1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Peroxide Forming Chemicals (PFCs).

For a list PFCs covered by this SOP and their use(s), see the “List of Chemicals”. Procedures described in Section 12 apply to all materials covered in this SOP. A change to the “List of Chemicals” does not constitute a change in the SOP requiring review or retraining.

If you have questions concerning the applicability of any recommendation or requirement listed in this procedure, contact the Principal Investigator/Laboratory Supervisor or the campus Chemical Hygiene Officer at ucbcho@berkeley.edu

2. Physical & Chemical Properties / Definition of Chemical Group

Peroxide forming chemicals are usually flammable, and all may form explosive peroxides.
A wide variety of organic compounds spontaneously form peroxides by a free radical reaction of the hydrocarbon with molecular oxygen. Under normal storage conditions, formed peroxides can accumulate in the chemical container and may explode when subjected to heat, light, friction or mechanical shock.

Organic functional groups likely to form peroxides include:

- Ethers and acetals
- Alkenes and allylic hydrogen
- Chloroalkenes and fluoroalkenes
- Vinyl halides, esters, ethers
- Dienes
- Vinylalkynes with α hydrogen
- Alkylalkynes with α hydrogen
- Alkylarenes with tertiary α hydrogen
- Alkanes and cycloalkanes with tertiary hydrogen
- Acrylates and methacrylates
- Secondary alcohols
- Ketones with α hydrogen
- Aldehydes
- Ureas, amides, and lactams with α hydrogen on a carbon attached to nitrogen

3. Potential Hazards/Toxicity

PFCs are chemicals that when exposed to air may produce unstable and dangerous hydroperoxide and peroxides products over time.

PFCs may also have other hazardous properties including toxicity. Safe use requires assessing all potential hazards.

It is the Principal Investigator’s responsibility to ensure activity-specific laboratory procedures and/or processes are taken into account when using this Chemical Class SOP.

Please, review the SDS of any chemical before use (see Section 11 – SDS Location).

4. Engineering Controls

Lab-specific information on engineering controls may be included in the Protocol/Procedure section. The following is the set of engineering controls required when handling PFCs:

- Work with PFC – the work must be conducted in a fume hood unless other controls are designated in the lab-specific Protocol/Procedure section. Sash height must be kept as low as possible to avoid escaping fumes and provide a physical barrier.
- Laboratories and rooms where PFCs are used must have general room ventilation that is negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

5 Personal Protective Equipment

At a minimum, the following PPE must be worn at all times.
Eye and Face Protection

A. ANSI Z87.1-compliant safety glasses with side shields, or chemical splash goggles.
   - Ordinary prescription glasses will NOT provide adequate protection unless they also meet ANSI standard and have compliant side shields.

B. If the potential for explosion/splashing exists, and adequate coverage is not provided by the hood sash, a face shield must be worn.

Skin and Body Protection

1. Gloves are required when handling hazardous chemicals.
   - Refer to specific chemical SDS for information on glove selection.
   - For additional information on glove selection, go to: http://ehs.berkeley.edu/hs/63-laboratory-safety/94-glove-selection-and-usage.html

2. Lab coats are required when handling hazardous chemicals in the lab. Select the type of lab coat according to the hazards at the specific workplace.

3. Long pants, closed-toe/closed-heel shoes, covered legs, and ankles.

Respiratory Protection

Respiratory protection is normally not required for UC Berkeley laboratory activities. Any lab personnel considering the use of a respirator (e.g. N-95 respirator, dust mask) must contact EH&S for a workplace assessment.

6. First Aid Procedures and Medical Emergencies

In the event of an injury, notify your supervisor immediately and EH&S within 8 hours.

Go to the Occupational Health Facility (Tang Health Center, on campus); if after hours, go to the nearest emergency room (Alta Bates, 2450 Ashby Ave in Berkeley); or

Call 911 (from a cell phone: 510-642-3333) if:
   - it is a life threatening emergency; or
   - you not are confident in your ability to fully assess the conditions of the environment and/or the condition of the contaminated/injured person, or you cannot be assured of your own safety; or
   - the contaminated/injured person is not breathing or is unconscious.

