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Hydrogen Peroxide Safety & Handling

Responsible Care®

- What are the principles of Responsible Care®?
- What is the Responsible Care Management System (RCMS)?
- Active member of the American Chemistry Council (ACC) and the Chemical Industry Association of Canada (CIAC)
- Applying Plan-Do-Check-Act
- Committed to constant improvement in:
  - Occupational Safety and Health
  - Process Safety
  - Environmental Protection
  - Security
  - Distribution Safety
  - Product Stewardship Performance

Hydrogen Peroxide – H_2O_2

- Diversified industrial uses
- Water-like appearance and physical properties
- Oxidizer
- Chemically active
- Shipped as 70%, 50%, 35%, or 31%

  but normally stored at 50% or less

Hydrogen Peroxide Grades

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Current Name	Main Uses	Specifications Source Dilution Water	Comments
Standard	• Waste treatment • Non-food bleaching	PeroxyChem internal Approved tap water	Stannate + other stabilizers Heavily stabilized
Technical	• Chemical synthesis	PeroxyChem internal DI water	Organic “tin free” stabilizer
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 stabilizers Heavily stabilized for shelf life
SemiConductor Grades	• Routine semiconductor processing • ACS reagent uses • Ultra high purity for critical semiconductor use	SEMI specifications DI water	Lightly stabilized Or non-stabilized

Hydrogen Peroxide Grades

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Current Name	Main Uses	Specifications Source Dilution Water	Comments
Durox® Durox LRA® and LRD®	• U.S. CFR approved food uses in bath, and low residue spray aseptic packaging use	Food Chemical Codex DI water	Stannate + other Stabilizers Stabilized for food and equipment sanitization
OxyPure®	• Potable water treatment	NSF approved Food Chemical Codex DI water	Lightly Stabilized
HTP	• Propulsion	N/A	Lightly Stabilized
OHP	• Environmental – Fenton's Chemistry	DI water	Stabilized for Environmental Applications

Sample Applications

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Pulp & Paper

- Bleaching of chemical and mechanical pulps
- De-inking

Textiles

- Cottons (Stone-washed effect)
- Bleaching

Food and Beverage

- Aseptic packaging
- Bacterial disinfecting agent
- High-fiber additives (bleaching)

Electronics

- Circuit board cleaning & etching

Environment

- Organic pollutant treatment
- Chlorine, sulfide and cyanide removal
- Bioremediation
- Potable water treatment

Cleaning and Sanitization

- Perborates/percarbonates/peracids
- Liquid H_2O_2 bleach
- Detergent manufacturing

