Standard Operating Procedure
SODIUM

1. Procedure/Hazardous Material:
Sodium: CAS 7440-23-5
Formula: Na
Sodium is commonly used to dry solvents in solvent stills with benzophenone added to produce sodium benzophenone anion. Sodium is used as a reducing agent in chemical reactions. It is also used to react with alcohols to produce sodium alkoxides.

2. Department: Campus wide

3. Revision Date: February 2013

4. Special Notifications:
Lab workers can only use sodium after instruction on this SOP by the Lab Director.

Notify all staff in the lab when you are working with sodium.

Solvent stills or other processes involving sodium must never be left running while unattended or overnight.

5. Hazard Description:

OSHA Classification:	DANGER. Water reactive, cat. 1; Skin corrosion, cat. 1B
Physical Properties	Soft, silvery-white metal bp 881.4 °C, mp 97.8 °C Reacts violently with water
Vapor Pressure	1.2 mmHg at 400 °C
Autoignition Temperature	>115 °C in air
Major Hazards	Reacts violently with water, liberating highly flammable hydrogen gas; causes severe burns on eye or skin contact.
Toxicity	Sodium reacts with the moisture on skin and other tissues to form highly corrosive sodium hydroxide. Contact of metallic sodium with the skin, eyes, or mucous membranes causes severe burns; thermal burns may also occur due to ignition of the metal and liberated hydrogen.
Flammability and Explosibility	Sodium spontaneously ignites when heated above 115 °C in air that has even modest moisture content, and any sodium vapor generated is even more flammable. Sodium reacts violently on contact with water and often ignites or explodes the hydrogen formed. Sodium fires must be extinguished with a class D dry chemical extinguisher or by the use of sand. Because these fires are very difficult to extinguish, sound the fire alarm before you attempt to extinguish the fire. *Water or CO_2 extinguishers must never be used on sodium fires.*
Reactivity and Incompatibility	Sodium is a potent reducing agent and reacts violently with water to form hydrogen and sodium hydroxide. It also reacts violently with mineral acids and halogens and reacts exothermically with oxidizing agents, organic and inorganic halides, and protic media. Shock-sensitive mixtures can form upon reaction of sodium with halogenated hydrocarbons such as carbon tetrachloride and chloroform. Sodium also reacts to generate shock-sensitive products with sulfur oxides and phosphorus, and reacts with incandescence with many metal oxides such as mercurous and lead oxides. Sodium dissolves in many other metals such as mercury and potassium with great evolution of heat. The reactivity of a sample of sodium is largely related to its surface area. Thus, reactions involving large pieces of sodium metal (especially those with some oxide or hydroxide coating) may be slow and controlled, but similar reactions involving clean, high-surface-area sodium dispersions may be vigorous or violent.

6. Engineering Controls:
All work with sodium must be performed in a working fume hood. The fume hood sash must be closed as much as possible.

A safety shield must be used if there is a risk of explosion or reaction and the fume hood splash shield is not protective.

7. Personal Protective Equipment:

The following must be worn at all times when working with sodium:

- Safety goggles meeting the requirements of ANSI Z87.1 for Chemical Splash Goggles
- Nitrile gloves, min. thickness 4 mil (disposable – must be dry & free of any water before handling sodium)
- Fire-retardant laboratory coat (100% cotton, worn with snaps or buttons fully closed)

8. Storage Requirements:

Sodium must be stored in a closed container under kerosene, toluene, or mineral oil.
Contact with water should be avoided because sodium reacts violently with water to form hydrogen (H_2) with evolution of sufficient heat to cause ignition.

Store away from water and moisture. Store away from oxidizing agents. Store away from halogens. Do not store with acids.

9. Handling Precautions/Conditions:

The metal should be handled under the surface of an inert liquid such as mineral oil, xylene, or toluene. Sodium should be used only in areas free of ignition sources and should be stored under mineral oil in tightly sealed metal containers under an inert gas such as argon. Open flames, such as Bunsen burners are obvious ignition sources. Gas burners should not be used as a source of heat in any laboratory where flammable substances are used. Less obvious ignition sources include gas-fired space heating or water-heating equipment and electrical equipment, such as stirring devices, motors, relays, and switches, which can all produce sparks that will ignite flammable vapors. Because the location of this equipment is often fixed, operations with flammable substances may have to be carried out elsewhere.

Combustible material must be kept more than 10 feet away from any area where sodium is being used. This includes wads of paper towels, laboratory notebooks and especially flammable solvents. It should also be handled in a dry area away form any sinks or other sources of water. Unlike potassium, which usually stays in place when it ignites, sodium has a tendency to melt and blow apart when it reacts with water and starts fires in multiple places.

Metals like sodium become more reactive as the surface area of the particles increases. Prudence dictates using the largest particle size consistent with the task at hand. For example, use of sodium "balls" or cubes is preferable to use of sodium "sand" for drying solvents.

All equipment used to cut or handle sodium must be bone dry and free of all water moisture before use. All equipment and work surfaces must be thoroughly cleaned and decontaminated with isopropanol before storage or reuse.

Mixtures of sodium and halogenated solvents can explode violently.

