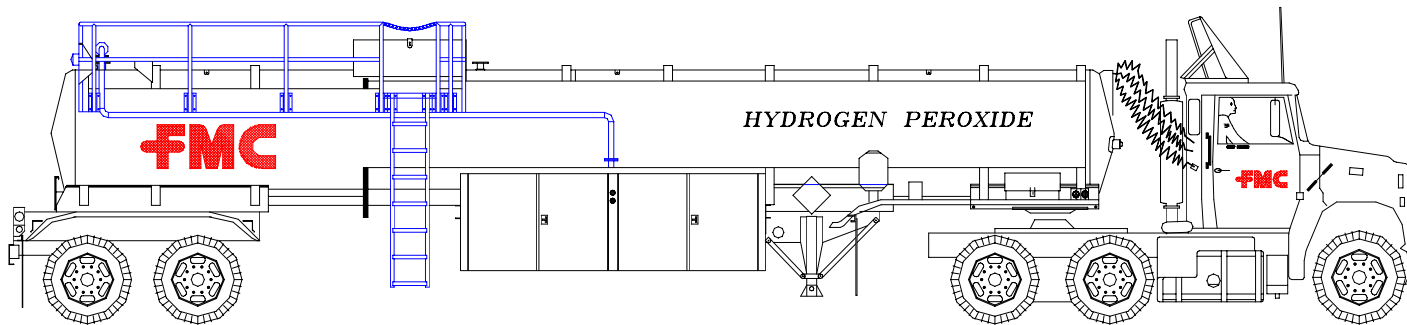


Safety and Handling of Hydrogen Peroxide

Safety Presentation



FMC and Responsible Care®

- **Active Member of the American Chemistry Council (ACC) and the Canadian Chemical Producers Association (CCPA)**
- **Committed to the principles of Responsible Care®. A voluntary industry program started in 1988.**
- **FMC implementing the Responsible Care Management System (RCMS) at all sites.**
- **RCMS oversees all Health, Safety, Security & Environmental Programs with FMC.**
- **Third party auditing of RCMS.**
- **Committed to constant improvement in Health, Safety, Security & Environmental performance every year.**

What is Hydrogen Peroxide?

- **Chemical formula H_2O_2**
- **Diversified industrial uses**
- **Water-like appearance and physical properties**
- **Oxidizer**
- **Chemically active**

How Is Hydrogen Peroxide Described?

- **Hydrogen Peroxide solution is described by concentration as percent by weight of H_2O_2 in water.**
- **Hydrogen Peroxide is shipped as 70%, 50%, 35%, or 31% but normally stored at 50% or less.**

FMC Hydrogen Peroxide Grades

Current Name	Main Uses	Specifications Source Dilution Water	Additives
Standard	Waste Treatment Non-food bleaching	FMC internal Approved tap water	Stannate + other < 1000 ppm residue @ 35%
Technical	Chemical synthesis	FMC internal DI water	Organic "tin free" < 500 ppm residue @ 35%
Super D	Hair bleach, topical uses Specialty laundry bleach Extra stabilizer for stability on dilution to 1-6%	U.S. Pharmacopeia for 3% solution DI water	Stannate + other < 3000 ppm residue @ 35%
SemiConductor	Routine semiconductor processing ACS reagent uses	SEMI specifications DI water	< 1ppm Sn < 20ppm residue

FMC Hydrogen Peroxide Grades

Current Name	Main Uses	Specifications Source Dilution Water	Additives
SEG	Critical semiconductor processing	< 10 ppb each metal DI water	None
RGS	Most critical semiconductor work	< 1 ppb each metal DI water	None
Durox	U.S. CFR approved food uses More stabilizer, suitable for use in bath type aseptic packaging	Food Chemical Codex DI water	Stannate + other < 60 ppm residue
Durox LR	U.S. CFR approved food uses Low residue for spray aseptic packaging use	Food Chemical Codex DI water	Stannate + other < 60 ppm residue
OxyPure	Potable water treatment	NSF approved Food Chemical Codex DI water	< 60 ppm residue