Polymers and Chemical Synthesis

- Organic and inorganic peroxides
- Epoxides/oxides/specialty chemicals

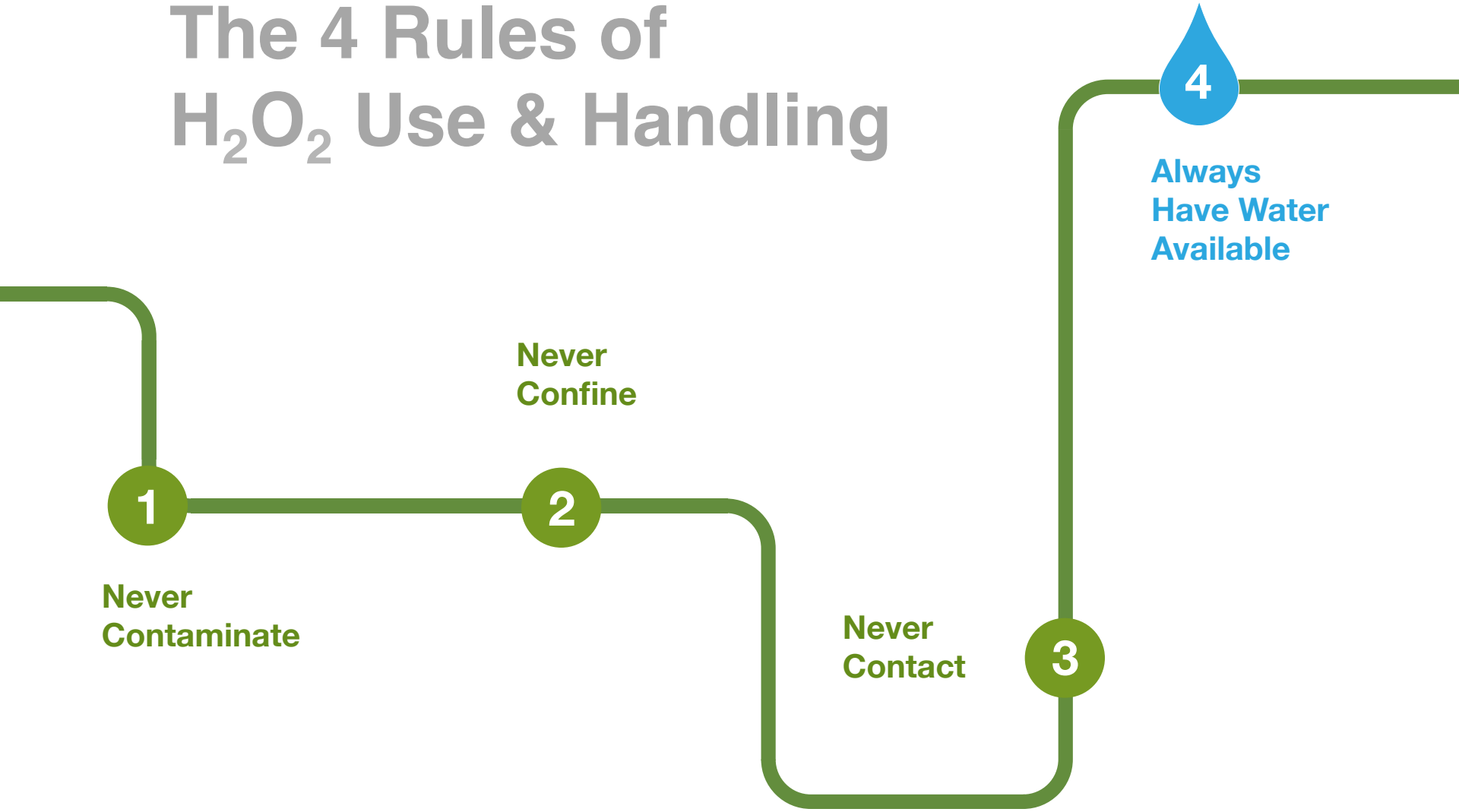
Natural Resources Extraction

- Leaching enhancement for gold and silver extraction
- Hydraulic fracturing biocide

Pharmaceutical and Cosmetic

- Mouthwash
- Contact lens cleaner
- Disinfectant

The 4 Rules of H_2O_2 Use & Handling



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Preventing contamination ensures safety and quality.

