

NC STATE UNIVERSITY **Safety Plan Report**

Plan Number 509 **Annual Approval** 3/9/2012
Area 111 Lampe Drive **Approved** 4/21/2011
Room 122 **Approval Notes**

Investigators

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Authorized Personnel

Personnel	Position	Contact	Number
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Emergency Contacts

Campus Emergencies	911
Carolinas Poison Center	(800) 848-6946
Environmental Health and Safety Center	(919) 515-7915
Wake Medical Canter Emergency	(919) 350-8000
Rex Hospital Emergency	(919) 7843100
Kyle Knowlson - Lab Manager	(919) 247-9408
Ola Harrysson -PI	(919) 637 - 0962

EBM

Description

Arcam Electron Beam melting

Description

Categories

Hazardous Chemicals/Chemicals Classes

Special Animal use Precautions

N/A

Hazards

Category	Type	Description
Eye	Dust	metal powders
Hand	Cuts/Abrasion	sharp sheet metal
Other	Dust	metal powders

PPE

Category	Type	Description
Respirator	Protection	Head
Safety Glasses		Eye

SLA

Description

Rapid prototyping system. 3D systems SLA 250

Description

Categories

Engineering and Ventilation Controls Required	Parts cleaning station has a fume hood to remove alcohol vapors.
Hazardous Chemicals/Chemicals Classes	liquid epoxy: skin irritant
Special Handling and Storage Requirements	Isopropyl alcohol is flammable. Do not store waste in cleaning area

Hazards

Category	Type	Description
Eye	Chemical Splash	liquid epoxy resin, isopropyl alcohol
Hand	Chemical Exposure	liquid epoxy resin, isopropyl alcohol

PPE

Category	Type	Description
Face Shield	Eye	,
Gloves	Hand wear	nitrile gloves

FDM

Description

Dimension FDM rapid prototyping process

Description

Categories

Hazardous Chemicals/Chemicals Classes	sodium hydroxide: corrosive
Potential Hazards	heads inside the machine are hot and could cause burns while performing routine maintenance

Hazards

Category	Type	Description
Hand	Burn	heated head components in the machine
Eye	Chemical Splash	sodium hydroxide support removal solution

PPE

Category	Type	Description
Gloves	Hand	heat resistant when doing head maintenance
Gloves	Hand	nitrile gloves when removing parts from support removal bath
Goggles	Eye	chemical goggles when removing parts from cleaning bath

Objet

Description

Alaris objet rapid prototyping system

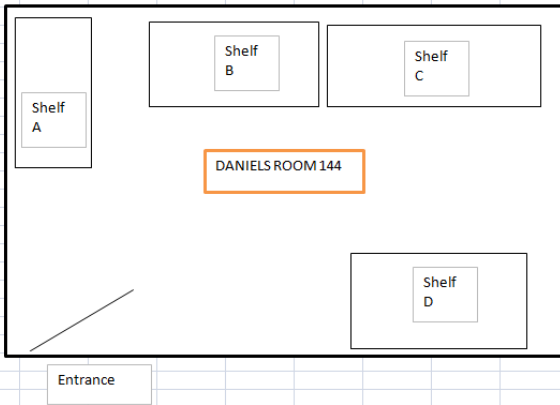
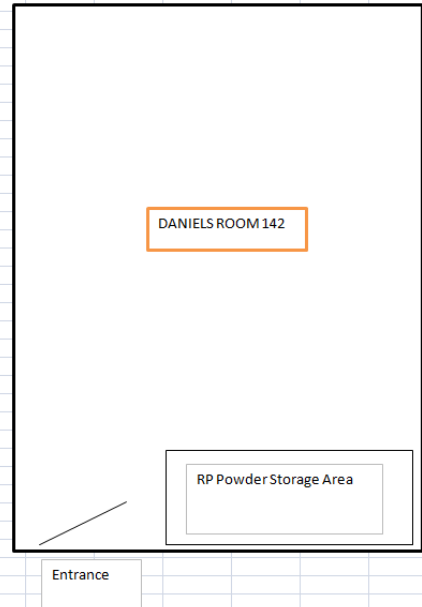
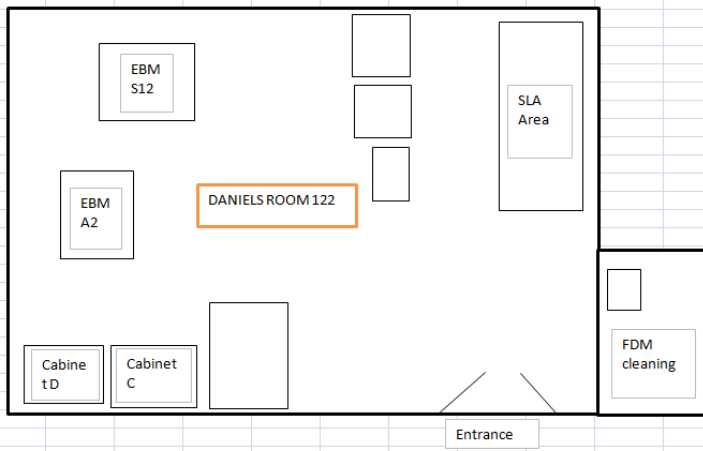
Categories	Description
Spill and Accident Procedures	Emergency eyewash station and shower are available just outside of the lab