Sample Applications for H₂O₂

Pulp & Paper

- Bleaching of Chemical and Mechanical Pulps
- De-inking

Textiles

- Cottons (Stone-washed effect)
- Bleaching

Food Processing

- Bacterial Disinfecting Agent
- Fiber Bleaching

Electronics

- Circuit Board Cleaning & Etching

Environmental Applications

- WWTP Oxygen Source
- Reduced Sulfur, Cyanides, NO_x Treatment
- Organic Pollutant Treatment
- Bioremediation
- Heavy Metal Removal

Detergent Manufacture

- Perborates/Percarbonates/Peracids
- Liquid H₂O₂ Bleach

Chemical Manufacturing

- Organic and Inorganic Peroxides
- Epoxides/Oxides/Specialty Chemicals

Mining

- Leaching Enhancement for Gold and Silver Extraction

Cosmetic/Medical

- Bleaching of Hair
- Mouthwash (3%)
- Contact Lens Cleaner
- Disinfectant (3%)

Potable Water Treatment

The Four Rules of H₂O₂ Use and Handling

1. Never **CONTAMINATE**
2. Never **CONFINE**
3. Never **CONTACT**
4. Always Have **WATER** Available

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Types of Contamination

- **Heat & Energy**
- **Materials of Construction**
- **Externally Introduced Materials**

Chemical Reaction Caused by Contamination

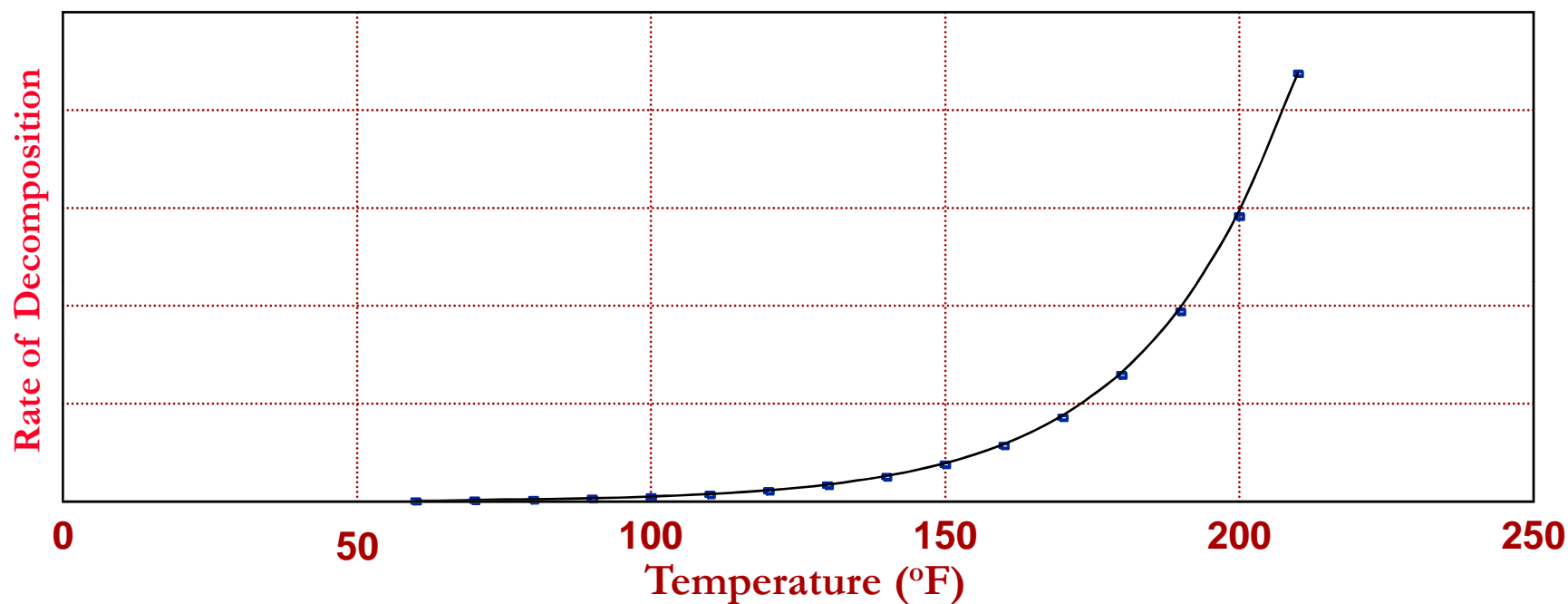
$\text{H}_2\text{O}_2 + \text{Contaminant}$
Yields

