UT - Ultrasonic Testing	Most common method used, conducted by a trained and certified individual to determine remaining metal thickness so a corrosion rate, and ultimately, an expected life can be calculated based on the specific size, material of construction, and pressure.
PT - Penetrant Testing	Conducted by a trained and certified individual to identify surface defects in non-porous materials – most commonly stainless steel in ethanol production facilities.
MT - Magnetic Particle Testing	Conducted by a trained and certified individual to identify surface and slightly sub-surface deformities in ferromagnetic materials – most commonly carbon steel in ethanol production facilities.
ET - Eddy Current Testing	Conducted by a trained and certified individual – most typically used to identify deformities of all varieties inside tubes of tube and shell heat exchangers, but can be used on other equipment as well.
MFL – Magnetic Flux Leakage Testing	Conducted by a trained and certified individual to identify both top and bottom side deformities of ferromagnetic materials – most typically used on tank floors in ethanol production facilities, but can be used on other equipment as well.

## CONCLUSION

Throughout this technical memorandum, it has been established that OSHA requires companies to verify design and construction, conduct inspections to specific codes/standard and the ensure repair of equipment to be at acceptable limits and to applicable codes/standards before further use. Although regulatory requirement is often the driver, below you will see there are several other very important business reasons to conduct inspection and ensure your assets are managed and maintained effectively.

- Improved equipment reliability
- Reduction in equipment failures and potential insurance claims
- Reduce or maintain lower insurance costs
- Improved product consistency
- Improved maintenance consistency and efficiency
- Reductions of unplanned maintenance and downtime
- Reduced operating costs
- Improved spare parts management
- Improved contractor performance

Everything that moves or has something moving through it, experiences wear and tear on an ongoing basis and will experience failure at some point in time. When proven codes and standards are followed those failures can be identified in advanced and greatly reduced or eliminated.