Hazards

Category	Type	Description
Hand	Chemical	Exposure when handling uncured resins

PPE

Category	Type	Description
Goggles	Eye	wear safety goggles when loading/unloading resins
Gloves	Hand	wear nitrile gloves



Room Number	Storage Location	Storage Device	Chemical Name	Number of Units	Quantity per Unit	Volume Size
122	Flammable storage cabinet	Glass bottle	TPM (Tripropylene glycol)	2	4.00	liter
122		Glass bottle	Acetone	3	4.00	liter
122		Glass bottle	Isopropyl Alcohol	4	4.00	liter
122	Box (with plastic bottles)		Brush on 35	1	1.90	lbs
122	Plastic Spray Bottle		Isopropyl Alcohol	1	1.00	liter
122	Glass Jar		Methanol	1	100.00	mL
122	Plastic Bottle		Waterworks concentrate (sodium hydroxide)	6	1.00	liter
122	Metal spray can		Proclean (alcohol)	3	16.00	oz
122	Plastic Bottle		Goo Gone	1	12.00	oz
122	Metal bottles		Helium Gas	2	50.00	liters
122	Plastic Bottles		Titanium powder (PREP)	6	10.00	kg
122	Various		copper powder	10	20.00	lb
122	Plastic Bottle		Resin: SOMOS Watershed 11112	1	1.00	kg
122	FDM Bath		diluted Waterworks (sodium hydroxide, H2O)	1	1.00	gallon
122	Alaris		Fullcure 830 model,	1	1.00	kg
122	Alaris		fullcure 720 Support	1	1.00	kg
122	Alaris		Alaris Waste Product	1	2.00	kg
122	EBM S12		Titanium powder	1	80.00	kg
122	EBM A2		Experimental Powder (currently Copper)	1	80.00	kg
122	SLA 250		Resin: SOMOS Watershed 11112	1	50.00	kg

Physical State	CAS #	Receipt Date
liquid	25498-49-1	unknown/variou
liquid	67-64-1	unknown/variou
liquid	67-63-0	unknown/variou
liquid	108-45-2; 471-34-1	unknown/variou
liquid	67-63-0	unknown/variou
liquid	67-56-1	unknown/variou
solid	1310-73-2	unknown/variou
liquid	64-17-5;811-97-2;67-56-1;67-63-1	unknown/variou
liquid	64742-47-8, 25498-49-1,94266-47-4	unknown/variou
gas	7440-59-7	unknown/variou
powder	7440-32-6;7429-90-5;7440-62-2	unknown/variou
powder	7440-50-8	unknown/variou
liquid	not listed on MSDS	unknown/variou
liquid	1310-73-2	unknown/variou
liquid	25322-68-3;57-55-6;56-81-5 (2 cher	unknown/variou
liquid	25322-68-3;57-55-6;56-81-5 (2 cher	unknown/variou
liquid	25322-68-3;57-55-6;56-81-5 (2 cher	unknown/variou
powder	7440-32-6;7429-90-5;7440-62-2	unknown/variou
powder	7440-50-8	unknown/variou
liquid	not listed on MSDS	unknown/variou