Please remember to provide a copy of the appropriate manufacturer SDS (if available) to the emergency responders or physician. At a minimum, be ready to provide the identity/name of any hazardous materials involved.

In case of skin contact

If skin contact occurs, and/or skin or clothing are on fire, immediately drench in the safety shower with copious amounts of water for no less than 15 minutes to remove any remaining contaminants. If possible to do so without further injury, remove any remaining jewelry or clothing.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible.
If swallowed
Do NOT induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water.

If inhaled
Move into fresh air.

Needle stick/puncture exposure
Wash the affected area with antiseptic soap and warm water for 15 minutes.

7. Special Handling, Storage, Testing and Disposal Requirements
Lab-specific information on handling and storage may be included in Section 12-Protocol/Procedure.

Precautions for Safe Handling:

- Label each container with the Date Received, Date Opened and Date Last Tested.
- Test chemicals for peroxide before any distillation or purification of PFCs.
- Do not allow to evaporate to near dryness unless absence of peroxides has been shown. When possible, add a non-volatile organic compound (such as mineral oil) to dilute any peroxides remaining after distillation.
- Use extreme caution before concentrating or purifying PFCs as most explosions occur during these processes.
- PFCs must be stored in their original manufacturer’s container whenever possible. This is very important in the case of diethyl ether because the iron in the steel shipping containers acts as a peroxide inhibitor. PFCs must be stored in sealed, air-impermeable containers and must be kept away from light (light can initiate peroxide formation). Dark amber glass with a tight fitting cap is appropriate.
- Keep away from sources of ignition – Open flames (e.g., Bunsen burner). In particular, take measures to prevent the build-up of heat or electrostatic charge.
- Eliminate or substitute for a less hazardous material when possible.
- Design your experiment to use the least amount of material possible to achieve the desired result.
- Do not exceed the scale of procedures specified in Protocol/Procedure section without approval of the PI.
- Verify your experimental set-up and procedure prior to use.
- Know the location of the nearest eyewash, safety shower and fire extinguisher before beginning work.
- Upon leaving the work area, remove any personal protective equipment worn and wash hands.
- At the end of each project, thoroughly decontaminate the work area according to the material being handled.

Conditions for Safe Storage and Shelf Life

- Peroxides tend to form in materials slowly over several months to years. Therefore, it is imperative that researchers are aware of the age of their PFCs.
- PFCs must be stored in their original manufacturer’s container whenever possible. Minimize peroxide formation in ethers and other PFC by storing in tightly sealed containers in a cool place in the absence of light.
- Some PFCs must be kept under inert atmosphere, but others that contain inhibitors require oxygen to function. Refer to manufacturer’s recommendation for proper storage of those materials.

- Each container of a PFC, upon arrival in the laboratory, must be dated. It must also be dated when opened for the first time. Special labels, provided by EH&S and attached to the container, are used to record these dates, as shown below. Additionally, dates of testing must be added to the label.

![Peroxide Forming Chemicals](image)

Visual Inspection
Visually inspect all PFCs before any operation.

**For liquids:** Evidence of possible peroxide formation in liquids includes:
- Solids or crystals are observed in either the liquid
- Solids or crystals are observed around the cap of PFCs
- Visible discoloration
- Liquid stratification

Diethyl ether is commonly sold in steel containers which prevents visual inspection of the liquid. Therefore, diethyl ether containers whose age and use history are unknown must be assumed to contain dangerous levels of peroxides and must not be disturbed.

**For solids:** Evidence of possible peroxide formation in solids (potassium metal, potassium amide, and sodium amide) includes:
- Formation of a surface crust (for example, potassium metal forms a yellow or orange superoxide at the surface)
- Discoloration of the solid

Evaluation of alkali metals and their amides is based on visual criteria only. These substances react strongly with water, and the SOP for handling water reactive materials (WR) must be followed for these chemicals, as well as the precautions described in this SOP.

Only chemicals that pass visual inspection must be tested.

