



# Understanding Common RAGAGEPs

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*Process Safety Consultant*  
*Resource Compliance*

*Session Code TH-A2*  
*February 29, 2024*



26th California Unified Program  
Annual Training Conference  
February 26-29, 2024

# INTRODUCTION



RAGAGEP & the  
CalARP  
Regulation



RAGAGEPs Applied  
to Common  
Substances



RAGAGEP  
Examples in the  
Field



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# RAGAGEP & the CalARP Regulation

# CalARP P2

## Section 2755.1(b) Safety Information

- (b) The owner or operator shall ensure that the process is designed in compliance with **recognized and generally accepted good engineering practices**. Compliance with federal or state regulations that address industry-specific safe design or with **industry-specific design codes and standards** may be used to demonstrate compliance with this section.



# CalARP P3

## Section 2760.1(d) Process Safety Information

- (2) The owner or operator shall document that equipment complies with recognized and generally accepted good engineering practices.
- (3) For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the owner or operator shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.



# CalARP P2

## Section 2755.5(d) Maintenance

- (d) 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.



# CalARP P3

## Section 2760.5(d) Mechanical Integrity

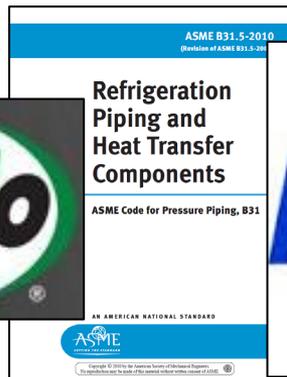
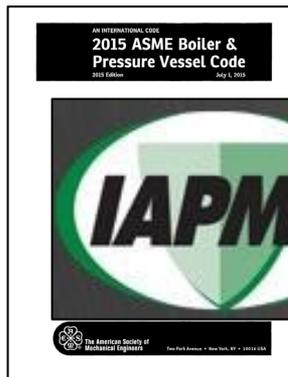
- (2) Inspection and testing procedures shall follow **recognized and generally accepted good engineering practices.**
- (3) The frequency of inspections and tests of process equipment shall be consistent with applicable **manufacturers' recommendations** and **good engineering practices**, and more frequently if determined to be necessary by prior **operating experience.**



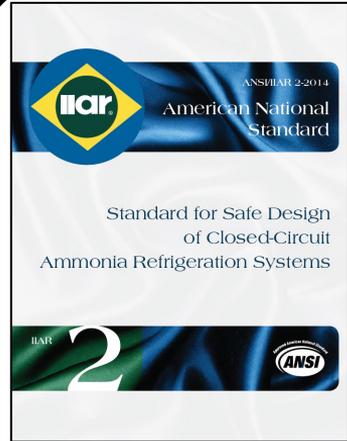
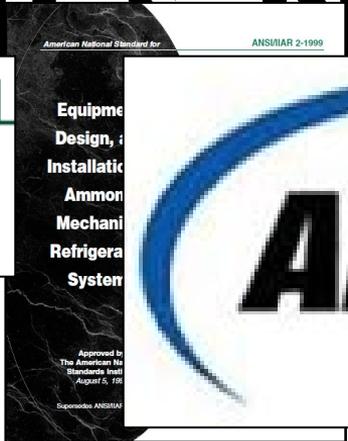
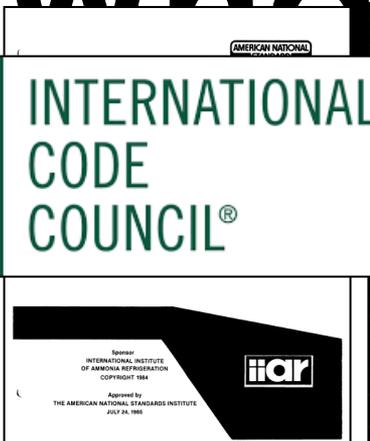
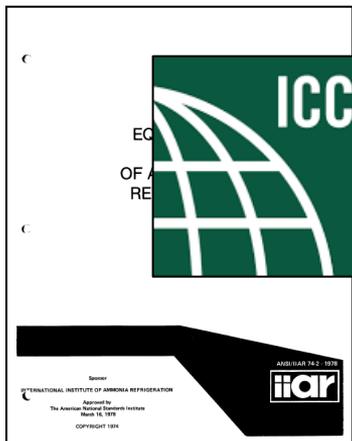
	Title 19 CCR Division 2 Ch 4.5 California Accidental Release Prevention (CalARP) Program	Title 40 CFR §68 EPA's Risk Management Program
Equipment (design)	§2760.1(2) The owner or operator shall document that equipment complies with <b>recognized and generally accepted good engineering practices</b> .	§68.65(d)(2) The owner or operator shall document that equipment complies with <b>recognized and generally accepted good engineering practices</b> .
Inspection and testing procedures	§2760.5(d)(2) Inspection and testing procedures shall follow <b>recognized and generally accepted good engineering practices</b> .	§68.73(d)(2) Inspection and testing procedures shall follow <b>recognized and generally accepted good engineering practices</b> .
Inspection and testing frequency	§2760.5(d)(3) The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and <b>good engineering practices</b> , and more frequently if determined to be necessary by prior operating experience.	§68.73(d)(3) The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and <b>good engineering practices</b> , and more frequently if determined to be necessary by prior operating experience.