Rapid Prototyping Laboratory Procedures



Do not attempt to use any equipment or perform any of the tasks outlined without being previously trained by a qualified operator. Damage to the equipment or personal injury may result.

If you have any questions about the proper way to use any equipment or perform any procedure, ask an experienced operator before proceeding.

General Laboratory Procedures and Safety Rules

Much useful information about working in laboratory environments can be found in the document titled “Safety in Academic Chemistry Laboratories”, available in printed form in the lab or online at:

http://membership.acs.org/c/ccs/pubs/SACL_Students.pdf

General Lab Rules

1. The General Statutes of the State of North Carolina require **all persons in a laboratory** to wear industrial-quality eye-protective devices **at all times while in the laboratory**.
2. Shoes must be worn to be admitted to the lab and worn the **entire time** while in the laboratory. Shoes must cover the feet, without gaps such as open toes. Sandals, thongs and similar footwear are not permitted in the lab.
3. Users are urged to dress with potential lab hazards in mind. Clothing should protect as much of the body as possible. Clothing may have to be immediately removed if grossly contaminated with chemicals or ignited; therefore users are advised that laboratory aprons can be worn to provide some protection from accidents. Loose fitting clothes, easily combustible clothes, and long, unrestrained hair are all fire and accident hazards
4. Since hearing is important for learning and to avoid accidents, radios and tape players (etc.) may not be used in the lab.
5. Do not bring excess personal items into the laboratory, where they may be subject to damage
6. Smoking, drinking, and eating are forbidden in the laboratory due to danger of chemicals entering mouth or lungs.
7. Treat all chemicals in the lab as toxic substances. Keep them off your skin and clothes.
8. Do not taste anything in the laboratory. This applies to food as well as to chemicals.
9. Do not place your mouth on any chemical equipment.
10. Keep your hands and face clean. Wash with soap and warm water whenever a chemical gets on your skin and always when leaving the laboratory (sink is available in public restroom or in the Manufacturing lab)



11. Avoid inhalation of fumes of any kind. Exhaust fumes through hood. To test an odor, fill your lungs with air and cautiously sniff the vapors as you waft (fan) them from the source. Never inhale fumes directly from a chemical substance.
12. Never leave excess or spilled chemicals on equipment; wipe clean with a damp towel immediately and dry with a towel.
13. If you transfer a chemical from its original container to another container, **FIRST** clearly label the new container.
14. Many chemicals are thought to pose special risks to unborn children, especially during the first few months of pregnancy. To minimize this risk, consult the Laboratory Director if you are pregnant.
15. For additional information on the properties of laboratory chemicals, consult the Material Safety Data Sheet (MSDS) file

Emergency Procedures

1. Immediately alert the laboratory supervisor or PI to ANY fire or accident.
2. In the event that your hair or clothing catches fire - **DO NOT RUN**. This will fuel the fire. **STOP - DROP - ROLL** to smother the fire. Help to smother the fire on a co-worker with your apron or lab coat, or with your own body.
3. In case of a fire alarm, turn off equipment, water, and electrical devices, collect purses and calculators and exit building by assigned routes - **DO NOT RUN**. Avoid inhaling smoke from a chemical fire. Return to the building **only** after a security officer gives clearance. Posted by the door of each room is an evacuation route. **Be familiar with your exit route before you need it!**
4. Be familiar with the location and operation of the eye-wash fountains and safety showers. First aid supplies are available on the back of the laboratory doorway. Report all burns, cuts or other injuries to the laboratory supervisor or PI at once.