Oxygen + Water + Heat
If a Fuel is Present



FIRE

The Effect of Heat on H₂O₂



Temperature (°F)

72

151

218

Rate of Decomposition

1% per Year

1% per Week

2% per Day

Materials of Construction

Storage Tanks

- #5254 Aluminum (Passivated)
(Consult with FMC on Application)
- SS316L/SS304L (Passivated)
(Standard and Technical Grades only)
- Polyethylene (linear/Cross-Linked HD)
(Consult with FMC on Application)

Piping (Passivated)

- SS316, SS316L, SS304, SS304L
- 1060 Aluminum

Valves (Vented, Passivated)

- SS316, B356 Aluminum
- Virgin Teflon Seats and Seals

Pumps (Passivated)

- SS316, B356 Aluminum
- Mechanical Seals
Pure Ceramic, Silicon Carbide,
Teflon, SS316

Hoses (Passivated)

- SS316, SS304

Gaskets, Diaphragms, O-Rings

- Virgin Teflon, PP363 Vinyl,
Garlock Gylon, Viton A

Reasons for Passivation

- Removes surface impurities
- Provides a compatible metal oxide surface for Hydrogen Peroxide contact:
 - Ensuring stability and quality
 - Inhibiting corrosion

Partial List of Common Materials to Avoid

- Graphite
- Copper
- Magnesium Alloys
- Brass
- Chromium
- Lubricating Oil
- Bronze
- Iron/Steel
- Lead
- Nickel
- Monel
- Pipe Dope

Do Not Use These Materials: They will cause accelerated decomposition of Hydrogen Peroxide