# RAGAGEP

References in  
CalARP & RMP  
Regulations



# What's Next?



CALIFORNIA GOVERNOR'S OFFICE OF EMERGENCY SERVICES  
TEXT OF REGULATIONS

CALIFORNIA CODE OF REGULATIONS

TITLE 19 - PUBLIC SAFETY

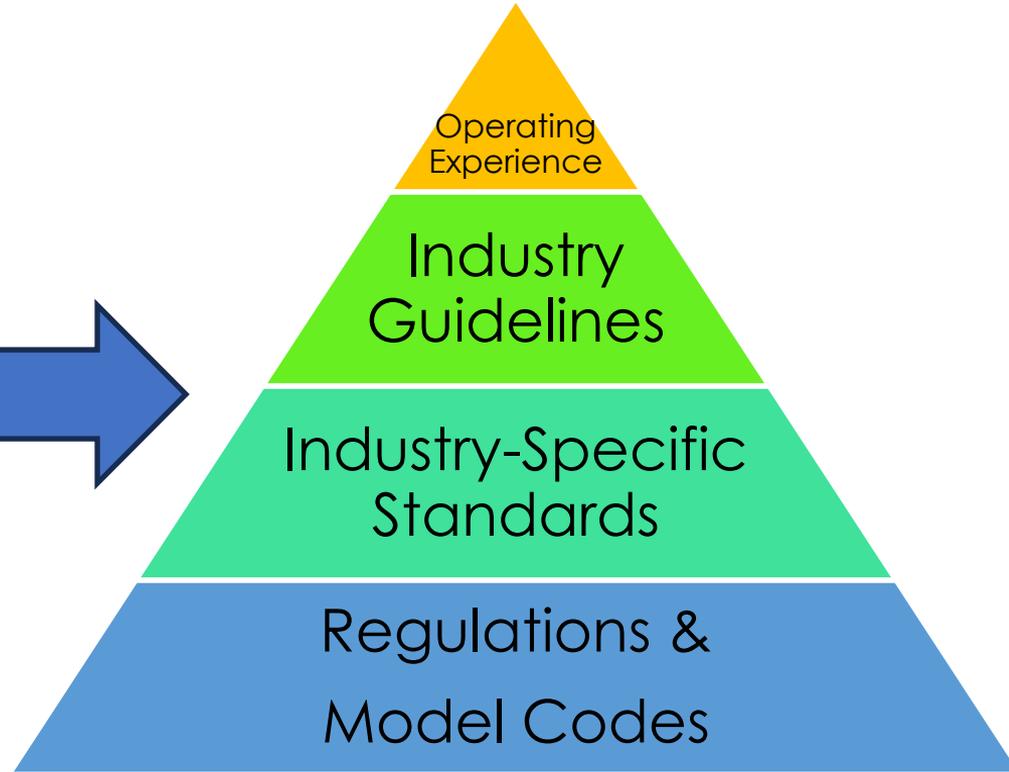
DIVISION 2. CALIFORNIA GOVERNOR'S OFFICE OF EMERGENCY SERVICES

CHAPTER 4.5 CALIFORNIA ACCIDENTAL RELEASE PREVENTION (CalARP)  
PROGRAM

Detailed Analysis

<b>Article 1.</b>	<b>General</b> .....	1
2735.1	Purpose .....	1
2735.2	Scope .....	1
2735.3	Definitions .....	2
2735.4	Applicability .....	6
2735.5	General Requirements .....	8
2735.6	CalARP Program Management System .....	10
2735.7	Emergency Information Access .....	11
<b>Article 2.</b>	<b>Registration</b> .....	11
2740.1	Registration .....	11
<b>Article 3.</b>	<b>Risk Management Plan Components and Submission Requirements</b> .....	13
2745.1	Submission .....	13
2745.2	RMP Review Process .....	15
2745.3	RMP Executive Summary Component .....	16
2745.4	RMP Offsite Consequence Analysis Component .....	17
2745.5	RMP Five-year Accident History Component .....	18
2745.6	RMP Program 2 Prevention Program Component .....	18
2745.7	RMP Program 3 Prevention Program Component .....	20
2745.8	RMP Emergency Response Program Component .....	21
2745.9	RMP Certification .....	22
2745.10	RMP Updates .....	22
2745.10.5	Required RMP Corrections .....	24
2745.11	Covered Process Modification .....	24
2745.12	Certificate of Occupancy .....	25
<b>Article 4.</b>	<b>Hazard Assessment</b> .....	25
2750.1	Hazard Assessment Applicability .....	25
2750.2	Offsite Consequence Analysis Parameters .....	26

CalARP Program Regulations January 1, 2015 Page 1



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# Frustrations with RAGAGEP

- Confusing
- Updates & new additions
- Grandfathering
- What's required vs. recommended

**Check the facilities PSI – Design Codes & Standards Employed; Materials of Construction**



# OSHA RAGAGEP Memo



June 5, 2015

**MEMORANDUM FOR:** REGIONAL ADMINISTRATORS AND STATE PLAN DESIGNEES

**THROUGH:** DOROTHY DOUGHERTY  
Deputy Assistant Secretary

**FROM:** THOMAS GALASSI Director  
Directorate of Enforcement Programs

**SUBJECT:** RAGAGEP in Process Safety Management Enforcement

This memorandum provides guidance on the enforcement of the Process Safety Management (PSM) Standard's recognized and generally accepted good engineering practices (RAGAGEP) requirements, including how to interpret "shall" and "should" language in published codes, standards, published technical reports, recommended practices (RP) or similar documents, and on the use of internal employer documents as RAGAGEP. Enforcement activity, including the *Petroleum Refinery Process Safety Management National Emphasis Program* (Refinery NEP), and requests for assistance from the field, revealed the need for guidance on the PSM standard's RAGAGEP provisions.



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# OSHA RAGAGEP Memo



- Shall vs. Should
- Normative vs. Informative
- Primary Sources of RAGAGEPs
- Use of Internal Standards



# Model Codes & Standards Development

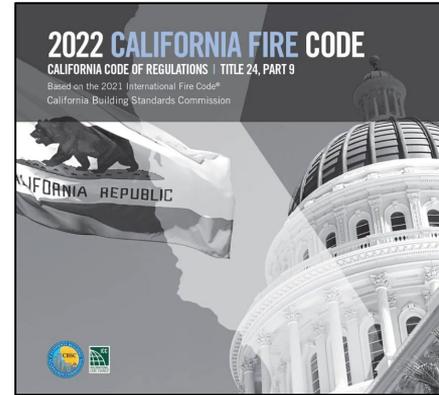
- American National Standards Institute (ANSI)
- International Code Council (ICC)
- International Association of Plumbing and Mechanical Officials (IAPMO)
- American Society of Mechanical Engineers
- California Building Standards Commission (CBSC)



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# Model Codes

- California Mechanical Code (CMC)
- Uniform Mechanical Code (UMC)
- California Fire Code (CFC)