Some rules adapted from: NORTH CAROLINA STATE UNIVERSITY, Department of Chemistry,

LABORATORY SAFETY RULES AND REGULATIONS, Revised – August 8, 2005



Cleanliness and Hygiene Policy

1. When working with chemical (specifically SLA resin), avoid touching surfaces other than the tools provided in that area while wearing resin-contaminated gloves. If you need to pick up a bottle or open a cabinet or door, use a piece of paper towel to keep resin off of the surface. If you accidentally contaminate a surface, clean it thoroughly with isopropyl alcohol.
2. Never carry liquid resin off of the provided gray mat. If you drip resin on any surface, wipe it up with a towel followed by isopropyl alcohol (spray bottle provided for this).
3. Metal powders are expensive, it is worth the extra effort to attempt to not spill ANY on the floor (carts and other equipment are provided for this purpose). If there is an accident and some powder is spilled, it should be swept up before leaving the area using the provided brooms and dustpans. Follow up with a general sweep off the lab with provided dust mop. If you notice metal powder on any surface, wipe it up with a wet paper towel.
4. Do not use PCs, general hand tools or touch doors, cabinets or other areas with contaminated hands. Remove gloves and wash hands after a task is finished on a specific machine before proceeding to the task.

Hazardous Waste

Some of the wastes generated in our lab must be disposed of following special procedures. Make certain that all chemicals (resins, etc.) are placed in a **labeled** container as they are generated. Do not allow large amounts of wastes to be generated.

There is a hazardous waste can provided near the SLA area where any items which are contaminated with uncured resin can be deposited for proper disposal. Do not placed general waste into this can as it will increase disposal costs.

If you are unsure how to handle the disposal or storage of a specific item, ASK laboratory supervisory personnel.



Processes Overview

There are 4 main processes in use in the lab. They include:

- **Electron Beam Melting (EBM)**
- **Stereolithography (SLA)**
- **Polyjet (Alaris)**
- **Fused Deposition Modelling (FDM)**

Detailed descriptions of each of the processes as well as link to the manufacturers' website can be found at: <http://www.ise.ncsu.edu/rplab/processes/index.html>

Detailed operating instructions for all of the equipment in the laboratory can be found online at: <http://www.ise.ncsu.edu/rplab/private/equipment/equipment.html> (NOTE: this site is WRAP protected, please contact laboratory supervisor for access)



Before using any process in the laboratory which involves chemical of any type, you must familiarize yourself with the contents of the material safety data sheet (MSDS) for that chemical. This document will explain all hazards associated, appropriate protective equipment as well as information on what to do in case of an accident or emergency.

EBM Hazards

- **Eye:** There is a risk of getting liquid chemicals or dust in the eyes while loading/unloading/cleaning the machine. Always wear appropriate eye protection when performing these operations (chemical splash goggles or full-face respirator). Prescription glasses are not sufficient eye protection and must be covered by appropriate eyewear.
- **Hands/Arms/Body:** Start plates can be hot when removed from the machine. Wear heat protective gloves when handling plates. The inside of the machine contains many sharp metallic edges. When loading/unloading or performing maintenance or cleaning on parts inside of the chamber always wear appropriate protective gloves (leather over nitrile is ideal). Wear nitrile gloves when handling all powders. A lab coat should be worn to prevent getting powder onto your clothes and contaminating other areas (including your home). If you get powder on your shoes, clean it off before leaving the area. Full-body Tyvek suits and shoe covers are available if desired.
- **Foot:** When lifting buckets or hoppers of powder or removing large metal parts from the build chamber there is a risk of dropping an item and causing a foot injury. Use appropriate lifting devices (there is a hydraulic trolley provided for this) and wear protective footwear.