Decomposition of H₂O₂ by Pure Metals

Low Decomposition

Aluminum
Tantalum
Zirconium

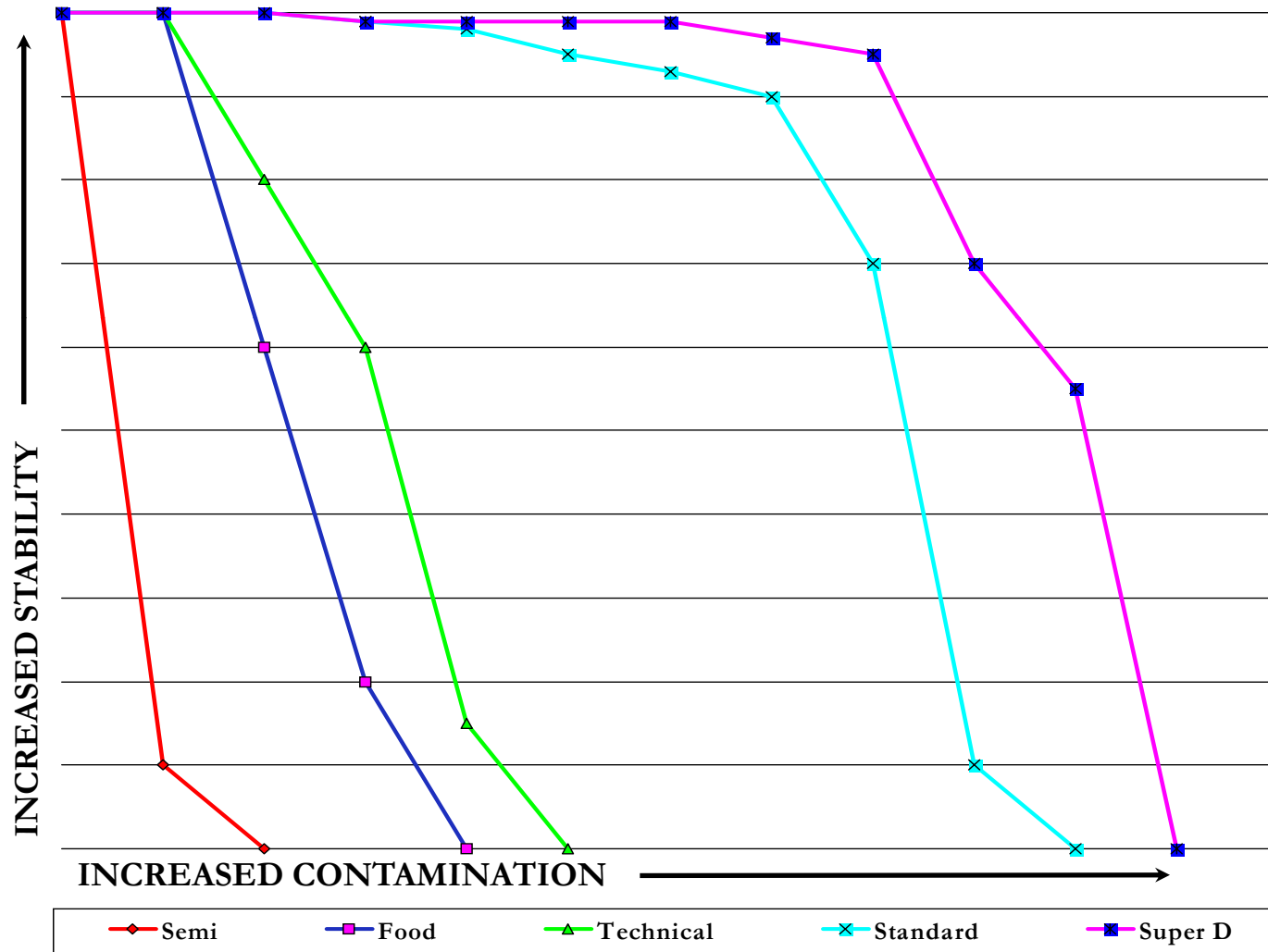
Moderate Decomposition

Silicon
Tin

High Decomposition

Beryllium
Cadmium
Chromium
Cobalt
Columbium
Copper
Gold
Iron
Lead
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Platinum
Silver
Sodium
Titanium
Tungsten
Zinc

Decomposition of H₂O₂ by Pure Metals



Externally Introduced Materials

- Wrong materials delivered into storage vessel
- H₂O₂ delivered into wrong tank
- Process backs up into H₂O₂ system
- Returning unused H₂O₂ into original container
- Dust, dirt, etc.

Indications of Hydrogen Peroxide Decomposition

- **Pressure build up**
 - Activation of pressure relief devices
- **H₂O₂ visually active**
 - Rapid bubbling
- **Temperature increase**
- **Gas or steam evolution**