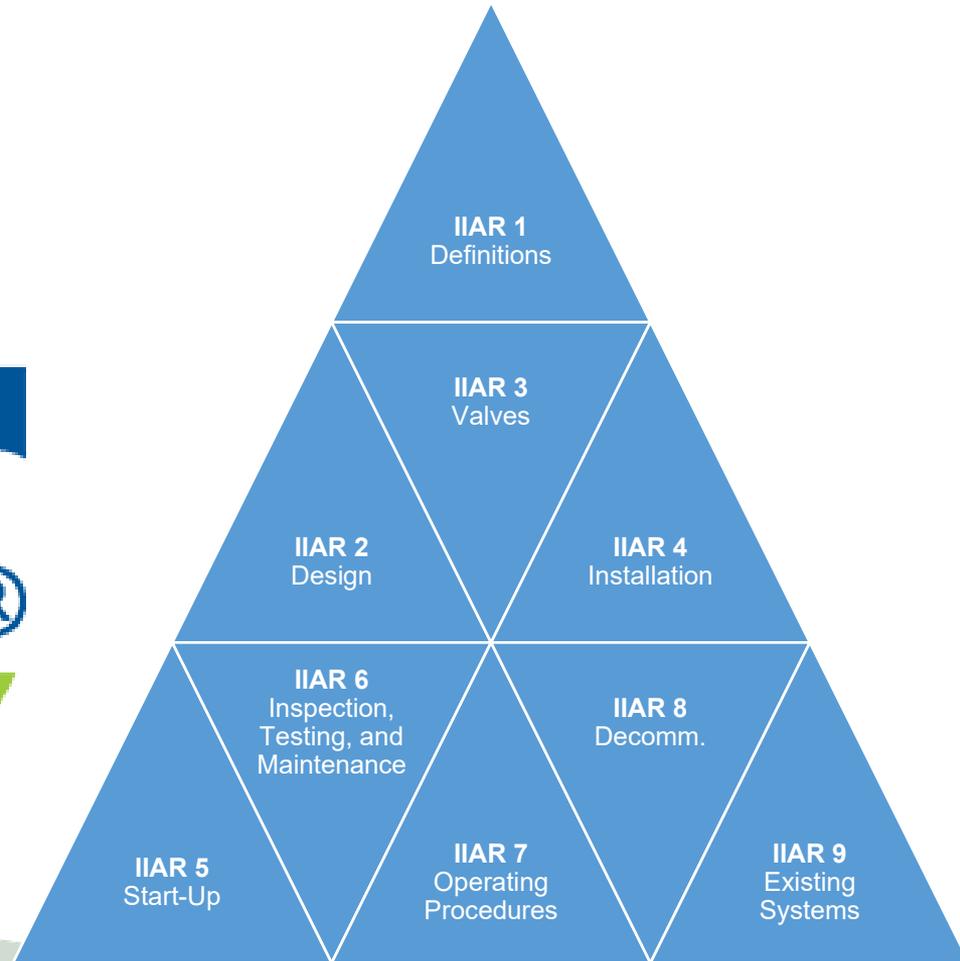


# RAGAGEPs Applied to Common Substances



*RAGAGEPs  
Applied & Field  
Examples:*

Ammonia  
Refrigeration



# Updates to IIAR Standards

#	Standard Title	Previous	New
1	American National Standard for <b>Definitions</b> and Terminology Used in IIAR Standards	2017	2022
2	American National Standard for <b>Design</b> of Safe Closed-Circuit Ammonia Refrigeration Systems	2014	2021
3	American National Standard for Ammonia <b>Refrigeration Valves</b>	2017	2022
4	American National Standard for the <b>Installation</b> of Closed-Circuit Ammonia Refrigeration Systems	2015	2020
5	American National Standard for the <b>Startup</b> of Closed-Circuit Ammonia Refrigeration Systems	2013	2019
6	American National Standard for the <b>Inspection, Testing, and Maintenance</b> of Closed-Circuit Ammonia Refrigeration Systems	N/A	2019
7	American National Standard for Developing <b>Operating Procedures</b> for Closed-Circuit Ammonia Refrigeration Systems	2013	2019
8	American National Standard for <b>Decommissioning</b> of Closed-Circuit Ammonia Refrigeration Systems	2015	2020
9	American National Standard for <b>Minimum System Safety</b> Requirements for <b>Existing</b> Closed-Circuit Ammonia Refrigeration <b>Systems</b>	N/A	2020

Model code	Reference to IIAR
<b>2021 Uniform Mechanical Code</b>	§1102.2 Ammonia Refrigeration Systems. Refrigeration systems using ammonia as the refrigerant shall comply with <b>IIAR 2, IIAR 3, IIAR 4, and IIAR 5</b> and shall not be required to comply with this chapter.
<b>2021 International Mechanical Code</b>	§1101.1.2 Ammonia refrigerant. Refrigerant systems using ammonia as the refrigerant shall comply with <b>IIAR 2, IIAR 3, IIAR 4 and IIAR 5</b> and shall not be required to comply with this chapter.

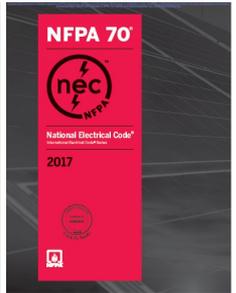
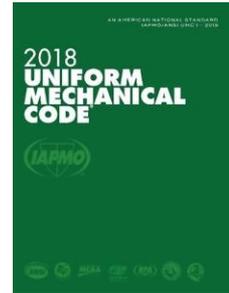
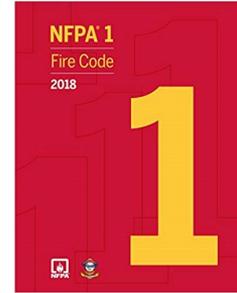
## IIAR Standards

Referenced in model codes

Model code	Reference to IIAR
2021 International Fire Code	§608.1.2 Ammonia refrigeration. Refrigeration systems using ammonia refrigerant and the buildings in which such systems are installed shall comply with <b>IIAR 2</b> for system design; <b>IIAR 6</b> for inspection, testing and maintenance; and <b>IIAR 7</b> for operating procedures. Decommissioning of ammonia refrigeration systems shall comply with <b>IIAR 8</b> , and engineering practices for existing ammonia refrigeration systems shall be in accordance with <b>IIAR 9</b> .
2021 NFPA 1	§53.1.3.2 Refrigeration systems using ammonia as the refrigerant shall comply with ANSI/ <b>IIAR 2</b> , Standard for Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems; ANSI/ <b>IIAR 6</b> , Standard for Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems; ANSI/ <b>IIAR 7</b> , Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems; and ANSI/ <b>IIAR 8</b> , Decommissioning of Closed-Circuit Ammonia Mechanical Refrigerating Systems.

# IIAR Standards

Referenced in model codes



# IIAR Literature - Bulletins

## NOTICE

The information contained in these **guidelines** has been obtained from sources believed to be reliable. However, it should not be assumed that all acceptable methods or procedures are contained in this document, or that additional measures may not be required under certain circumstances or conditions.

The International Institute of Ammonia Refrigeration makes no warranty or representation, and assumes no liability or responsibility, in connection with any information contained in this document.