- **Inhalation Hazard:** The metal powders used in the lab can present an inhalation risk. Anyone present in the lab during or immediately following a procedure that involves disturbing metal powders in any way must have been through the university's respiratory protection training program. Please contact the laboratory supervisor if you feel you need this training. Respirators should be worn by all present in the lab when sifting, loading/unloading powder or parts as well as when sweeping spilled powder from the floor. Use the provided moveable ventilation hood as an engineering control to prevent dusts from migrating out of the immediate work area. Refer to the MSDS for each powder for specific hazards associated with the material being used at the time.
- **Fire:** Many of the metal powders in the lab pose some risk of a fire or explosion. Avoid heat, sparks, open flames when handling powders. Do not attempt to clean parts in the blasting cabinet until they have cooled to room temperature. Avoid creating dust clouds from powders. If a powder seems to be creating a visible amount of airborne dust, STOP and ask the laboratory supervisor for advice before proceeding. Use caution to avoid creating sparks when scraping deposited metal from chamber equipment including the heat shield. Make certain all containers are grounded when filling/sifting etc. to avoid static electricity build up. There is a "Class D" fire extinguisher available in the lab for metal fires. Do NOT attempt to fight a fire unless you have been specifically trained to do so. The normal ABC fire extinguishers are NOT effective on metal powder fires. Putting water on a metal fire can increase the reaction rate and/or cause an explosion.
- **X-Ray Radiation** - the electron gun generates a certain amount of x-ray radiation inside of the chamber under normal operation. The shielding of the machine is sufficient to contain essentially all of this radiation. DO NOT modify the machine, or operate with any doors open, window coverings or outside panels removed or damaged. If you are unsure of the condition or normal position of a part of the machine STOP and ask supervisory personnel for advice. In particular make certain that the yellow-colored leaded glass is properly placed over the camera window and that gun and rear door are closed before starting the equipment.

Stereolithography Hazards

- **Eye:** There is a risk of getting liquid chemicals in the eyes while loading/unloading/cleaning the machine. Always wear appropriate eye protection when performing these operations (chemical splash goggles). Prescription glasses are not sufficient eye protection and must be covered by appropriate eyewear.
- **Hands/Arms/Body/Feet:** Nitrile gloves, long pants and closed-toes shoes should be worn at all times when working this equipment to protect the skin from chemical exposure. A full apron should be worn when moving large amount of chemicals when a significant spill could occur.
- **Laser (UV) radiation** - This equipment contains a laser which is used for curing the resin into a solid material. The glass door and black metal covers on the outside of the machine serve to protect the operator from possible direct exposure to the laser beam. DO NOT operate the equipment with any external covers removed or with the front door of the build chamber open. The door safety switch should never be defeated in any way.



- **Fire** - Finished parts and build platforms are cleaned in an open bath of isopropyl alcohol which is considered highly flammable. Also perform cleaning operations under the fume hood in the lab. Avoid heat, sparks, and open flames of any kind near the solvent bath. Always dry the parts completely before placing them in the curing oven or taking them out of the hood. The ABC rated fire extinguisher in the lab can be used by trained personnel in the event of a fire in this area.

Polyjet Hazards

- **Eye:** There is a risk of getting liquid chemicals in the eyes while loading/unloading/cleaning the machine. Always wear appropriate eye protection when performing these operations (chemical splash goggles). Prescription glasses are not sufficient eye protection and must be covered by appropriate eyewear.
- **Hands/Arms/Body/Feet:** Nitrile gloves, long pants and closed-toes shoes should be worn at all times when working this equipment to protect the skin from chemical exposure. A full apron should be worn when moving large amount of chemicals when a significant spill could occur.

Fused Deposition Modeling Hazards

- **Eye:** There is a risk of getting liquid chemicals or flying plastic in the eyes while cleaning parts in the bath or breaking away support structure. Always wear appropriate eye protection when performing these operations (chemical splash goggles). Prescription glasses are not sufficient eye protection and must be covered by appropriate eyewear.
- **Hands/Arms/Body/Feet:** Nitrile gloves, long pants and closed-toes shoes should be worn when using the ultrasonic cleaning bath to protect the skin from chemical exposure. A full apron should be worn when moving large amount of chemicals when a significant spill could occur.
- **Burns** – Some of the internal parts of the FDM machine get hot during normal operation. Be aware of warning signs on the equipment and wear heat protective gloves when performing maintenance operations on this equipment.