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Types of Contamination

- Heat & energy
- Materials of construction
- Externally introduced materials

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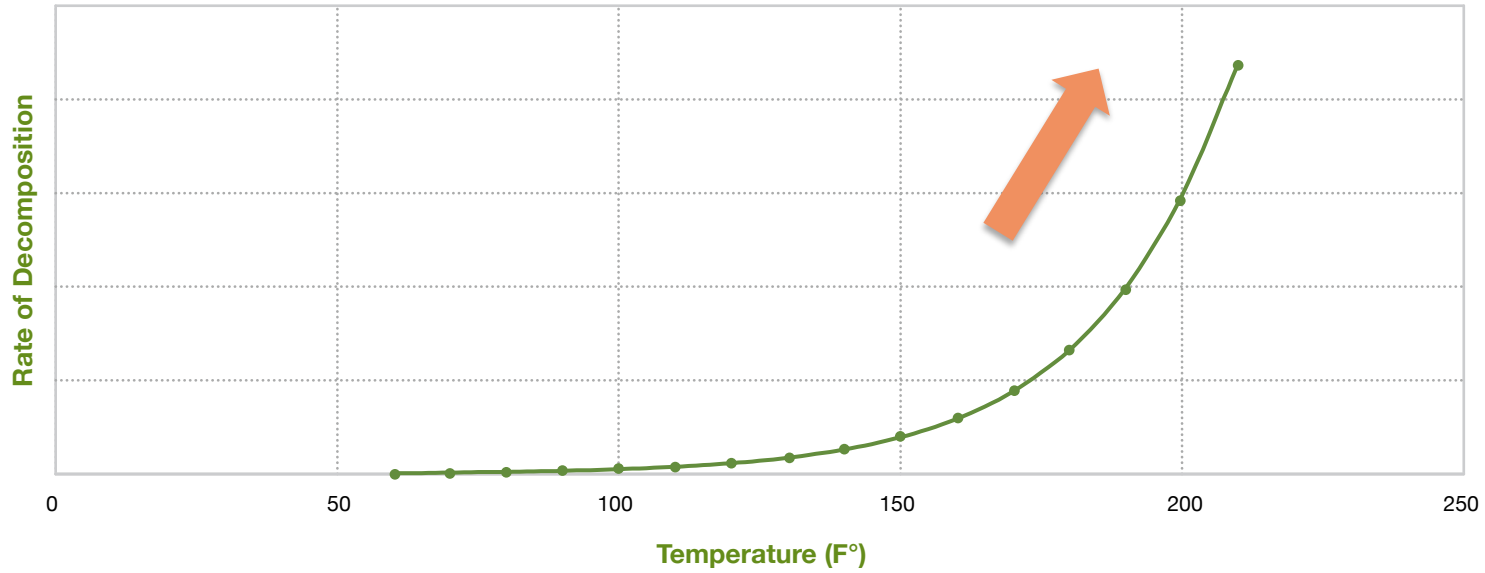
Chemical Reaction Caused by Contamination

With fuel present → **Fire**

The Effect of Heat on H_2O_2

The Effect of Temperature on the Rate of H_20_2 Decomposition



For every 10◦C rise in temperature the decomposition rate approximately doubles.

Temperature (F°)	Rate of Decomposition
72°	1% per Year
151°	1% per Week
218°	2% per Day

Materials of Construction

Storage Tanks	Piping	Valves	Pumps	Hoses	Gaskets, Diaphragms, O-Rings
#5254 Aluminum ***PASSIVATED*** *Consult with PeroxyChem on Application* SS316L/SS304L ***PASSIVATED*** *Standard and Technical Grades only* Polyethylene ***LINEAR/CROSS-LINKED HD*** *Consult with PeroxyChem on Application*	***PASSIVATED*** SS316, SS316L, SS304, SS304L 1060 Aluminum	***VENTED, PASSIVATED*** SS316, B356 Aluminum Virgin Teflon Seats and Seals	***PASSIVATED*** SS316, B356 Aluminum Mechanical Seals Pure Ceramic, Silicon Carbide, Teflon, SS316	***PASSIVATED*** SS316, SS304	Virgin Teflon, PP363 Vinyl, Garlock Gylon, Viton A

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Reasons for Passivation

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

Common Materials to Avoid

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

These will cause accelerated decomposition of H_2O_2

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How Materials are Introduced Externally

- **Wrong materials** delivered into storage vessel
- H_2O_2 delivered into **wrong tank**
- **Process backs up** into H_2O_2 system
- Returning **unused H_2O_2** into original container
- Dust, dirt, etc.

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Indications of Hydrogen Peroxide Decomposition

- Pressure buildup
  - **Activation of pressure relief devices**
- H_2O_2 visually active
  - **Rapid bubbling**
- Temperature increase
- Gas or steam evolution

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Pressure buildup can cause tank failure.

