



# H2O2 Handling Safety Overview

Month, 2015

- Hydrogen Peroxide is used in a variety of industries from medical, to paper processing, to propulsion systems.
- Peroxide is specified as the percentage of pure hydrogen peroxide to the amount of water in the solution.
  - 90% Peroxide is composed of 90% H<sub>2</sub>O<sub>2</sub> and 10% H<sub>2</sub>O.
- Typical grades for propulsion applications range from about 80 to 99% peroxide.
  - These grades are commonly referred to as High Test Peroxide (HTP).
- At concentrations above 67% peroxide, the decomposition of peroxide produces enough energy to vaporize the water along with the peroxide.
- The rate of decomposition is a function of pressure.

# Typical PPE for HTP

- The three main hazards from handling peroxide are
  - 1) Ignition of clothing
  - 2) Chemical Burns on skin, eyes, etc.
  - 3) Injury resulting from rupture of Pressure Vessel of storage container.
- To mitigate against these hazards the following PPE is recommended:
  - Eye goggles
  - Face Shield
  - Fully Body suit of Neoprene or other suitable rubber (Can be overalls and coat with hood, just mitigating spill hazard).
  - Rubber boots
  - Rubber gloves
- Covered in additional detail in Section 6.4 of AFRPL-TR-67-144

- The rate of decomposition of Peroxide is a function of pressure.
- When handling peroxide it should only be transferred in, vented, unpressurized containers.
- Storage containers must be vented at all times.
  - Pressure will slowly build, raising the reaction rate, which can lead to a run away reaction that will destroy the storage container if it is not vented.
- For testing requiring the pressurization of hydrogen peroxide, the pressurization should always be done remotely with personnel protected in the event of a pressure vessel failure.
- In the event of a sudden build up of pressure in a hydrogen peroxide container, the container should be dumped and the peroxide neutralized with water.

- Hydrogen Peroxide storability (and more generally, compatibility) is based off of the rate of decomposition when in contact with a given material.
- Hydrogen Peroxide Material compatibility is generally ranked through a class structure.
  - Class 1: Materials Satisfactory for Unrestricted use with H2O2
  - Class 2: Materials Satisfactory for Repeated Short-Time Contact with H2O2. Maximum of 4 hours at 160 F or 1 Week at 70 F.
  - Class 3: Materials Satisfactory for Short-Term Contact Only, Less than 1 minute at 160 F and 1 hour at 70 F for unpressurized systems. Single use only.
  - Class 4: Not recommended for use with H2O2.

# Class System limitations

- The class system is only used to provide a relative guide, and is not a perfect system.
- The class of a given material is a function of concentration and temperature.
  - For example Material A may be a Class 2 material with 90% peroxide, but a Class 3 material with 98% peroxide at 70 F.
  - There are several materials that are Class 2 at 70 F and Class 4 at 160 F.
- Surface finish and surface treatment has a large impact on compatibility.
- Most Metals need to be passivated prior to service with HTP.

# Aluminum @ 70 F

Material	90% H2O2	98% H2O2	Notes
Aluminum 355	Class 2	Class 3	
Aluminum B356	Class 1	Class 1	
Aluminum 1060	Class 1	Class 1	
Aluminum 1160	Class 1	Class 1	
Aluminum 1260	Class 1	Class 1	
Aluminum 2014	Class 4	Class 4	
Aluminum 2017	Class 4	Class 4	
Aluminum 2024	Class 3	Class 4	
Aluminum 5254	Class 1	Class 1	
Aluminum 5652	Class 1	Class 1	
Aluminum 6061	Class 2	Class 2	
Aluminum 7072	Class 1	Class 1	
Aluminum 7075	Class 4	Class 4	

Source: AFRPL-TR-67-144

# Stainless Steel @ 70 F

Material	90% H2O2	98% H2O2	Notes
301	Class 2 / 3	Class 2 / 3	Depends on surface treatment
302	Class 2 / 3	Class 2 / 3	Depends on surface treatment
304	Class 2	Class 2	
316	Class 2	Class 2	
329	Class 3 / 4	Class 3 / 4	Depends on surface treatment
347	Class 2	Class 2	
443	Class 4	Class 4	
446	Class 4	Class 4	

Source: AFRPL-TR-67-144

# Inconel 718

Material	90% H2O2	98% H2O2	Temperature	Notes
718	Class 2	Class 2	70 F	Surface Finish must be better than 10 rms
718	Class 4	Class 4	151 F	

Source: AFRPL-TR-67-144

- Note: Surface finish and operating temperature is extremely important when using Inconel 718 with HTP.

# Elastomers and Seal Materials @ 70 F

Material	90% H2O2	98% H2O2	Notes
Buna N	Class 4	Class 4	
Butyl Rubber	Class 4	Class 4	
Delrin	Class 4	Class 4	
Kel-F	Class 1 to 3	Class 1 to 3	Depends on actual grade
Polyethylene	Class 2 to 4	Class 2 to 4	Depends on actual grade / Vendor
Silicon	Class 2 to 4	Class 2 to 4	Depends on actual grade / Vendor
Teflon (Virgin)	Class 1	Class 1	
Viton A	Class 2 to 4	Class 2 to 4	Depends on actual grade / Vendor
Viton B (805)	Class 1	Unknown	From Dupont, 1967 Vintage

Source: AFRPL-TR-67-144

# Metals to avoid

Material	90% H2O2
Beryllium	Class 4
Cadmium	Class 4
Chromium	Class 4
Cobalt	Class 4
Columbium	Class 4
Copper	Class 4
Gold	Class 4
Iron	Class 4
Lead	Class 4
Magnesium	Class 4

Material	90% H2O2
Manganese	Class 4
Mercury	Class 4
Molybdenum	Class 4
Nickel	Class 4
Platinum	Class 4
Silver	Class 4
Sodium	Class 4
Titanium	Class 4
Tungsten	Class 4
Zinc	Class 4

Source: AFRPL-TR-67-144