**Testing for Peroxides**
- Researchers must never test containers of unknown age or origin. Older containers are far more

Rev. Date: 2021-06-29
likely to have concentrated peroxides or peroxide crystallization in the cap threads and therefore can present a serious hazard when opened for testing.

- Never try to force open a rusted or stuck cap on a container of a PFC.
- All PFCs which are to be distilled must be tested prior to distillation regardless of age.

The most convenient test method is the use of peroxide test strips manufactured by Aldrich and several other suppliers; they may be obtained from EH&S. Strips that offer a 1-100 ppm peroxide range are useful for determining if the material is below the control point of 100 PPM. Other testing methods are available. Contact EH&S at 642-3073 for more information.

Disposal

- A PFC must be disposed of by the end of the expiration date, or tested for peroxide content.
- Assume that containers that exhibit any unusual visual characteristics contain dangerous levels of peroxides and do not disturb the container. Notify EH&S, who will assist in the further evaluation. If there is any doubt about the safety of handling a chemical container, notify EH&S immediately.
- Any container found to have a peroxide concentration greater than or equal to 100 ppm must be dispose of. Contact EH&S at 642-3073 for assistance.
- Materials which are older than the suggested shelf life but have been tested and have peroxide concentrations less than 100 ppm may be retained but must be tested at regular intervals (see manufacturer’s recommendation for proper testing and disposal).
- Waste materials generated must be treated as a hazardous waste.
- The empty container must be rinsed three times with a COMPATIBLE solvent; leave it open in the back of the hood overnight. Solvent rinses and water rinse must be disposed of as hazardous waste.
- As an alternative, un Girişed empty containers can be disposed of through EH&S as hazardous waste. The un Girişed empty containers must be capped.
- Do not mix with incompatible waste streams.
- Decontamination of containers in order to use them for other purposes is not permitted.

8. Spill and Accident Procedure

Spill – Assess the extent of danger; if necessary request help by calling 911 (from a cell phone: 510-642-3333) for emergency assistance or 510-642-3073 for non-life threatening situations. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

- Minor Spill – In the event of a minor spill, if there is no potential for hazardous chemical exposure, report the spill to 510-642-3073 and proceed to clean it, if you are trained. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and request pick-up.

- Major Spill – Any hazardous chemical spill that involves chemical exposure, any chemical spill that due to size and/or hazard requires capabilities beyond your training, or any chemical spill that gives the perception (because of odor, for example) that there has been a hazardous release. Call 911 or 510-642-3073 for assistance.
9. Cleaning and Decontamination

Lab-specific information on decontamination may be included in Section 12 - Protocol/Procedure.

- Wearing proper PPE, laboratory work surfaces must be cleaned at the conclusion of each procedure and at the end of each work day.
- Decontaminate all equipment before removing from a designated area.

10. Hazardous Waste Disposal

Label Waste

- Label all waste containers. See the EH&S Fact Sheet, “Hazardous Waste Management” for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

- Dispose of regularly generated chemical waste within 6 months.
- Contact EH&S at 642-3073 if you need assistance.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at http://ucsdss.com
-Take Ownership of Your Safety-

Before starting any work, ask yourself:
1. What will I be doing?
2. Do I know what the hazards are?
3. Do I have everything I need to do the job safely?
4. Am I doing the job safely?
5. What can we do better?
### 12. Protocol/Procedure – Peroxide Forming Chemicals (PFC)

<table>
<thead>
<tr>
<th>Procedure/Use</th>
<th>Scale</th>
<th>Engineering Controls/Equipment</th>
<th>PPE (eye, face, gloves, clothing)</th>
<th>Procedure Steps and Special Precautions for this Procedure</th>
</tr>
</thead>
</table>
| 1. PFC used as a reagent. | Up to 100 g as supplied in the reagent bottle. 