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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

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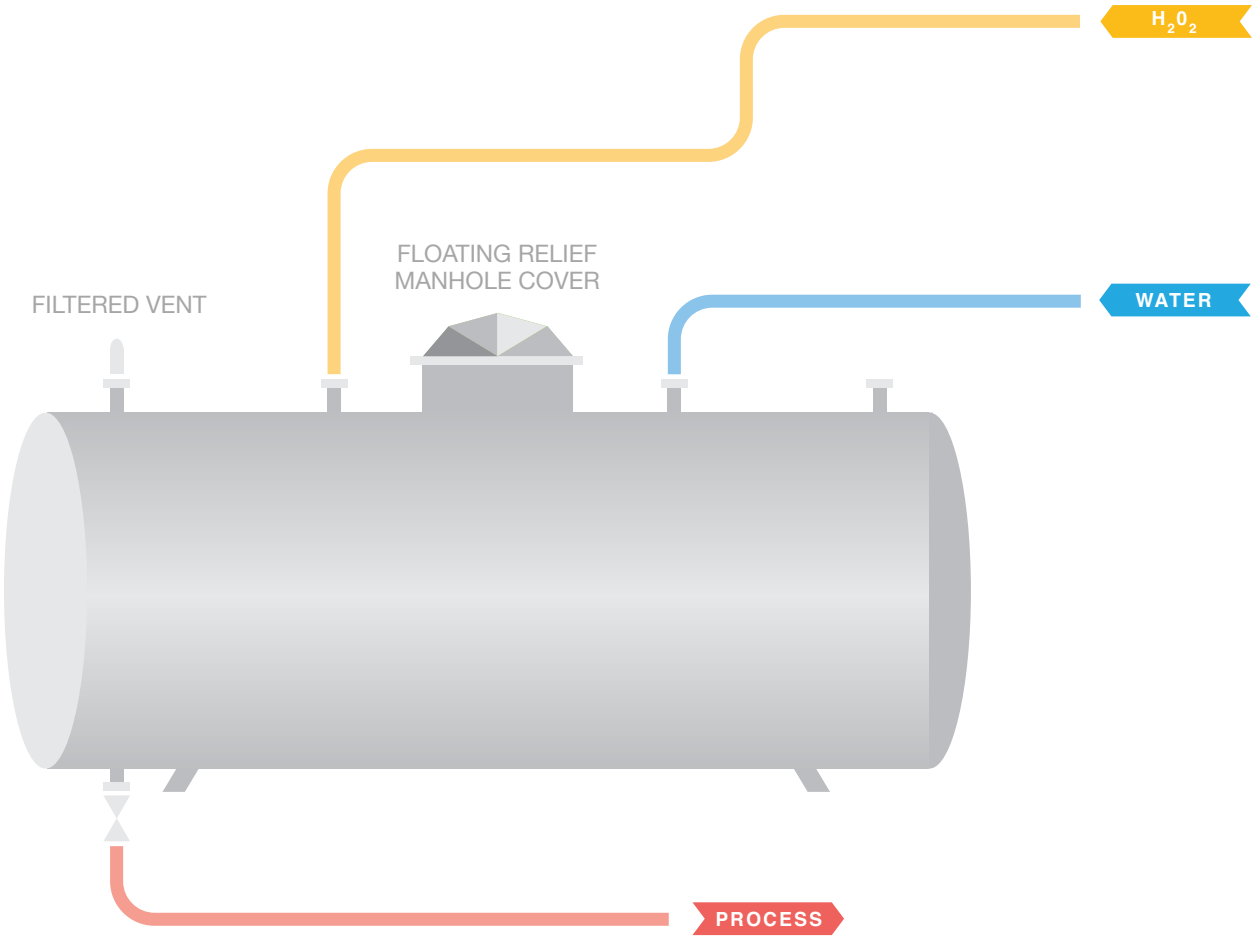
Horizontal Tank



