



# RESOURCE COMPLIANCE

Mechanical Integrity (MI)

*By: Nate Torres – Operations Manager*

## Outline

- What is Mechanical Integrity?
- Purpose of Mechanical Integrity?
- Scope and regulatory requirements of a Mechanical Integrity Program
- Keys to effective Mechanical Integrity Program



# What is Mechanical Integrity?

An organized plan for performing the following activities on a covered process:

## 1. Inspections

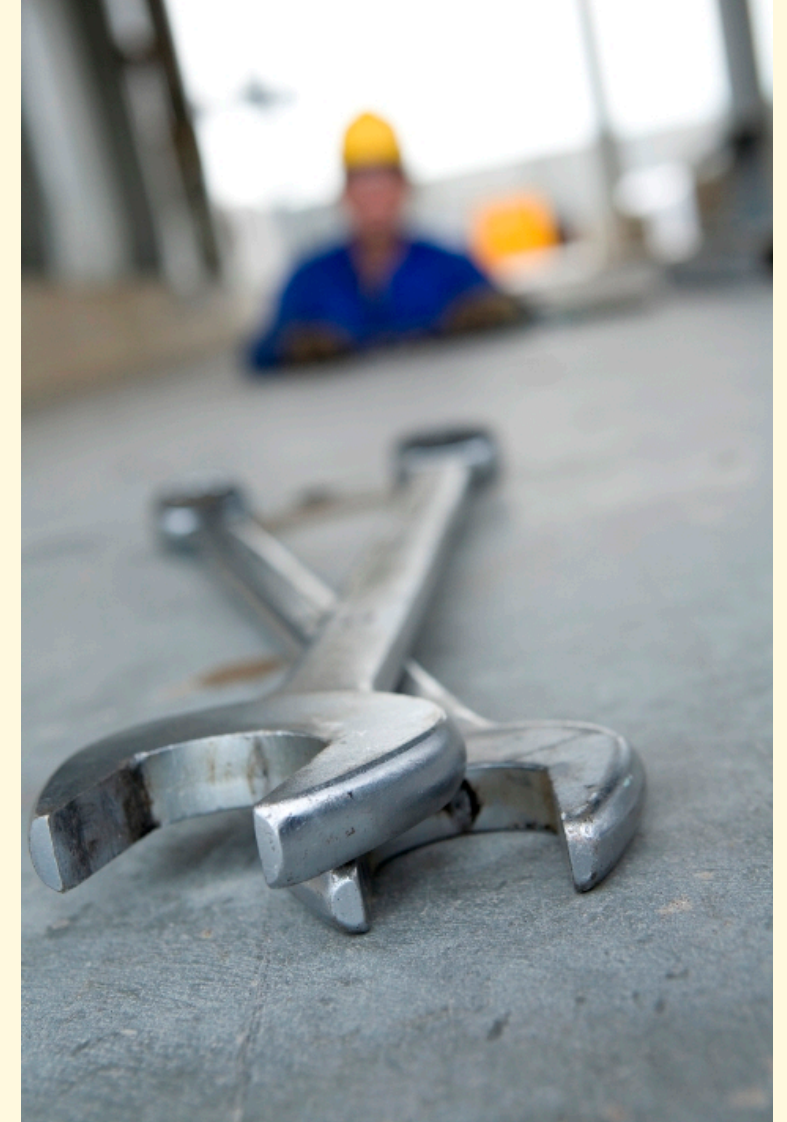
(Visual)

## 2. Testing

(Vibration Analysis/Safety Devices/Oil Sampling)

## 3. Maintenance

(Draining Oil/Exercising Valves)



## Value (purpose)

1. Prevent failure of process
2. Minimize process down time
3. **Prevent accidental releases of process chemical**
4. Maximize efficiency of process operation
5. Maximize life of process





# Regulatory Requirement

## Program 2 Prevention Program

### Section 2755.5 Maintenance:

The owner or operator shall perform or cause to be performed inspections and tests 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, ***industry standards or codes***, good engineering practices, and prior operating experience.



# Regulatory Requirement

## Program 3 Prevention Program

### Section 2760.5 Mechanical Integrity:

(2) Inspection and testing procedures shall follow ***recognized and generally accepted good engineering practices***.

(3) 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.



