NATIONAL PARK SERVICE
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Conserve O Gram

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Safe Storage And Handling Of Natural History Specimens Preserved In Fluid

Most fluid-preserved natural history specimens are stored in alcohol or formaldehyde (see Table 1 for a list of commonly used preservatives and their names). The most widely used preservative is ethyl alcohol, mixed with water in a concentration of 70%. The federal government closely regulates the sale and use of ethyl alcohol. A permit must be obtained from the Bureau of Alcohol, Tobacco, and Firearms National Revenue Center to purchase tax-free ethyl alcohol. The second most commonly used preservative is isopropyl alcohol, in concentrations of 45-70%. Isopropyl alcohol may be purchased without a permit.

Denatured Alcohol and Alcohol Additives

Ethyl alcohol that has been denatured may be purchased without a permit. Alcohol is denatured by the addition of other chemicals to make it unsuitable for human consumption. Common denaturants include methyl alcohol and aviation fuel. Because of the addition of the denaturants, denatured alcohol is undesirable as a preservative. Other substances may have been added to alcohol solutions in an attempt to enhance their utility as preservatives. The most common additives are glycerin, acetic acid, and formaldehyde.

Formaldehyde

Formaldehyde is widely used as a fixative to prepare specimens, but is not commonly used as a storage fluid. Formaldehyde is sold as a solution of 37% formaldehyde gas in water, with a small amount of methyl alcohol added. The word *formalin* refers to a mixture of this solution with water. The term "10% formalin" refers to a solution of one part formalin and nine parts water, which results in a solution that is actually 3.7% formaldehyde in water. Formaldehyde is a widely used and closely regulated chemical. Improper use may cause serious human health problems. See *Conserve O Gram* 11/1 for detailed instructions for transferring specimens from formalin to other preservatives.

Other Preservative Fluids

Although not very common in collections, many other preservatives may be used, particularly for histological and anatomical preparations. Sometimes these solutions include caustic or acidic chemicals. If you do not know what a particular preservative solution is, treat it as you would a hazardous chemical. Refer to *Conserve O Gram* 2/1 and *Conserve O Gram* 2/10 for information on handling hazardous chemicals.

Safety

There are two main issues with the safety of fluid-preserved collections. The first is to ensure that the collection is stored and handled in ways that are safe both for the specimens and for the collections care workers. The second consideration is compliance with fire codes and hazardous chemical regulations.

Safe storage of preserving fluids begins with using containers that provide adequate seals and keeping the containers on appropriate shelving. See *Conserve O Gram* 11/14 for information on storage containers, tags, and labels and *Conserve O Gram* 11/13 for information on collections storage concerns.

The collections storage area must be adequately ventilated. Alcohol and formaldehyde are absorbed through the skin and the mucous membranes of the body, particularly through the lungs. Work areas should have bench-top fume collectors positioned so that fumes are drawn directly from the mouths of containers or from trays of specimens. Open containers of fluid-

preserved specimens only in a well-ventilated area.

A small amount of evaporation of preservative occurs constantly in a fluid collection, either by gas escaping from containers due to changes in temperature and air pressure, or when containers are opened to access specimens. Work areas and storage areas must have sufficient airflow to prevent the accumulation of preservative fumes. Because alcohol is heavier than air, alcohol fumes accumulate at floor level. Keep equipment that produces sparks, flames, or heat out of collections storage areas.

Class A-B-C fire extinguishers should be available in both work and storage areas.

Fire Code and Safety Regulations

When the vapors from flammable or combustible liquids mix with air and come into contact with an ignition source, they can ignite. Fire prevention is directed towards reducing the escape of vapors, diluting the vapors to a safe level, and eliminating ignition sources such as sparks, static electricity, hot surfaces, or flame. A strict no-smoking policy must be enforced in the collections storage and work areas.

The use of fluid preservatives in natural history collections is not addressed directly in the Uniform Fire Code or the Uniform Fire Code Standards. The fire code addresses the storage of bulk containers of full-strength (95%) alcohol and the storage of retail liquor (usually 5-15% alcohol). The containers and concentrations of fluid preservative used in collections do not fit either of these categories, so it is necessary to work out an acceptable fire prevention and safety plan with the appropriate local officials. Discuss fire and safety issues with local officials so that they understand that fluid preservatives are diluted for museum use and kept in small, well-sealed containers.