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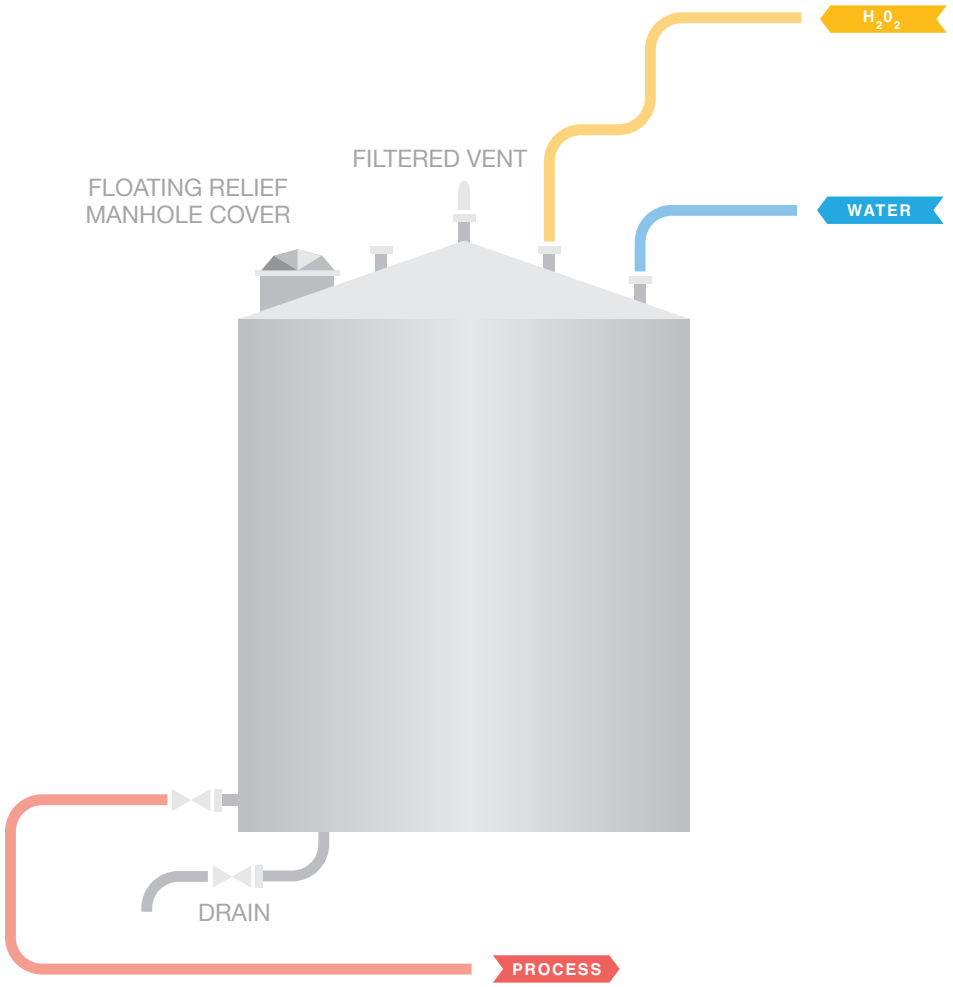
Vertical Tank