Remember to obtain PI approval if higher scale is necessary. Document this approval in your notebook | All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible or in an inert atmosphere glovebox. 
Open flames and possible sparking and static electricity must be avoided whenever possible. 
Blast shield is required if a PFC may be distilled to dryness or evaporated to dryness. | **Eye protection**: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. 
**Face Protection**: Face shields are to be used when there is a risk of splashing or spraying and there is no protection from the hood sash. 
**Hand Protection**: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use. 
**Clothing**: Wear lab coat; full-length pants or equivalent; and close-toed, close-heeled shoes. | Do not allow to evaporate to dryness unless absence of peroxides has been shown. 
Chromatography, distillation, or evaporation of PFCs efficiently removes all stabilizers. Collected fractions and rotavap condensate must be treated as unstabilized and should not be stored in air for prolonged periods. |

**Notes**

Any deviation from this SOP requires approval from PI.
<table>
<thead>
<tr>
<th>Procedure/Use</th>
<th>Scale</th>
<th>Engineering Controls/Equipment</th>
<th>PPE (eye, face, gloves, clothing)</th>
<th>Procedure Steps and Special Precautions for this Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Using PFCs as solvents in reactions, for extractions.</td>
<td>Up to 2 L as supplied in the reagent bottle. Remember to obtain PI approval if higher scale is necessary. Document this approval in your notebook.</td>
<td>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible or in an inert atmosphere glovebox. Open flames and possible sparking and static electricity must be avoided whenever possible. Blast shield is required if a PFC may be distilled to dryness or evaporated to dryness.</td>
<td><strong>Eye protection</strong>: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. <strong>Face Protection</strong>: Face shields are to be used when there is a risk of splashing or spraying and there is no protection from the hood sash. <strong>Hand Protection</strong>: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use. <strong>Clothing</strong>: Wear lab coat; full-length pants or equivalent; and close-toed, close-heeled shoes.</td>
<td>Do not allow to evaporate to dryness unless absence of peroxides has been shown. If a rotary evaporator is used, use an open cold trap system to condense the solvent vapor and vent the exhaust into the fume hood. Distillation/evaporation of PFCs efficiently removes all stabilizers. Collected fractions and rotavap condensate must be treated as unstabilized and should not be stored in air for prolonged periods. Pressure can be built up when these solvents are used in closed reaction vessels. Adequate ventilation (e.g. pressure bubbler on Schlenk manifold, or an equilibrating balloon) must be used to prevent dangerous over pressurization. Pressure may be built up when performing extractions. Adequate ventilation (open the valve frequently during the extraction) has to be used to prevent dangerous over pressurization. The vapor in such a process must be released in a fume hood. If heated, the reaction apparatus has to be fitted with an adequately sized condenser with adequate cooling to prevent evaporation. Coolant hoses have to be secured with hose clamps to the condenser and the outlet.</td>
</tr>
</tbody>
</table>

**Notes** | Any deviation from this SOP requires approval from PI. |
<table>
<thead>
<tr>
<th>Procedure/Use</th>
<th>Scale</th>
<th>Engineering Controls/Equipment</th>
<th>PPE (eye, face, gloves, clothing)</th>
<th>Procedure Steps and Special Precautions for this Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Using PFCs as solvents in column chromatography (CC) or thin layer chromatography (TLC).</td>
<td>Up to 2 L as supplied in the reagent bottle. Remember to obtain PI approval if higher scale is necessary. Document this approval in your notebook</td>
<td>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible or in an inert atmosphere glovebox. Open flames and possible sparking and static electricity must be avoided whenever possible. Blast shield is required if a PFC may be distilled to dryness or evaporated to dryness.</td>
<td><strong>Eye protection:</strong> Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. <strong>Face Protection:</strong> Face shields are to be used when there is no protection from the hood sash and a risk of splashing or spraying exists. <strong>Hand Protection:</strong> Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use. <strong>Clothing:</strong> Wear lab coat; full-length pants or equivalent; and close-toed, close-heeled shoes.</td>
<td>Do not allow to evaporate to dryness unless absence of peroxides has been shown. Chromatography and evaporation of PFCs efficiently removes all stabilizers. Collected fractions and rotavap condensate must be treated as unstabilized and should not be stored in air for prolonged periods. Column Chromatography: collect fractions of interest and concentrate as needed. If more than 2 L of total solvent is required for the operation, dispense, collect, and concentrate no more than 2 L at a time. If a rotary evaporator is used, use an open cold trap system to condense the solvent vapor and vent the exhaust into the fume hood. After use in the column, allow the solvent to evaporate from the packing material prior to proper disposal of the packing material.</td>
</tr>
</tbody>
</table>