# Basis

## RAGAGEP

### 1. Industry Standards

Bulletins and Standards

### 2. Manufacturer's Recommendation

IOM Manuals

### 3. Prior Operating Experience

Historical Operating Data



# Industry Standards

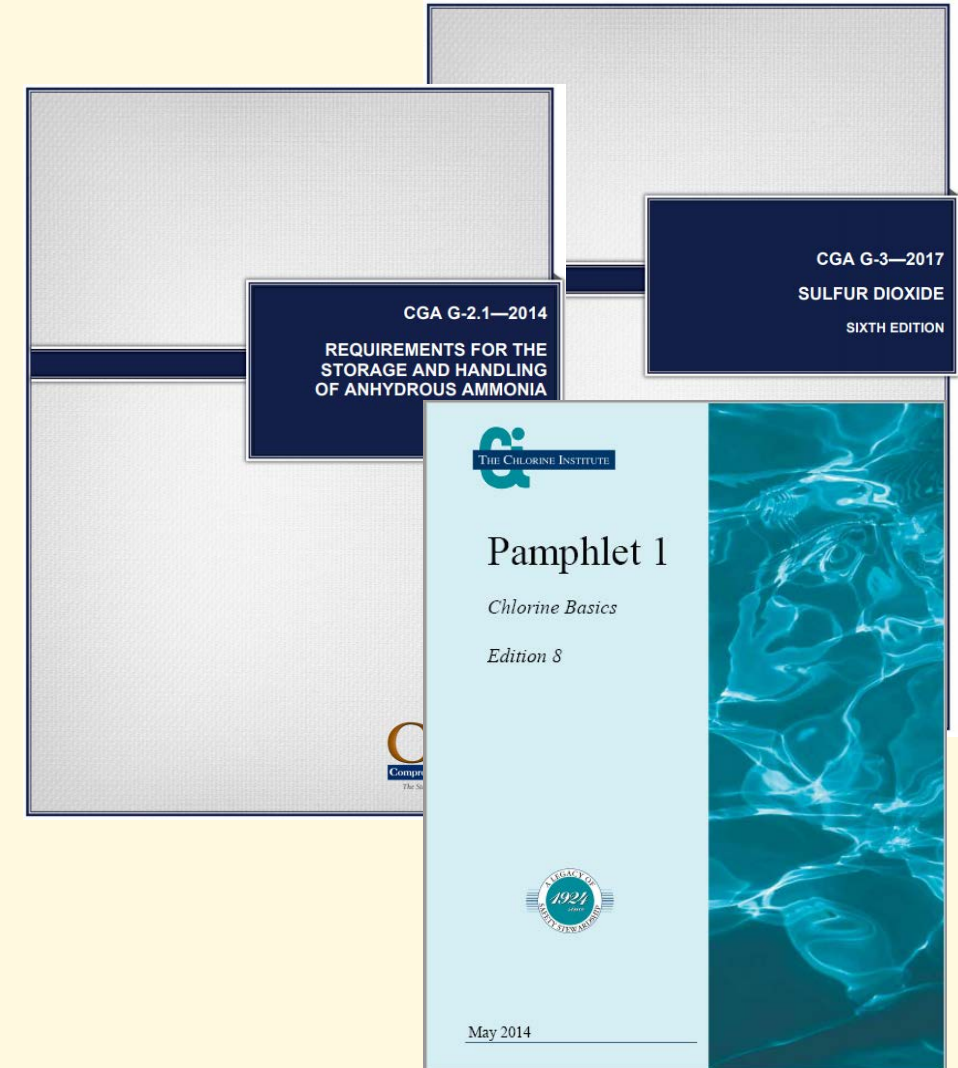
## CGA G-3 2017 Sulfur Dioxide

- Wineries
- Cold Storage Fumigation
- Dehydrators

## CGA G-2.1 2014 Storage of Ammonia

- Agriculture Application
- Water Treatment

## The Chlorine Institute – The Chlorine Manual



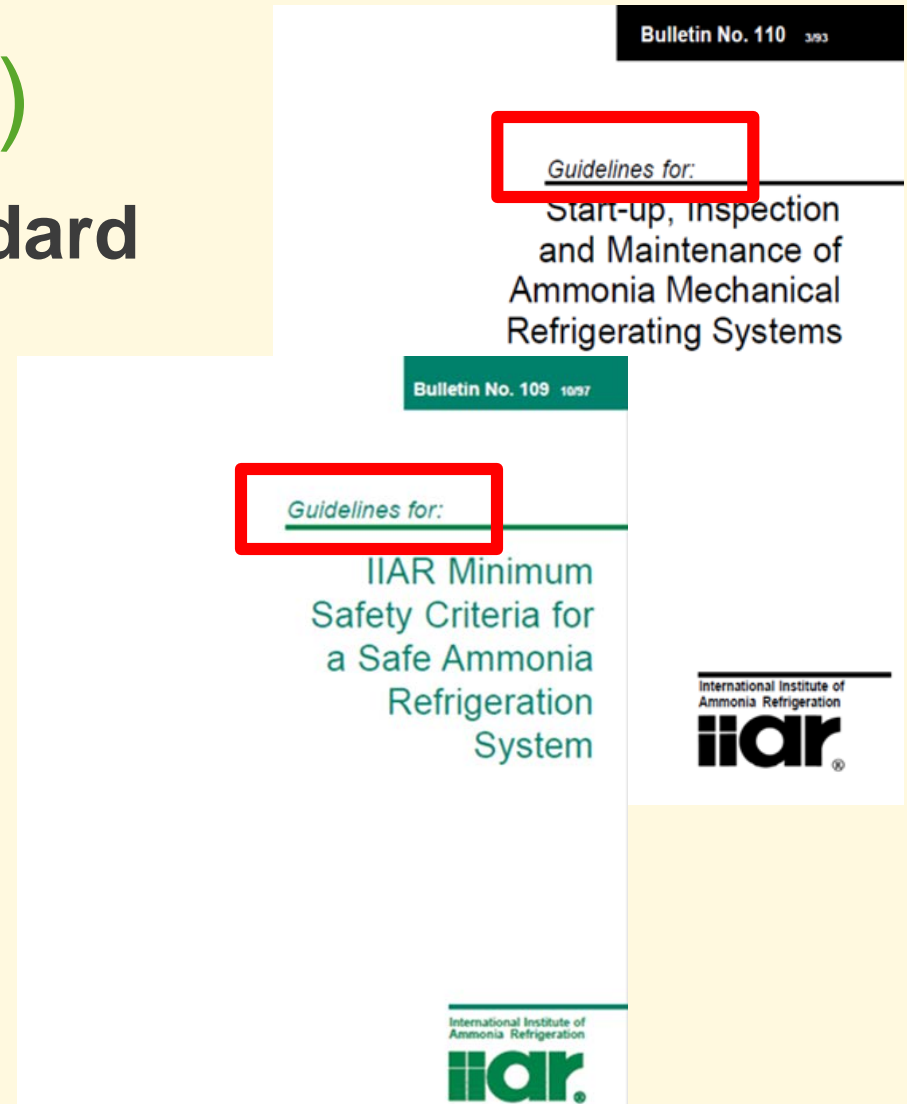
***“information relating to the properties, transportation, storage, and handling of compressed gases”***



# Industry Standards (Refrigeration)

## Currently being used as Industry Standard

- IIAR Bulletin 109 & 110
  - “Guidelines”



# Industry Standards

## Coming Soon: Industry Standards

- **IIAR 6 - Inspection, Testing, and Maintenance of Safe Closed-Circuit Ammonia Refrigeration Systems**

**“minimum criteria for inspection, testing, and maintenance of closed-circuit ammonia mechanical refrigeration systems”**



**IIAR 6-201x**

**Public Review Announcement**

**March 31, 2017**

**First (1st) Public Review of Standard BSR/IIAR 6-201x, *Standard for Inspection, Testing, and Maintenance of Safe Closed-Circuit Ammonia***

*Refrigeration Systems*

The first (1st) public review of draft standard BSR/IIAR 6-201x *Standard for Inspection, Testing, and Maintenance of Safe Closed-Circuit Ammonia Refrigeration Systems* is now open. The public review will be conducted from March 31, 2017 through May 15, 2017. Comments must be submitted to the International Institute of Ammonia Refrigeration (IIAR) by 5:00 pm Eastern Standard Time on May 15, 2017.