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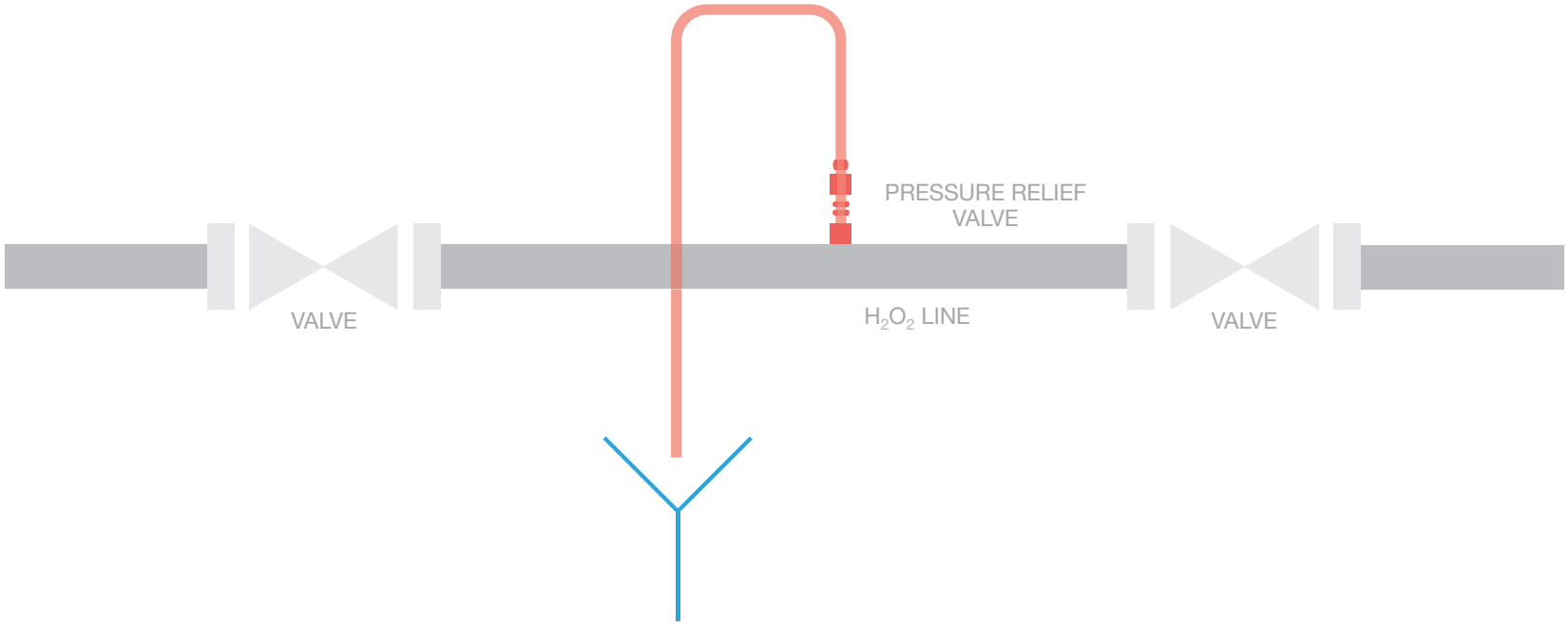
Pressure Relief in Pipe Between Closed Valves