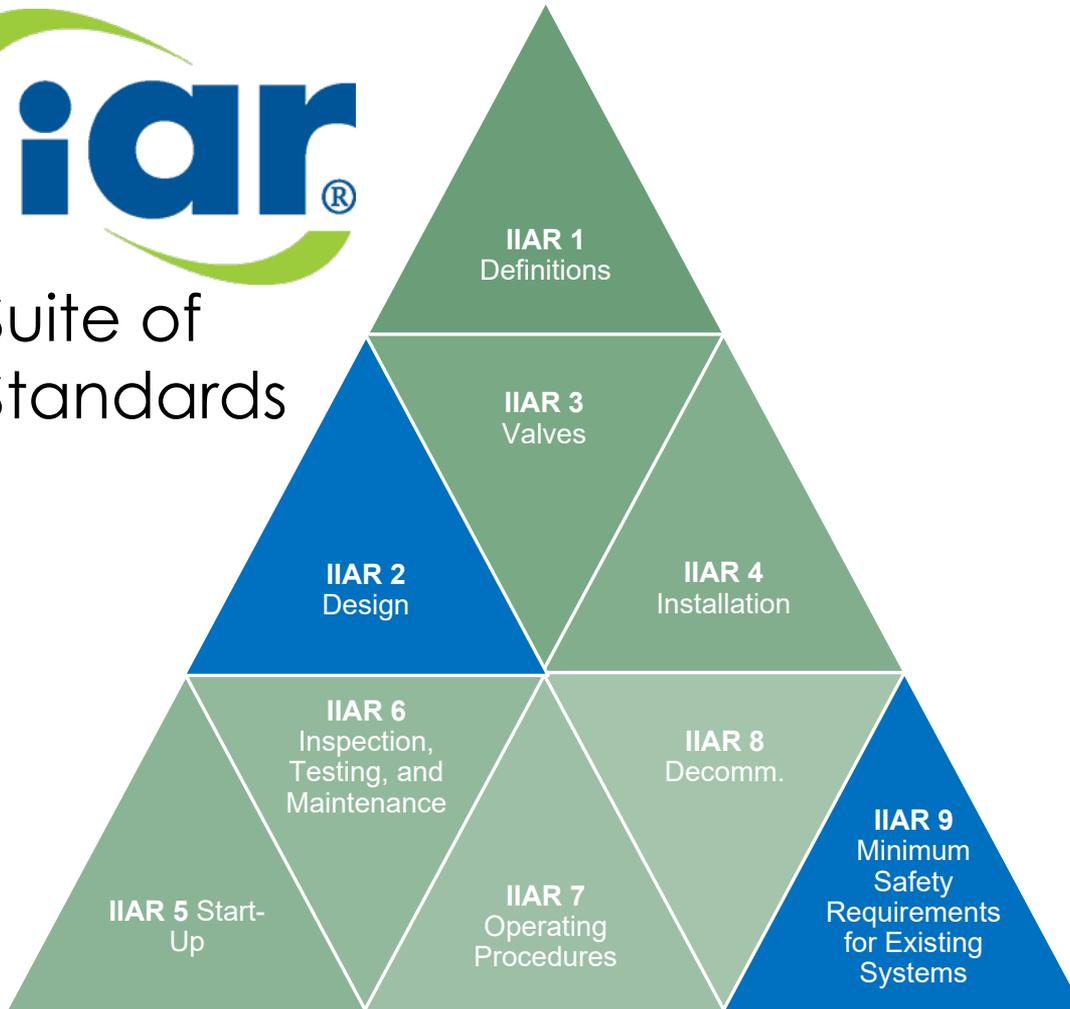
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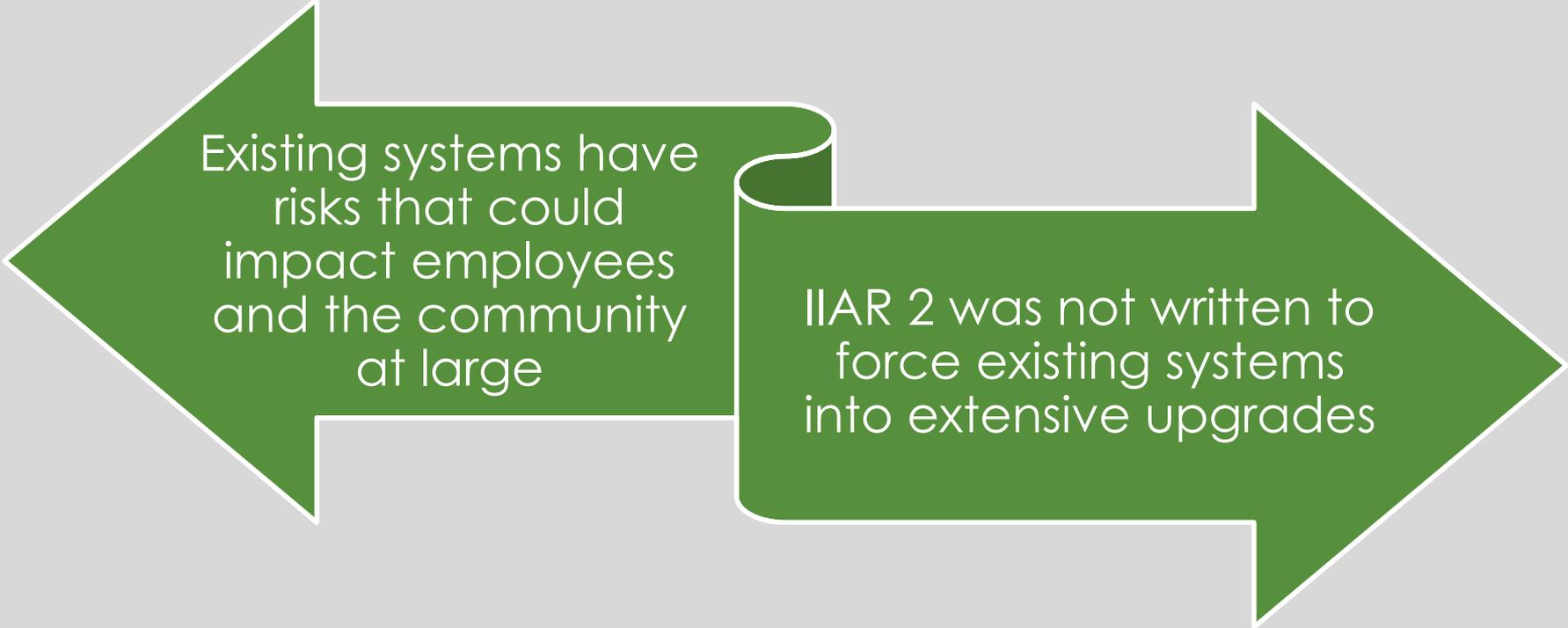


## Suite of Standards



## IIAR 2 and IIAR 9 - 2020:

1. Completed **IIAR's suite of standards** from standard 1 (Definitions) to this first installment of standard 9, addressing all phases of ammonia refrigeration in between.
2. IIAR 9 aims to address the age-old question of **"grandfathering" equipment** when compared to new design requirements.



Existing systems have risks that could impact employees and the community at large

IIAR 2 was not written to force existing systems into extensive upgrades

# High Pressure Receiver



# Compressor



# Evaporative Condenser



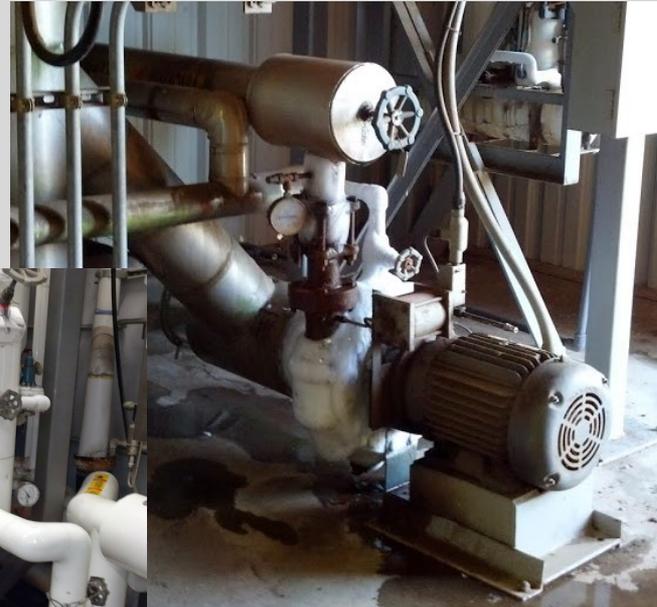
# King Valve



# Recirculator



# Ammonia Pump



# Control Valves



# Evaporators



# Evaporators



# Accumulators or Surge Drums



# Plate and Frame Heat Exchangers



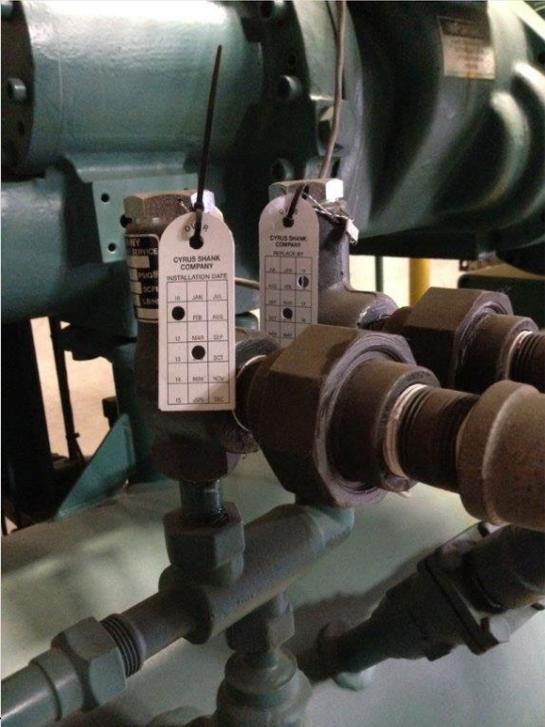
# Shell and Tube Heat Exchangers



# Jacketed Tanks (Silos)



# Relief Valves



# Relief Valves



# Ammonia Diffusion Tank



# Machinery Rooms



# Emergency Control Box



# Emergency Pressure Control System



# Ventilation



# Ammonia Detection



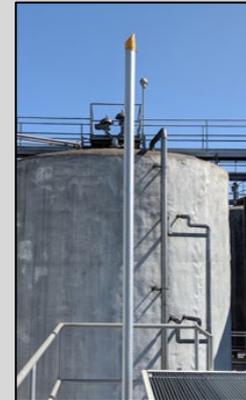
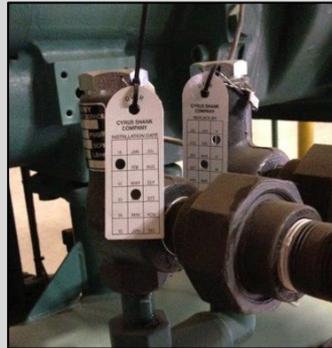
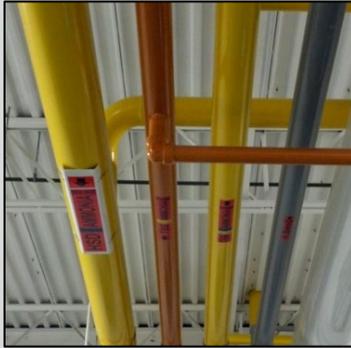
# Insulation