The International Institute of Ammonia Refrigeration (IIAR) invites you to make comments on the draft standard. Substantive changes resulting from this public review will also be provided for comment in a future public review if necessary.

**[CLICK HERE TO ACCESS COMMENT FORMS](#)**

## Application

- Pressure Vessels
- Heat Exchangers
- Piping and Valves
- Compressors
- Relief System
- Emergency Shut Down System
- Pumps



*\* Any component of the process or associated with the process that can cause process failures or accidental releases.*

# MI Program Elements

1. **Schedule** of all process equipment
2. **Frequency** of inspections, tests, and maintenance
3. **Procedure** to perform each task
4. **Form** to document task results and identify deficiencies
5. **System** to ensure deficiencies tracked to completion





# Example: Evaporative Condenser

## 1. Visual Inspections

*Weekly, Monthly, Annual, and 5-yr*

## 2. Testing

*Weekly Water Treatment Testing*

## 3. Maintenance

*Lubricate Fan Bearings Quarterly*

*Annual Cleaning of Water Sump and Strainers*



# Example: Evaporative Condenser

<u>Evaporative Condenser</u>	Frequency	Operating Procedure	Form
Visual Inspections	Weekly Inspection	SOP-101	EC-W
	Monthly Inspection	SOP-101	EC-M
	Annual Inspection	SOP-101	EC-A
	5-year Inspection	SOP-101	EC-5yr
Testing	Weekly Water Treatment Test	SOP-102	EC-WTT
Maintenance	Quarterly Fan Bearings Service	SOP-103	EC-QFB
	Annual Sump Cleaning	SOP-103	EC-ASC