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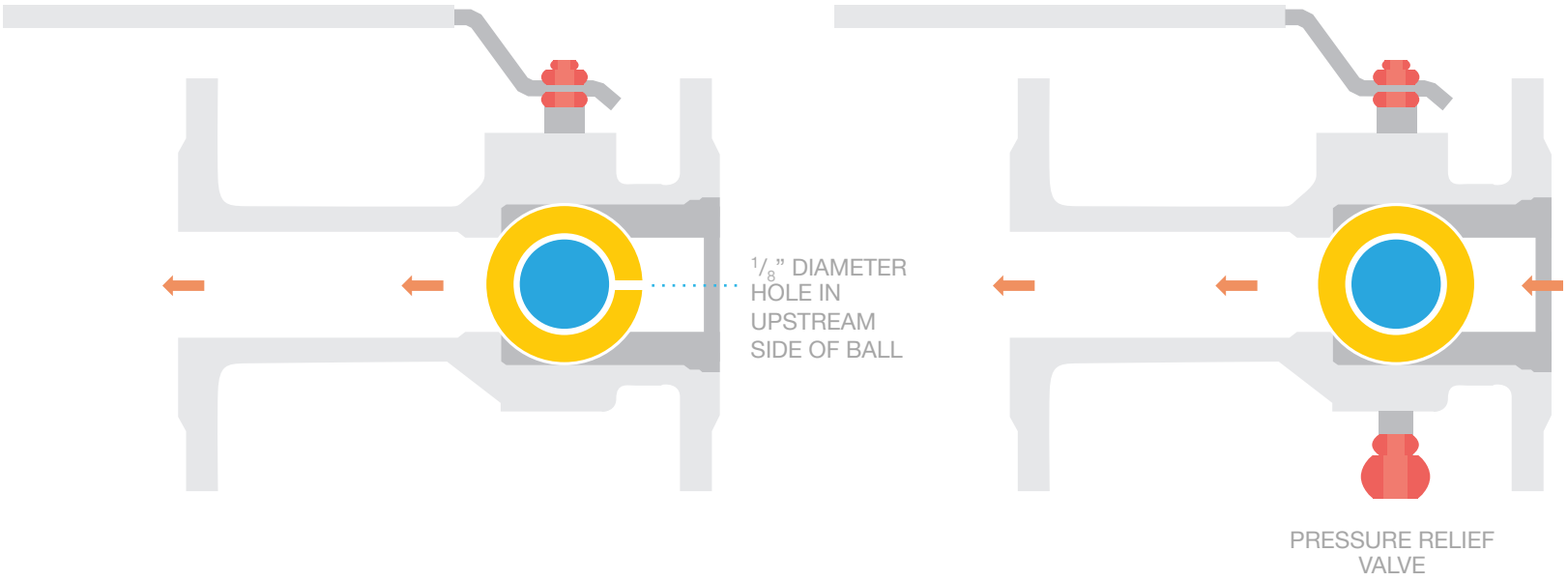
Two Methods of Venting the Ball Cavity of a Valve



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Serious injury is at stake.

Protect yourself.

Proper Protection

- Daily Work Around Equipment
  - **Chemical safety goggles**
  - **Rubber gloves**
- Increased Exposure Due to Spillage, Maintenance or Sampling
  - **Neoprene or vinyl acid suit (cotton clothing can catch fire)**
  - **Neoprene boots (leather footwear can catch fire)**
  - **Full face shield**
- Lack of proper eye protection or proper clothing could result in serious injury such as burning of the skin, tissue damage or throat inflammation

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Chemical Reaction Caused by Contact with a Fuel

Fuel can be any combustible material such as wood or leather boots

A diluted solution is less hazardous.

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Emergency Response Equipment When Handling H_2O_2

Always have water available to dilute H_2O_2

- Safety showers
- Eyewash
- 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.

Response

- H_2O_2 by itself is **non-flammable**
- Use **water** for extinguishing fires
- Keep area **clear** of all personnel
- If a fire is near a storage vessel or equipment cool with an **external** water spray
- Flush equipment with **water**