# Shared between IIAR 9 & IIAR 2-2021



# Shared between IIAR 9 & IIAR 2-2021



Subject	IIAR 2 Summary	IIAR 9 Summary	IIAR 9 Ref.
Low-side minimum design pressure	250 psig	150 psig	§7.2.2
Ammonia detection locations	Detection required everywhere ammonia refrigeration equipment is installed indoors; some exceptions apply	Prior to 2014, detection is not required outside of the machinery room.	§A.7.3.12
Ammonia detection minimum alarm levels	25 ppm	50 ppm	§7.3.12.2
Machinery room emergency ventilation activation	150 ppm	1,000 ppm	§7.3.12.2
Eyewash and safety showers	...required wherever deliberate opening of an ammonia system occurs (line break).	At least one inside one and outside the machinery room; no requirement in other areas.	§7.3.7.1

Allowed differences comparing IIAR 9 and IIAR 2-2021



# ANSI/IIAR 6-2019

American National  
Standard for the  
**Inspection, Testing, and  
Maintenance** of Closed-  
Circuit Ammonia  
Refrigeration Systems

# New Standard

## **IIAR Bulletin Nos. 109 & 110**

- These guidance documents are now retired
- Included soft language (e.g., may, should)
- Were not intended to be enforceable

## **ANSI/IIAR 6-2019**

- Covers the minimum requirements for inspection, testing, and maintenance (ITM)
- Removed all soft language with rigid language (e.g., shall, must)
- Intended to be enforceable by authorities having jurisdiction (AHJs)

# BREAK TIME!



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*RAGAGEPs  
Applied & Field  
Examples:*

Non-  
Refrigeration  
Ammonia

# Facility Overview – Non-Refrigeration Ammonia

- Ag Fertilizer Facilities
- NO<sub>x</sub> Reduction/SCR Facilities
- Water pH Control



# RAGAGEP Documents: Non-Refrigeration Ammonia



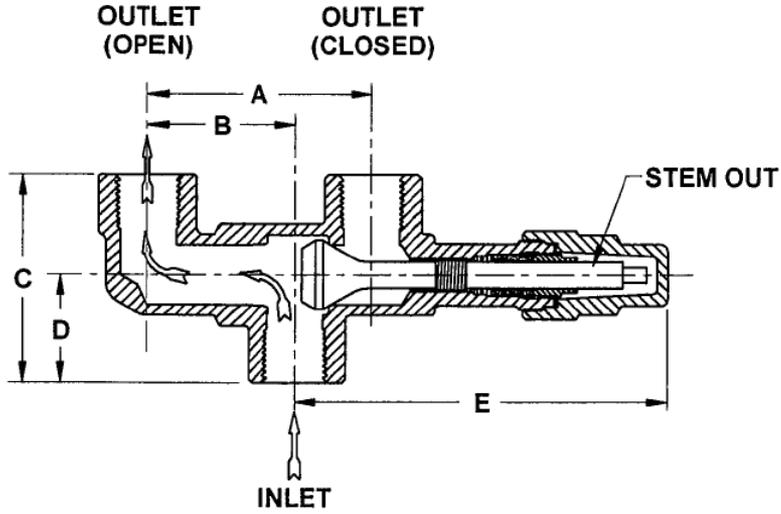
- Compressed Gas Association (CGA) G2.1-2023 *Storage of Ammonia*



# Relief Valves



# Ag Ammonia Relief Valves



It is common practice in the ammonia refrigeration industry to install a three-way isolation valve upstream of relief valves protecting an ammonia refrigeration pressure vessel. For vessels larger than 10 ft<sup>3</sup>, this is required by most model codes and standards. These three-way valves allow a relief valve to be replaced without the hassle of pumping down the entire vessel.

According to [Hansen Technologies Bulletin K109h](#) (Jul 2013) when a three-way isolation valve is used, "the valve stem should be positioned so that only one pressure-relief valve is activated."

I recently was mistaken when I assumed that this same principle would apply to three-way valves for *non-refrigeration* ammonia applications.



However, when reviewing the [Squibb Taylor website](#) regarding their three-way relief valve manifold, they included the following warning:

## WARNING!

**WHEN IN SERVICE, DO NOT USE A1416 WITH ONLY ONE PORT OPEN. TO GET PROPER CFM ALWAYS KEEP DIVERTER DISC IN CENTER POSITION. CLOSING PORT ONE OR TWO IS ONLY FOR CHANGING RELIEF VALVES. NEVER USE A PLUG IN PORT ONE OR TWO ON AN A1416 MANIFOLD.**

In summary, good engineering practice for sizing a relief valve for ammonia refrigeration vessel considers the capacity of a single valve on a dual assembly, while an ammonia storage application considers both valves. The lesson learned is to always check with the manufacturer regarding the recommended installation and operation of their equipment. Don't assume the best practices for one manufacturer or industry will apply to another.



# NO<sub>x</sub> Reduction/SCR Facilities

- Large Industrial Boilers, CoGen Applications, Large Diesel Engines emit NO<sub>x</sub> gases through exhaust
- NO<sub>x</sub> refers to harmful nitrous oxide compounds NO and NO<sub>2</sub> (smog & acid rain)
- Ammonia Selective catalytic reduction (SCR) can reduce NO<sub>x</sub> emissions by approximately 70-90%



# Big Picture – SCR Facilities



Ammonia supplier  
transfers ammonia  
from truck to storage  
tank



Ammonia storage tank is  
connected to the injection  
piping



Ammonia is injected into the  
boiler(s) in order to convert  
nitrogen oxide emissions into  
diatomic nitrogen and water

# Ammonia Storage Tank



# Injection Points



# Charging Connection



# Relief Valves



# Atmospheric Discharge



# Control Valves



# Pressure Sensors





*RAGAGEPs  
Applied & Field  
Examples:*

Sulfur Dioxide

# Facility Overview – Sulfur Dioxide

- Wineries
- Dehydrating Facilities
- Grape Cold Storage



# RAGAGEP Documents: Sulfur Dioxide



- Compressed Gas Association (CGA) G-3 2023 *Sulfur Dioxide*
- ANSI/ASME B31.3, *Chemical Plant & Petroleum Refinery Piping*