# Example: Evaporative Condenser

## Visual Inspections of Evaporative Condensers

### **Weekly Evaporative Condenser Inspection:**

- Entering the evaporative condenser basin through the access-door is a permit-required confined space activity. Follow all required confined space protocols;
- Make sure that the evaporative condenser shows no signs of an ammonia leak;
- Make sure that evaporative condenser and associated water piping is free from leaks;
- Make sure that the evaporative condenser is not experiencing unusual vibration;
- Make sure that non-authorized personnel are not working on or around the evaporative condenser;
- Make sure that the evaporative condenser has safe access in the event that the evaporative condenser must be worked on;
- Visually inspect the belt(s) for proper tension;
- Make sure that the basin strainer is clear of debris;
- Visually inspect the evaporative condenser for any unusual sights, sounds, or smells. Any unusual conditions must be addressed.

# Example: Evaporative Condenser

## Visual Inspections of Evaporative Condensers

<b>CHECKLIST (Weekly)</b> <b>Ammonia Evaporative Condenser Maintenance</b>			
See following instructions			
Evaporative Condenser Description: _____			
Evaporative Condenser Identification No: _____			
Evaporative Condenser Manufacturer: _____			
Evaporative Condenser Model Number: _____			
Evaporative Condenser Serial Number: _____			
<b>Weekly Ammonia Evaporative Condenser Inspection</b>			
Date	Time	Weekly Evaporative Condenser Inspection Completed? (Yes/No)	Initials
If answer is "No" to any of the questions above, please provide explanation, corrective measure(s) and planned completion date, below, for each.			



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# Example: Evaporative Condenser



CHEMICAL ANALYSIS							
Results expressed in parts per million							
SAMPLE MARKED	RAW	1	2	3	4	5	6
Total Dissolved Solids (Microsiemens)		798	839	620	779	745	740
Suspended Solids (Appearance)							
pH Value		8.88	8.90	8.81	8.93	8.98	8.47
Total Hardness (CaCO <sub>3</sub> )		230	230	160	260	240	240
Calcium Hardness (CaCO <sub>3</sub> )							
Magnesium Hardness (CaCO <sub>3</sub> )							
Sodium (Na)							
Silica (SiO <sub>2</sub> )							
"P" Alkalinity (CaCO <sub>3</sub> )							
"M" Alkalinity (CaCO <sub>3</sub> )		225	250	200	225	225	200
"OH" Alkalinity (CaCO <sub>3</sub> ) / as "OH"							
Chlorides (Cl)							
Phosphate (PO <sub>4</sub> )		15	20	20	15	15	15
Sulfite (SO <sub>3</sub> )							
Sulfate (SO <sub>4</sub> )							
Nitrite (NO <sub>2</sub> )							
Nitrate (NO <sub>3</sub> )							
Molybdate (MO)							
Iron (Fe)							
Copper (Cu)							
Cycles by Dissolved Solids							
Cycles by Total Hardness							
Cycles by Calcium Hardness							
Cycles by Chlorides							
Cycles by Sulfate							
Cycles by Silica							
Inhibitor Level							
Halogen (Free / Total)		.2	.3	.2	.4	.2	.2
Dispersant Level							
REMARKS: Towers - 1, 2, 4, 5, 6 - Conductivity and inhibitor good, bromine low. Calibrated all controllers and filled all brominators.							

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# Example: Evaporative Condenser

▼ A ABC      Maintenance      Annual Condenser Sump Maintenance      08/01/17

Toggle Sections   Documents ( 0 )   Save   Delete   Print   Duplicate

WO #: \* ABC      WO Name: \* Annual Condenser Sump Maintenance

Due Date 08/01/2017	Frequency Annual ▼
Type Maintenance	WO Assigned to <input type="text"/>
Completed Date <input type="text"/>	Completed By <input type="text"/>

▼ Work Description

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Clean Condenser 1 water sump and strainers. Follow the facility's Evaporative Condenser SOP and Confined Space Program when performing this maintenance activity.





# Keys to an Effective MI Program

1. *Access to equipment*
2. *Organized Program and Recordkeeping*
3. *Adequate Budget*
4. *Sufficient Manpower*
5. *Trained and Qualified Technicians*







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