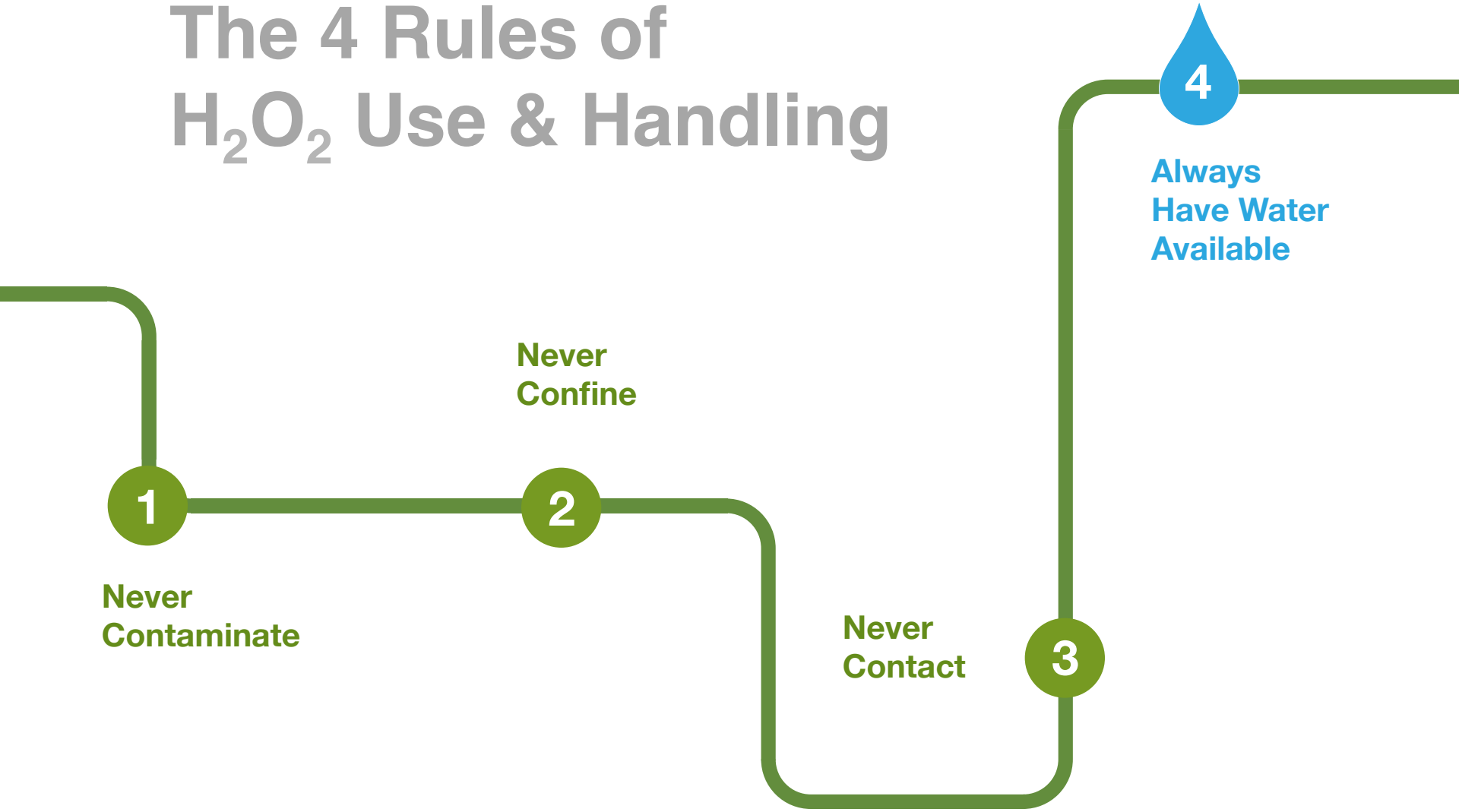
General Rules for Maintenance and Repair

- **Wear** proper protective equipment
- **Relieve** pressure on system (shut off H_2O_2 flow and isolate piping, equipment and storage tank)
- **Introduce** and **flush** compatible 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
- **Repassivate** if necessary
- **Avoid** incompatible material or equipment substitutions
- **Check** operation
- **Restart**

Maintain Safety and Quality

PASSIVATION	Passivate all components of Hydrogen Peroxide system
INSPECTION	Inspect tanks and delivery system once every two years
SAMPLING	Test Hydrogen Peroxide and water quality
MAINTENANCE	Repair defects immediately Repassivate equipment if needed

The 4 Rules of H_2O_2 Use & Handling



Our Vision

- PeroxyChem's vision is to be the leading global supplier of oxidation solutions to the electronics, environmental, food safety and other industrial and consumer markets, built on its peroxygen chemistries and adjacent technologies

- This vision is supported by our core values of safety, people, innovation, customer focus and growth.
  - **People:** Increase accountability and personal initiative. Challenge the status quo to improve efficiency and productivity.
  - **Safety:** Maintain our historic track record. Prioritize a fierce dedication to safe practices.
  - **Innovation:** Innovate in everything we do.
  - **Customer focus:** Nurture customer relationships with our expertise and provide innovative ways to meet customer needs.
  - **Growth:** Focus on market orientation and continue to serve markets around the world.

Questions