# Sulfur Dioxide Processes

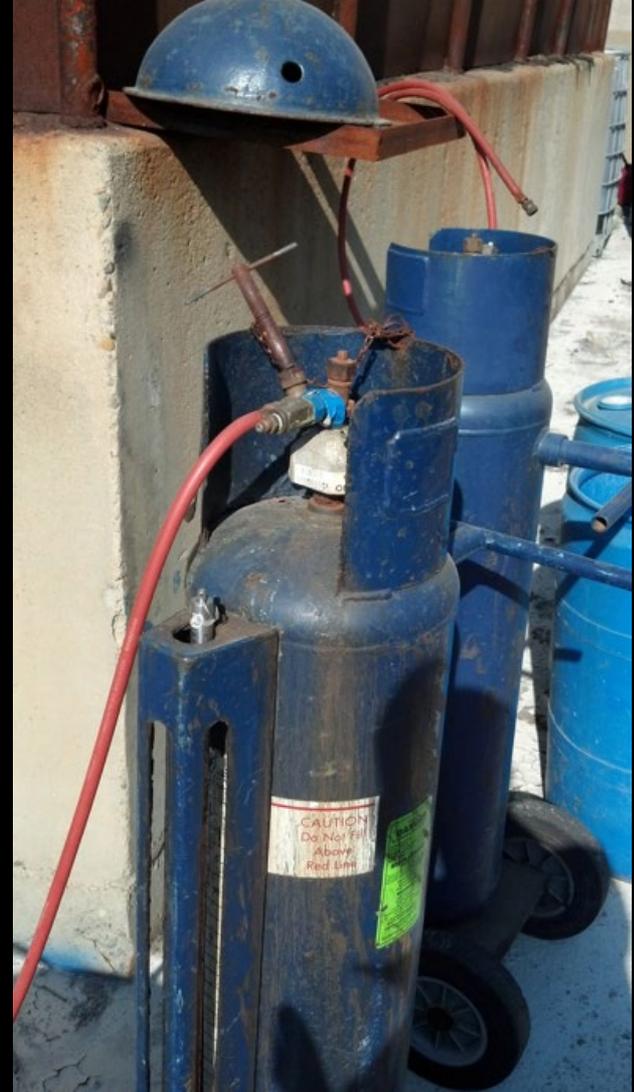
- The RAGAGEP for these processes is far less thorough. CGA G-3 is applicable for sulfur dioxide. This is not an ANSI-certified standard.
- Calibrated sulfur dioxide sensors are important.
- Proper respiratory protection is vital for sulfur dioxide applicators.



# Note on Wineries: Multi-Process



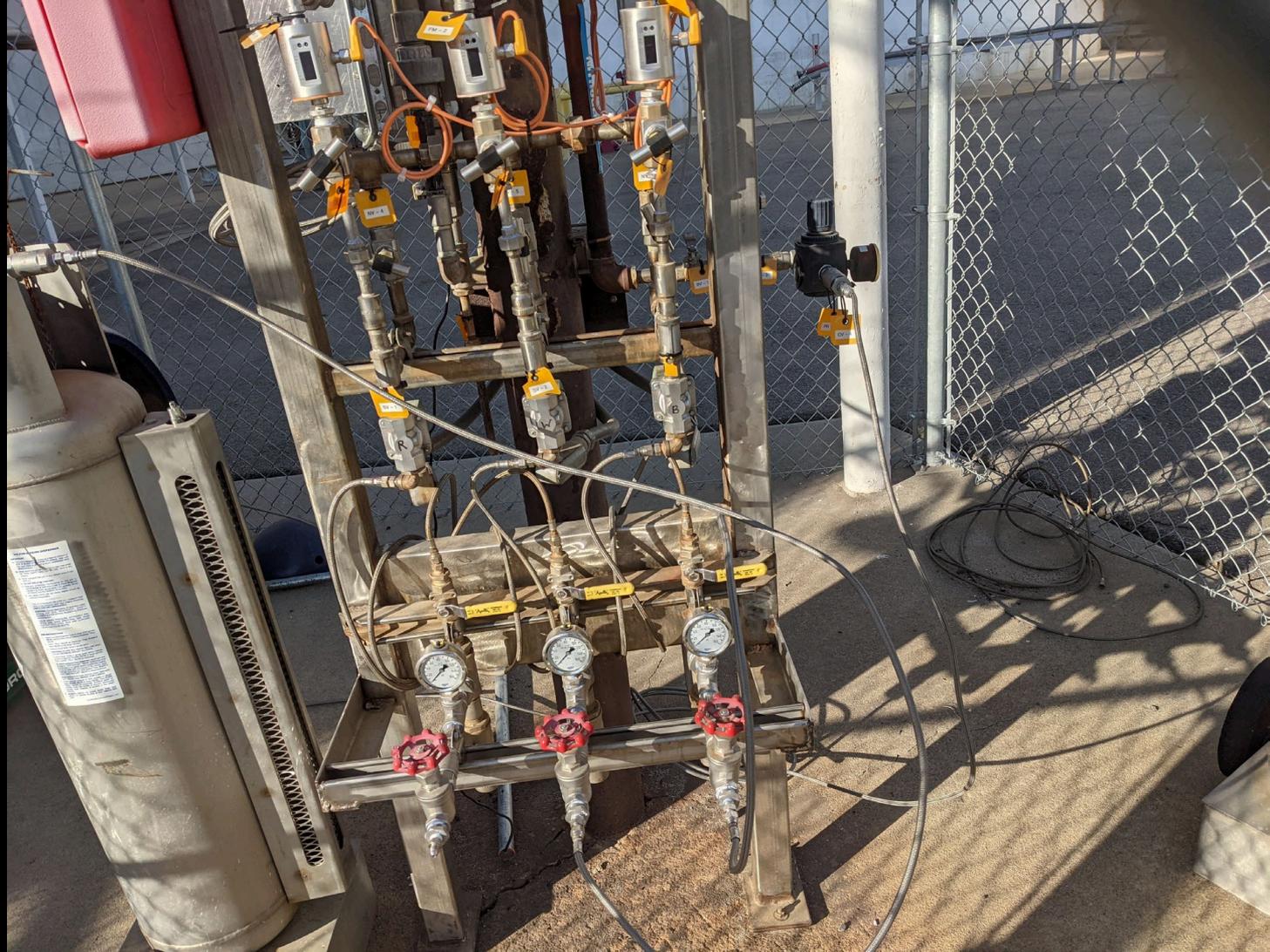
# Sulfur Dioxide



# Sulfur Dioxide



# Sulfur Dioxide





# Sulfur Dioxide



# Big Picture – Dehydrating Facilities



Grapes are grown  
on vines



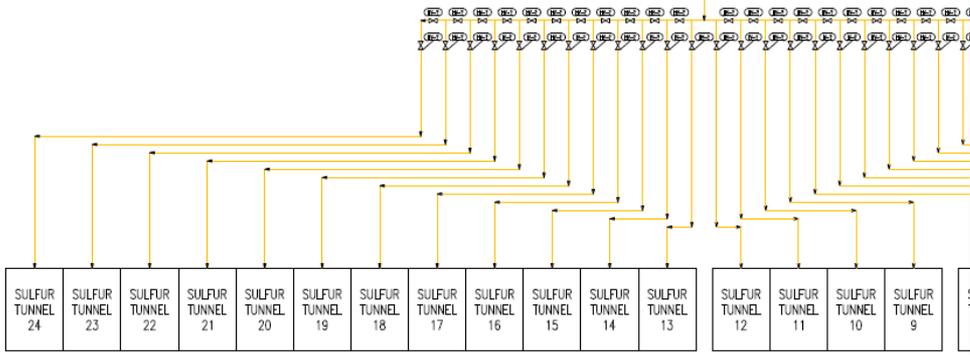
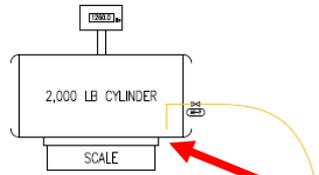
Grapes are dried  
on the ground by the  
sun



After processing,  
raisins are fumigated  
with sulfur dioxide



The raisins are  
“bleached” golden



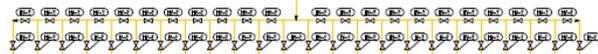
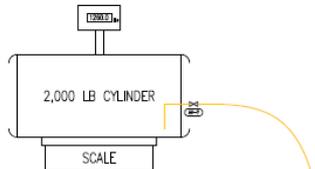
**NOTE:**  
 These drawings are for reference purposes only and should not be construed as construction or "As-Built" drawings. Prior to any modifications or additions the locations and sizes should be verified with changes clearly noted on these prints.