10. Emergency Procedures:

The following emergency equipment must be available when working with sodium:

- Emergency Eyewash
- Emergency Shower
- Bucket of clean, dry sand (or Class D fire extinguisher) for extinguishing fires

Contact University Police at 911 (campus phone) or 631-632-3333 (cell phone) in the event of fire, spill or personal contamination.

In the event of skin contact, immediately remove contaminated clothing and any metal particles and wash with soap and water. In case of eye contact, promptly wash with copious amounts of water for 15 min (lifting upper and lower lids occasionally) and obtain medical attention. If sodium is ingested, obtain medical attention immediately.

In the event of a spill, remove all ignition sources, cover the sodium with a dry chemical extinguishing agent, sweep up, place in an appropriate container under an inert atmosphere, and dispose of properly.

11. Decontamination:

The most dangerous procedure is decommissioning a used solvent pot from a solvent still where sodium was used as drying agent. Care must be taken that all the sodium is reacted before it was added to a waste solvents container. Start by adding isopropanol and finally water and monitoring the H2 which is given off. At the end, make sure that the reaction pot is well stirred to make sure all the sodium has reacted.

12. Waste Disposal:

All waste sodium must be disposed of as hazardous waste. Scraps must be in a bottle under mineral oil, properly labeled, and given it to EH&S for disposal.

Scraps of sodium can be destroyed in the lab shortly after generating them to reduce the hazards of storing sodium as hazardous waste. This waste must also be disposed of as hazardous waste by giving it to EH&S. Only properly trained lab staff are allowed to perform this procedure.

This procedure must be done in the hood since hydrogen gas is generated especially if more than a gram of material is involved. All flammable materials must be removed from the fume hood prior to beginning this procedure. Using tweezers, add the scraps of sodium to 95% ethanol in an Erlenmeyer flask at such a rate that the solvent does not boil. Generally, use about 20 mL of ethanol for each gram (estimated) of sodium. If a large amount of material (more than a few grams; large chunks should be cut into small pieces) is involved it is a good idea to put the flask in a secondary container like a crystallizing dish or a metal pan. Once the sodium has visually reacted, add water in small quantities (about 0.5 mL at a time) while swirling the flask to get good mixing until there is a clear solution. This step is important. When sodium reacts with ethanol it forms sodium ethoxide which has a tendency to form a gel with ethanol. Free sodium metal can remain unreacted and undetected in this gel for long periods of time. Adding water in a controlled fashion converts the sodium ethoxide to sodium hydroxide which is soluble in the ethanol-water mixture and also decomposes any residual sodium.

This solution must be put in a bottle and labeled as sodium hydroxide in water-ethanol and given to EH&S for disposal.

Never add ethanol to scraps of sodium in a beaker even if covered with an inert solvent is probably not a safe thing to do. If too much ethanol is added at once, the reaction could become very violent and there is no way to control it.

13. Laboratory Specific Procedures:

Lab Director:
Room:

Procedures for handling Sodium metal:

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14. Additional References

Guidelines and Standard Operating Procedure (SOP) for the Set-up, Use, and Neutralization of Solvent Stills Containing Reactive Metals or Metal Hydrides.
Safety Committee, Department of Chemistry & Biochemistry, University of Guelph
http://www.chembio.uoguelph.ca/sop/stills.htm
Solvent stills in which flammable liquids are purified by distillation from reactive metals or metal hydrides such as Na, Mg, CaH_2, or $LiAlH_4$ possibly pose the greatest danger in any organic, organometallic, or inorganic synthetic laboratory**.** The potential fire and explosion hazards associated with the combination of air- and/or water-reactive metals with large amounts of organic solvents are enormous and the effects on personnel and equipment of a solvent still on fire within the enclosed space of a laboratory are best likened to those of a Molotov cocktail. The chances of personnel escaping such an incident unharmed are very low. An accident, that occurred at the University of Western Ontario/London several years ago during an attempt to neutralize a sodium containing solvent still, killed one post-doctoral researcher and severely injured a student (3rd degree burns to large parts of the body).

Prudent Practices http://www.nap.edu/catalog.php?record_id=12654 (read it online for free)
Developed by experts from academia and industry, with specialties in such areas as chemical sciences, pollution prevention, and laboratory safety, Prudent Practices for Safety in Laboratories provides step-by-step planning procedures for handling, storage, and disposal of chemicals. The volume explores the current culture of laboratory safety and provides an updated guide to federal regulations. Organized around a recommended workflow protocol for experiments, the book offers prudent practices designed to promote safety and it includes practical information on assessing hazards, managing chemicals, disposing of wastes, and more. Prudent Practices for Safety in Laboratories is essential reading for people working with laboratory chemicals: research chemists, technicians, safety officers, chemistry educators, and students.

Reactive Chemicals

- Bretherick, L. *Bretherick's Handbook of Reactive Chemical Hazards*; 6th ed.; Butterworths: London, 1999.
- NFPA 484 *Standard for Combustible Metals*, 2006.
- NFPA 495 *Explosive materials Code*, 2006
- OSHA *Chemical Reactivity Hazards (http://www.osha.gov/SLTC/reactivechemicals/index.html)*