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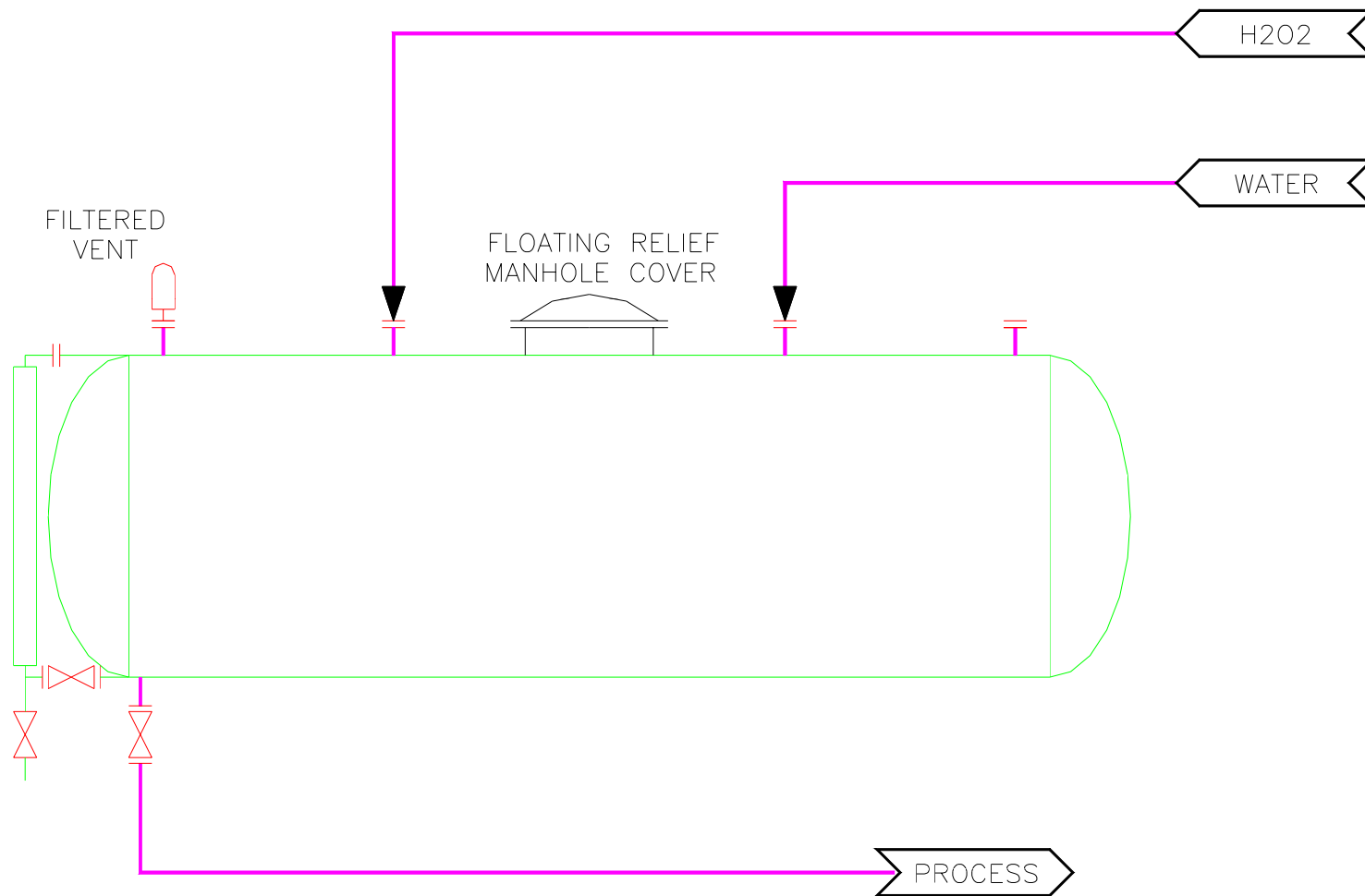
3. Never CONTACT