**Notes**

Any deviation from this SOP requires approval from PI.
<table>
<thead>
<tr>
<th>Procedure/Use</th>
<th>Scale</th>
<th>Engineering Controls/Equipment</th>
<th>PPE (eye, face, gloves, clothing)</th>
<th>Procedure Steps and Special Precautions for this Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Using PFCs as solvents for cleaning glassware</td>
<td>Up to 0.5 L at a time.</td>
<td>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible. Open flames and possible sparking and static electricity must be avoided whenever possible. Blast shield is required if a PFC may be distilled to dryness or evaporated to dryness.</td>
<td><strong>Eye protection:</strong> Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. <strong>Face Protection:</strong> Face shields are to be used when there is no protection from the hood sash and a risk of splashing or spraying exists. <strong>Hand Protection:</strong> Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use. <strong>Clothing:</strong> Wear lab coat; full-length pants or equivalent; and close-toed, close-heeled shoes.</td>
<td>Glassware rinsed with isopropanol to dry it as a final step in cleaning may be allowed to dry on a drying rack outside the fume hood. Allow glassware rinsed with other PFCs to dry in the fume hood before putting away.</td>
</tr>
</tbody>
</table>

**Notes**

Any deviation from this SOP requires approval from PI.
13. **Documentation of Training (signature of all users is required)**

- Prior to conducting any work with Peroxide Forming Chemicals, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with the specific chemical(s) used, work area decontamination, and emergency procedures.

- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.

I have read and understand the content of this SOP:

<table>
<thead>
<tr>
<th>Name</th>
<th>Signature</th>
<th>Identification</th>
<th>Date</th>
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</table>
**Appendix: List of Peroxide Forming Chemicals (non-exhaustive list)**

**List A:**
Chemicals that form explosive levels of peroxides without concentration. These are the most hazardous and can form explosive peroxide levels even if not opened. Test for peroxide formation or discard after 3 months of receiving the chemicals.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isopropyl ether</td>
<td>Divinyl acetylene</td>
<td>Potassium metal</td>
</tr>
<tr>
<td>Potassium amide</td>
<td>Sodium amide</td>
<td>Vinylidene chloride</td>
</tr>
<tr>
<td>Divinyl ether</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**List B:**
Chemicals that form explosive levels of peroxides on concentration through distillation, evaporation, or exposure to air after opening. Test for peroxide formation or discard after 12 months.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetal</td>
<td>Acetaldehyde</td>
<td>Benzyl alcohol</td>
</tr>
<tr>
<td>2-Butanol</td>
<td>Chlorofluoroethylene</td>
<td>Cumene (isopropylbenzene)</td>
</tr>
<tr>
<td>Cyclohexene</td>
<td>2-Cyclohexen-1-ol</td>
<td>Cyclopentene</td>
</tr>
<tr>
<td>Decahydronaphthalene</td>
<td>Diacetylene (butadiyne)</td>
<td>Dicyclopentadiene</td>
</tr>
<tr>
<td>(decalin)</td>
<td>(gas)</td>
<td></td>
</tr>
<tr>
<td>Diglyme</td>
<td>Diethyl ether (ether)</td>
<td>Ethylene glycol ether acetates</td>
</tr>
<tr>
<td>Furan</td>
<td>4-Heptanol</td>
<td>2-Hexanol</td>
</tr>
<tr>
<td>Methyl acetylene (gas)</td>
<td>3-Methyl-1-butanol</td>
<td>Methyl isobutyl ketone</td>
</tr>
<tr>
<td>4-Methyl-2-pentanol</td>
<td>2-Pentanol</td>
<td>4-Penten-1-ol</td>
</tr>
<tr>
<td>1-Phenylethanol</td>
<td>Tetrahydrofuran (THF)</td>
<td>Tetrahydronaphthalene (tetralin)</td>
</tr>
<tr>
<td>Vinyl ethers</td>
<td>Secondary alcohols</td>
<td>Dioxanes</td>
</tr>
<tr>
<td>Ethylene glycol dimethyl ether (glyme)</td>
<td></td>
<td>Methyl cyclopentane</td>
</tr>
</tbody>
</table>