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BY	
CHECKED BY	
SCALE	
PROJECT	
REV	
DATE	
BY	
CHECKED BY	

DATE	11/11/2016
BY	J. BARTNER
CHECKED BY	
SCALE	3/8"=1'-0"
PROJECT	NOTE
REV	
DATE	
BY	
CHECKED BY	
SCALE	500 P&ID-1
PROJECT	

**P&ID-1**





SULFUR TUNNEL 24

- SULFUR TUNNEL 12
- SULFUR TUNNEL 11
- SULFUR TUNNEL 10
- SULFUR TUNNEL 9
- SULFUR TUNNEL 8
- SULFUR TUNNEL 7
- SULFUR TUNNEL 6
- SULFUR TUNNEL 5
- SULFUR TUNNEL 4
- SULFUR TUNNEL 3
- SULFUR TUNNEL 2
- SULFUR TUNNEL 1

**NOTE:**  
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CUSTOMER: **PIPING & INSTRUMENTATION DIA**  
 PROJECT: **SULFUR DIOXIDE SYSTEM**

DESIGNED BY	J. BURTON
DATE	3/25/2018
SCALE	AS SHOWN
FILE NO.	502 PE2345

**P&ID-1**

# Grape Cold Storage





*RAGAGEPs  
Applied & Field  
Examples:*

Chlorine

# Facility Overview - Chlorine

- Agricultural/City Water Treatment
- Manufacturing Waste Water
- Food Production Water Treatment



# RAGAGEP Documents: Chlorine

- The Chlorine Institute *Pamphlet 6: Piping Systems for Dry Chlorine*
- Ton containers comply with 49 CFR §179, Subpart E with regard to DOT specifications





Bacteria and vegetation growth occurs in crop/city water supplies. Additionally, some manufacturing processes result in contaminated waste water.



Water is used in a variety of applications during food processing.

# Big Picture – Chlorine Facilities



Chemicals are injected into the water to kill bacteria/vegetation or to neutralize harmful elements.



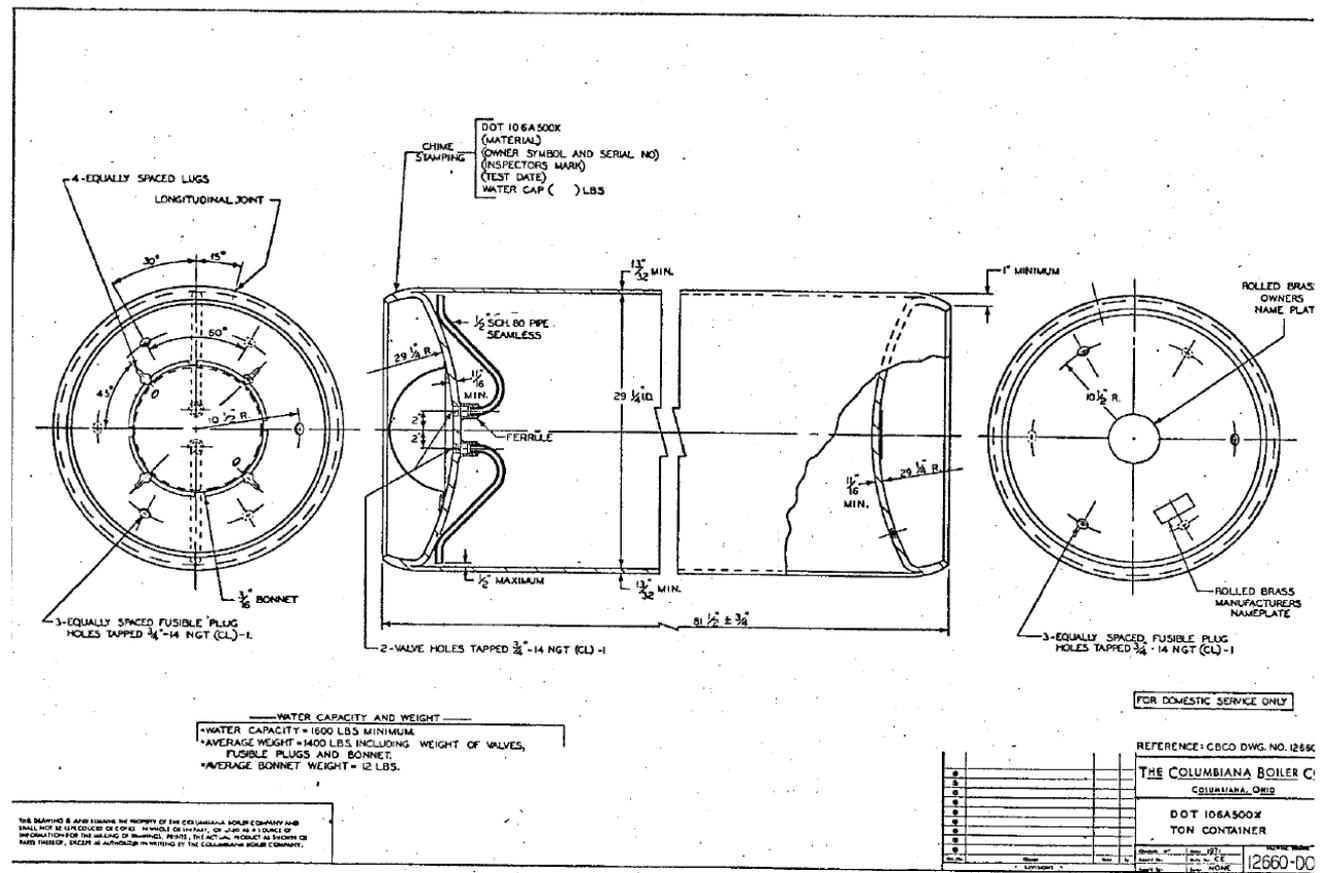
Clean water and food products are supplied to end-users.