4. Always Have WATER Available

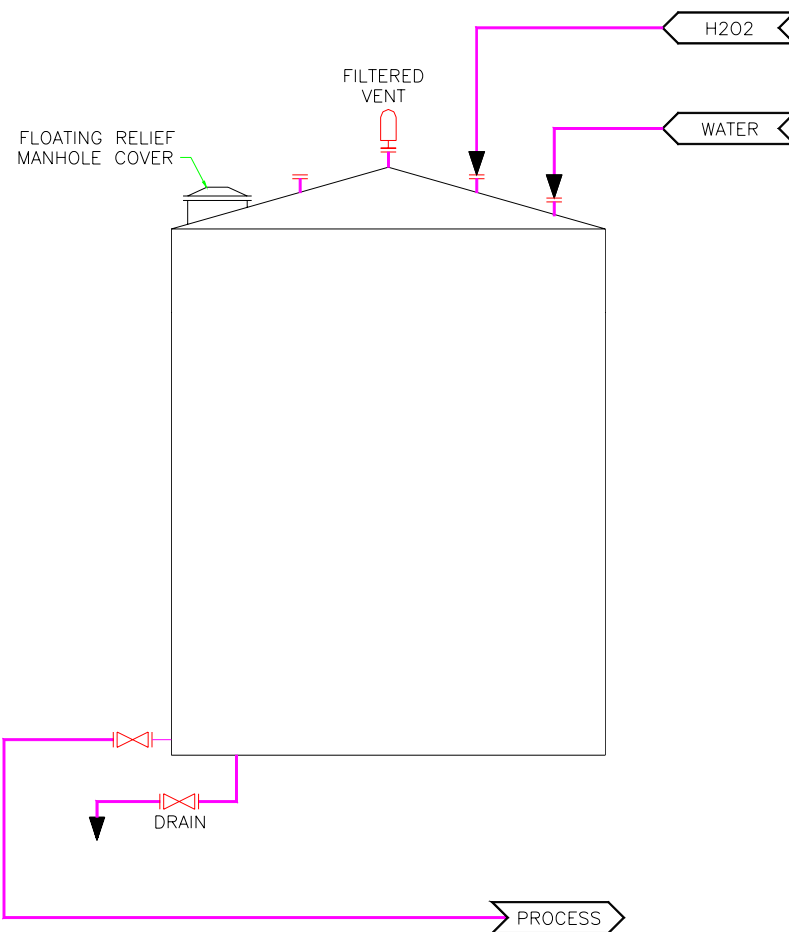
Reasons for Not Confining Hydrogen Peroxide

- **Hydrogen Peroxide always decomposes, only the rate varies.**
- **A volume ratio of 200:1 of Oxygen liberated to liquid decomposed is possible.**
- **Pressure build up will occur in a closed system.**
- **Excess pressure build up can result in tank or line rupture or failure.**