Fluid preservatives may be divided into three classes (I, II, and III) and three groups (A, B, and C) based on their *flash point* and boiling point. The *flash point* is the lowest temperature at which a liquid releases enough vapors to start burning if ignited. Alcohols are *flammable liquids*; formaldehyde is a *combustible liquid*. A flammable liquid is defined as one that has a flash point below 100°F (37.8°C). A *combustible* liquid has a flash point above 100°F (37.8°C). Preservative strength ethyl alcohol (70%) is a Class IB flammable liquid. Preservative strength isopropyl alcohol (40-55%) is a Class IC flammable liquid. The flash points and standard preservative strengths for these fluids are indicated in Table 1.

Fire code interpretations for fluid-preserved collections may include:

- limiting shelving to no more than seven feet above the floor
- requiring explosion-proof fixtures and switches
- requiring both heat and smoke detectors.

Sprinkler system requirements usually call for sprinklers in collection storage areas to have an output of 0.30 gpm/ft^2 (gallons per minute per square foot) over the entire floor area, and 0.21 gpm/ft^2 in laboratory areas. Ventilation requirements are designed to prevent the accumulation of vapors. This usually means an airflow of 1 $ft^3/m/ft^2$ (cubic feet per minute per square foot) for collection storage areas and laboratory ventilation of 5 $ft^3/m/ft^2$. There may be restrictions on the amount of preservative stored per room; the storage area may require a reduced temperature (65-70°F is preferred); and access to the storage area may be strictly controlled.

Flammable and combustible liquids cannot be stored in basements. The Uniform Fire Code limits storage volumes of Class IB fluids to 15,000 gallons on the ground floor of a building and 12,000 gallons per floor on upper floors. Shelving must have a lip or guard to prevent individual containers from falling. The Uniform Fire Code contains specific requirements for both metal and wooden shelving systems.

When dispensing flammable or combustible liquids from a storage drum, the pump must be grounded to eliminate static electricity and sparking. Connect the supplying container to the

receiving container with a *bonding wire*. Connect a *grounding wire* between the pump and a grounded structure such as a grounded water pipe or metal framework. A bonding wire or grounding wire is a length of electrical wire with a metal clip on each end for easy attachment to an object or structure. Metal and plastic supply containers, drums, and pumps must be grounded.

All storage and laboratory areas should be equipped with a spill kit for safe, efficient clean up of preservative spills. A spill kit is a five-gallon high-density polyethylene (HDPE) bucket with a lid. The contents should include absorbent pads, a small spill boom or dike, neoprene gloves, safety glasses, and plastic bags. Clean up preservative spills immediately with the absorbent pads and boom. Enclose the used pads and boom in a plastic bag for disposal.

Laboratory areas should be equipped with eye wash stations and an emergency shower. When working with fluid-preserved specimens or preservative fluids, wear safety glasses and neoprene gloves, which are rated for formaldehyde exposure.

References

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Spill Kit Supplies

Fisher Scientific
PO Box 14989
St. Louis, Missouri 63178-4989
(800) 325-4075
www.fisherscientific.com

Lab Safety Supply, Inc.
PO Box 1368
Janesville, WI 53547-1368
(800) 356-0783
Technical Support (800) 356-2501
www.labsafety.com

Ethyl Alcohol Permits
Bureau of Alcohol, Tobacco, and Firearms
National Revenue Center
550 Main Street
Cincinnati, Ohio
(800) 398-2282
www.atf.treas.gov/alcohol/info/cinoffice.htm

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Table 1. Commonly used preservatives

Name	**Chemical formula**	**Flash point**	**Vapor density** (air = 1.0)	**Standard preservative strength**
Ethyl alcohol, ethanol, grain alcohol, ETOH	CH_3CH_2OH	70°F in 70% solution	1.59	70%
Isopropyl alcohol, isopropanol, rubbing alcohol	$CH_3CHOHCH_3$	74°F in 55% solution	2.07	40-55%
Formaldehyde, formalin	HCHO	130°F in 37% solution	1.00	3.7%

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