# Chlorine



# Chlorine

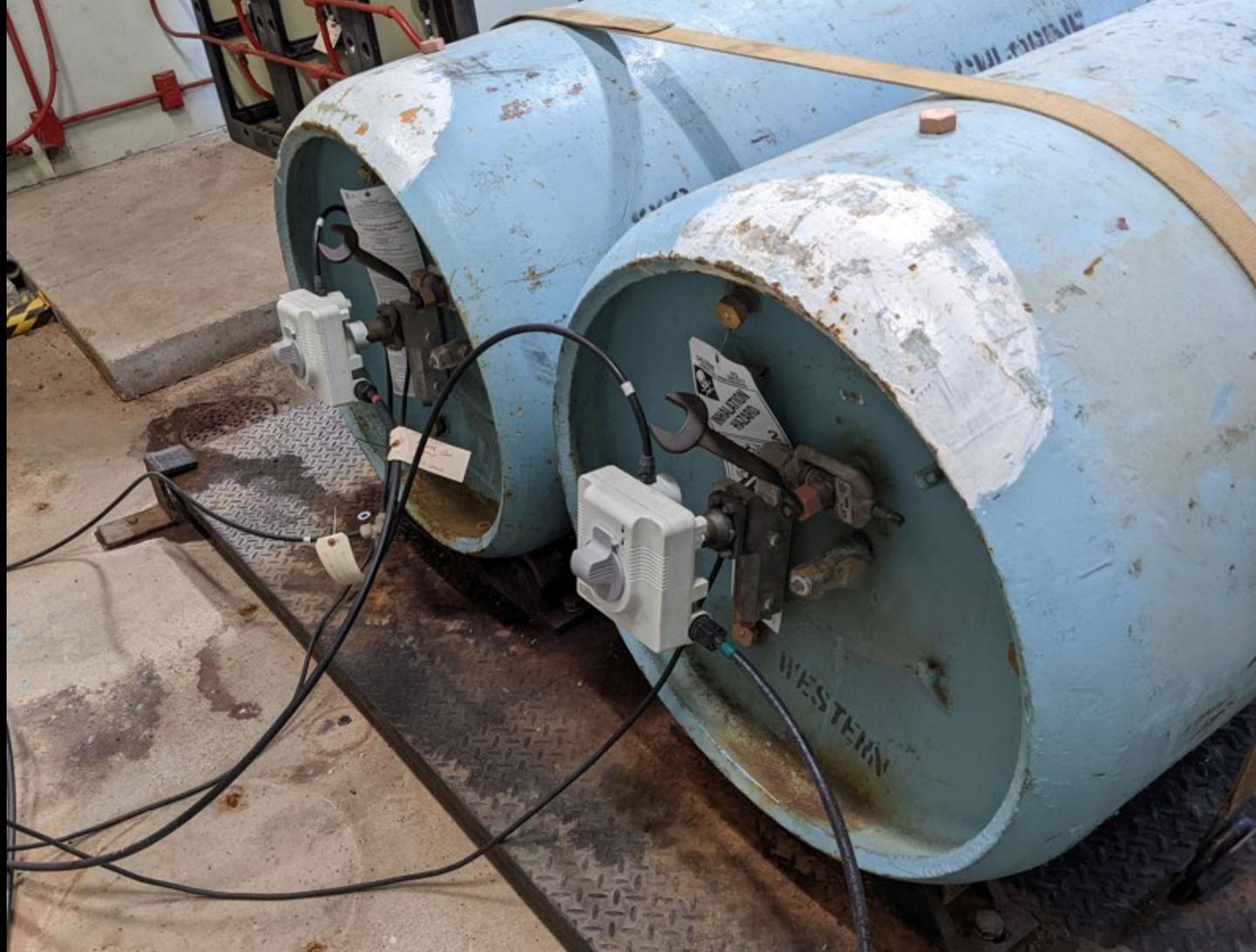
## DOT 106A Concave Head Chlorine One Ton Containers



# Chlorine



Chlorine



# Chlorine





*RAGAGEPs  
Applied & Field  
Examples:*

Petroleum

# RAGAGEP Documents: Petroleum



American  
Petroleum  
Institute

- API 510 - Pressure Vessel Inspection Code: In-service Inspection, Rating, Repair, and Alteration
- API standards have been referenced more than 1,100 times in international laws, regulations, national standards.



# Field Examples: Petroleum

**NOT  
AVAILABLE**



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CALIFORNIA GOVERNOR'S OFFICE OF EMERGENCY SERVICES  
TEXT OF REGULATIONS

CALIFORNIA CODE OF REGULATIONS

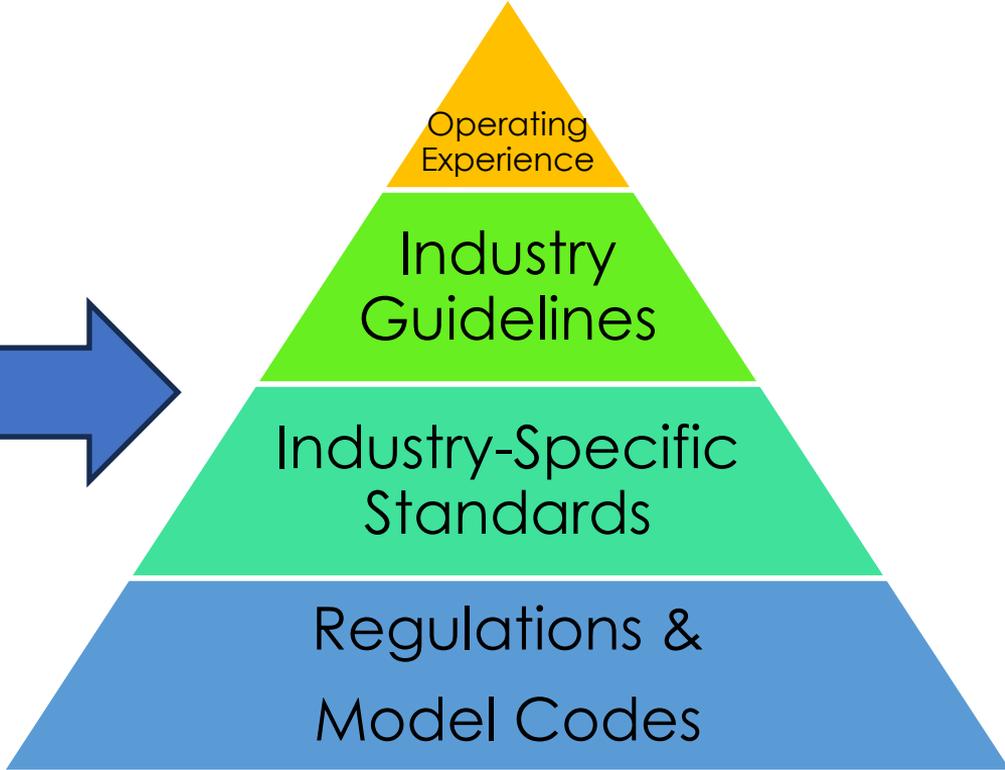
TITLE 19. PUBLIC SAFETY

DIVISION 2. CALIFORNIA GOVERNOR'S OFFICE OF EMERGENCY SERVICES

CHAPTER 4.5. CALIFORNIA ACCIDENTAL RELEASE PREVENTION (CalARP)  
PROGRAM

Detailed Analysis

<b>Article 1.</b>	<b>General</b> .....	1
2735.1	Purpose.....	1
2735.2	Scope.....	1
2735.3	Definitions.....	2
2735.4	Applicability.....	6
2735.5	General Requirements.....	8
2735.6	CalARP Program Management System.....	10
2735.7	Emergency Information Access.....	11
<b>Article 2.</b>	<b>Registration</b> .....	11
2740.1	Registration.....	11
<b>Article 3.</b>	<b>Risk Management Plan Components and Submission Requirements</b> .....	13
2745.1	Submission.....	13
2745.2	RMP Review Process.....	15
2745.3	RMP Executive Summary Component.....	16
2745.4	RMP Offsite Consequence Analysis Component.....	17
2745.5	RMP Five-year Accident History Component.....	18
2745.6	RMP Program 2 Prevention Program Component.....	18
2745.7	RMP Program 3 Prevention Program Component.....	20
2745.8	RMP Emergency Response Program Component.....	21
2745.9	RMP Certification.....	22
2745.10	RMP Updates.....	22
2745.10.5	Required RMP Corrections.....	24
2745.11	Covered Process Modification.....	24
2745.12	Certificate of Occupancy.....	25
<b>Article 4.</b>	<b>Hazard Assessment</b> .....	25
2750.1	Hazard Assessment Applicability.....	25
2750.2	Offsite Consequence Analysis Parameters.....	26



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# Questions?



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