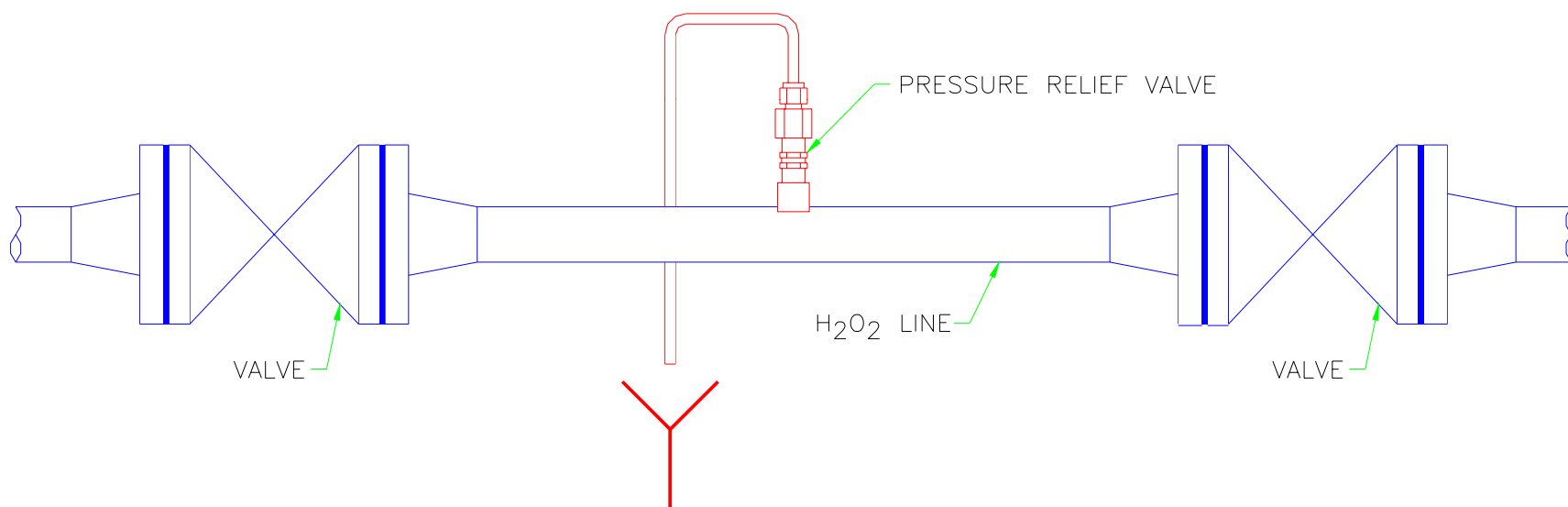
Horizontal Tank



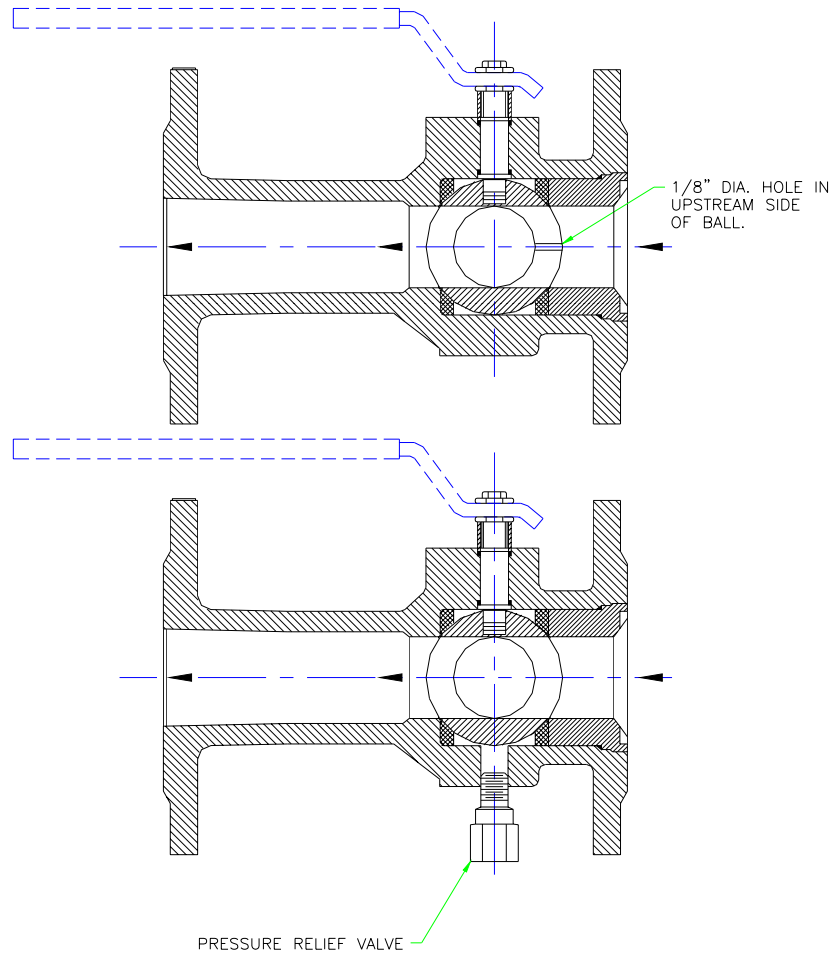
Vertical Tank



Pressure Relief in Pipe Between Closed Valves



Two Methods of Venting the Ball Cavity of a Valve



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Types of Contact

- **Personal Exposure**
- **Contact with Flammable or Combustible Materials**

Proper Personal Protection Equipment

Typical/Daily Work Around H₂O₂ Equipment

- **Chemical Safety Goggles**
- **Rubber Gloves**

Increased Exposure Due to Spillage, Maintenance or Sampling

- **All of the Above**
- **Neoprene or Vinyl Acid Suit**
- **Neoprene Boots**
- **Full Face Shield**