**List C:**
Chemicals that may autopolymerize as result of peroxide formation. Test for peroxide formation or discard after 12 months.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic acid</td>
<td>Styrene</td>
<td>Acrylonitrile</td>
</tr>
<tr>
<td>Tetrafluoroethylene (gas)</td>
<td>Butadiene</td>
<td>Vinyl acetylene (gas)</td>
</tr>
<tr>
<td>Chloroprene</td>
<td>Vinyl acetate</td>
<td>Chlorotrifluoroethylene (gas)</td>
</tr>
<tr>
<td>Vinyl chloride (gas)</td>
<td>Methyl methacrylate</td>
<td>Vinyl pyridine</td>
</tr>
<tr>
<td>Chlorobutadiene</td>
<td>Vinylidene chloride</td>
<td></td>
</tr>
</tbody>
</table>
## List of Chemicals

<table>
<thead>
<tr>
<th>Chemical(s)</th>
<th>Chemical(s)</th>
<th>Chemical(s) – Use(s) :</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3,4-Tetrahydronaphthalene</td>
<td>1,2-Dimethoxyethane</td>
<td>1,3-Butadiene</td>
</tr>
<tr>
<td>1,4-Dioxane</td>
<td>2-(2-Butoxyethoxy)ethyl acetate</td>
<td>2-Propylene-4-chlorophenoxy-N-(5-(3,4-dichlorobenzyl)-1,3-diene</td>
</tr>
<tr>
<td>2-Butoxyethyl acetate</td>
<td>2-Ethoxyethanol</td>
<td>2-Ethoxyethyl acetate</td>
</tr>
<tr>
<td>2-Furfuryl methyl ketone</td>
<td>2-Methoxyethanol</td>
<td>3,4-Dihydro-2H-pyran</td>
</tr>
<tr>
<td>4-Methyl-2-pentanone</td>
<td>Acetal</td>
<td>Acrylic acid</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Allyl ether</td>
<td>Anethole</td>
</tr>
<tr>
<td>Anisole</td>
<td>Butyl glycidyl ether</td>
<td>Chloroprene solution</td>
</tr>
<tr>
<td>Chlorotrifluoroethylene</td>
<td>Cumene</td>
<td>Cyclohexene</td>
</tr>
<tr>
<td>cyclopentadiene</td>
<td>Cyclopentene</td>
<td>Decahydropentanaphthalene, mixture of cis + trans</td>
</tr>
<tr>
<td>diacetylene (gas)</td>
<td>Dibenzyl ether</td>
<td>Dibutyl ether</td>
</tr>
<tr>
<td>Dicyclopentadiene</td>
<td>Diethyl ether</td>
<td>Diethyleneglycol dimethyl ether</td>
</tr>
<tr>
<td>Dibutyl ether</td>
<td>Dimethoxymethane</td>
<td>Diphenyl ether</td>
</tr>
<tr>
<td>Dipropyl ether</td>
<td>divinyl acetylene</td>
<td>divinyl ether</td>
</tr>
<tr>
<td>Ethyl vinyl ether</td>
<td>Ethylene glycol butyl ether</td>
<td>Furan</td>
</tr>
<tr>
<td>Isoamyl ether</td>
<td>iso-butyl ether</td>
<td>Isopropyl alcohol</td>
</tr>
<tr>
<td>Methyl methacrylate</td>
<td>Methylcyclopentane</td>
<td>p-Anisaldehyde</td>
</tr>
<tr>
<td>potassium amide</td>
<td>Propyne</td>
<td>Sodium amide</td>
</tr>
<tr>
<td>Styrene</td>
<td>Tetrafluoroethylene</td>
<td>Tetrahydrofuran</td>
</tr>
<tr>
<td>Vinyl acetate</td>
<td>vinyl acetylene (gas)</td>
<td>Vinylidene chloride</td>
</tr>
</tbody>
</table>

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