Hazards of Improper Protection

**Lack of Eye
Protection**

**Possible Ulceration of the
Cornea**

**Lack of Protective
Clothing**

Possible Burning of Skin

Cotton Clothing

Could Catch on Fire

Leather Footwear

Could Catch on Fire

Possible Health Hazards Caused By Exposure To Hydrogen Peroxide

- Eyes
 - May cause irreversible tissue damage, including blindness
- Skin
 - Causes whitening of the skin or, after prolonged exposure, redness and blistering
- Inhalation
 - May cause irritation and inflammation in the nose and throat
- Taken Internally
 - Swallowing may produce corrosion of the gastrointestinal tract that may be life-threatening

Refer to Material Safety Data Sheet for more Details

Chemical Reaction Caused by Contact with a Fuel

$\text{H}_2\text{O}_2 + \text{Fuel}$
Yields
Oxygen + Water +

FIRE



Fuel - Any Organic Combustible (ie. Wood, Leather Boots...)

The Four Rules of H₂O₂ Use and Handling

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Water Should Always Be Readily Available

Water Dilutes Hydrogen Peroxide

**A Dilute Solution is
Less Hazardous**

Emergency Response Equipment When Handling H₂O₂

- **Safety Showers**
- **Eyewash**
- **Water Hose**

First Aid

➤ Eyes

-- Immediately flush eyes with plenty of water for at least 15 minutes.

➤ Body

-- Flush skin with water. Remove and wash contaminated clothing and shoes promptly and thoroughly.

➤ Internal

-- If swallowed, drink water immediately to dilute. Do not cause vomiting. Call a Physician.

Fires Involving Hydrogen Peroxide

- **Hydrogen Peroxide is non-flammable**
- **Use water for extinguishing fire**
- **If fire is near storage vessel**
 - **Cool with external water spray**

Responding to Accelerated Decomposition

- **Keep area clear of all personnel**
- **Keep equipment cool with external water spray**
- **Flush equipment with water**

The Four Rules of H₂O₂ Use and Handling

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General Rules for Maintenance and Repair

- Wear proper protective equipment
- Relieve pressure on system (shut off H₂O₂ flow & isolate storage tank)
- Introduce and flush water through the piping system
- Lock out equipment
- Drain Water
- Rinse off all parts with Water (i.e. fittings, nuts, bolts, gaskets)
- Repair and clean component
- Cleanliness during repair is crucial
- Repassivate if necessary
- No incompatible material or equipment substitutions
- Check operation
- Restart

Four Ways to Maintain Safety & Quality

➤ Passivation

- Make sure all components of the Hydrogen Peroxide system are properly passivated

➤ Inspection

- Tanks and delivery system should be inspected once every two years

➤ Sampling

- Hydrogen Peroxide testing
- Water quality testing

➤ Maintenance

- Repair defects immediately
- Repassivate equipment if needed

General Overview

- **Protect against contamination**
- **Flush Hydrogen Peroxide spillage with water**
- **Never return Hydrogen Peroxide to its original container**
 - Dilute with plenty of water and discard abiding by proper regulations
- **Keep Hydrogen Peroxide storage vented at all times**
- **Use clean, passivated equipment only**
- **Keep combustibles away from Hydrogen Peroxide storage and handling areas**
- **Drain Hydrogen Peroxide equipment and flush with water before repair or disassembly**