T510 Danfoss IGV: Risk Assessment

Hunter Dabbs, Tye Fountain, Joseph Bechara, Thiago Todesco

Lab Safety Expectations/ Rules

Senior design projects provide wonderful hands-on experiences for students. The following safety rules will help to ensure every student has a safe, rewarding, and valuable educational experience in the lab.

- At least two people should be present in the lab when equipment and/or tools are in use.
- Always ask if you are unsure about something.
- Long pants and closed toed shoes are required in the lab when equipment and/or tools are in use.
- In the event of an injury or exposure to a chemical, regardless of severity, the lab user must report to the instructor and complete an accident report. In the event of serious/severe injuries or exposures call 9-1-1 immediately for medical attention.
- Do not attempt to remove foreign objects from the eye or body. Seek medical attention immediately. If chemicals are splashed into the eyes, utilize an eyewash station to rinse eyes for 15 minutes before seeking medical attention.
- Report any damage or missing parts to tools/equipment to the instructor immediately.
- During repair, cleaning or oiling, machines and equipment MUST be shut off and locked out to ensure unauthorized startup does not occur.
- Neck ties, loose clothing, jewelry, gloves, etc. are prohibited around moving or rotating machinery. Long hair must be tied back or covered to keep it away from moving machinery.
- A brush, hook or specialized tool is preferred for removal of chips, shaving, etc. from work areas. Never use hands to clear work areas.
- Maintain the lab in a clean and orderly manner.
- Keep the floor clean, dry and free from trip and slip hazards.
- Food and drinks are prohibited in the lab.
- Review the Safety Data Sheet (SDS) for all chemicals used.
- Store oily rags in approved containers only.
- Used chemicals should never be poured down the drain or disposed outdoors. Contact Environmental Health & Safety for chemical disposal services.
- Clean up solvent and chemical spills immediately. In the event of a large spill, contact Environmental Health & Safety emergency response team for cleanup services.
- Know the location of the fire extinguisher, eyewash station, first aid kit, and fire escape route for your room.

FAMU-FSU College of Engineering

Project Hazard Assessment Policy and Procedures

INTRODUCTION

University laboratories are not without safety hazards. Those circumstances or conditions that might go wrong must be predicted and reasonable control methods must be determined to prevent incident and injury. The FAMU-FSU College of Engineering is committed to achieving and maintaining safety in all levels of work activities.

PROJECT HAZARD ASSESSMENT POLICY

Principal investigator (PI)/instructor are responsible and accountable for safety in the research and teaching laboratory. Prior to starting an experiment, laboratory workers must conduct a project hazard assessment (PHA) to identify health, environmental and property hazards and the proper control methods to eliminate, reduce or control those hazards. PI/instructor must review, approve, and sign the written PHA and provide the identified hazard control measures. PI/instructor continually monitor projects to ensure proper controls and safety measures are available, implemented, and followed. PI/instructor are required to reevaluate a project anytime there is a change in scope or scale of a project and at least annually after the initial review.

PROJECT HAZARD ASSESSMENT PROCEDURES

It is FAMU-FSU College of Engineering policy to implement followings:

1. Laboratory workers (i.e. graduate students, undergraduate students, postdoctoral, volunteers, etc.) performing a research in FAMU-FSU College of Engineering are required to conduct PHA prior to commencement of an experiment or any project change in order to identify existing or potential hazards and to determine proper measures to control those hazards.
2. PI/instructor must review, approve and sign the written PHA.
3. PI/instructor must ensure all the control methods identified in PHA are available and implemented in the laboratory.
4. In the event laboratory personnel are not following the safety precautions, PI/instructor must take firm actions (e.g. stop the work, set a meeting to discuss potential hazards and consequences, ask personnel to review the safety rules, etc.) to clarify the safety expectations.
5. PI/instructor must document all the incidents/accidents happened in the laboratory along with the PHA document to ensure that PHA is reviewed/modified to prevent reoccurrence. In the event of PHA modification a revision number should be given to the PHA, so project members know the latest PHA revision they should follow.

6. PI/instructor must ensure that those findings in PHA are communicated with other students working in the same laboratory (affected users).
7. PI/instructor must ensure that approved methods and precautions are being followed by :
    a. Performing periodic laboratory visits to prevent the development of unsafe practice.
    b. Quick reviewing of the safety rules and precautions in the laboratory members meetings.
    c. Assigning a safety representative to assist in implementing the expectations.
    d. Etc.
8. A copy of this PHA must be kept in a binder inside the laboratory or PI/instructor's office (if experiment steps are confidential).

Project Hazard Assessment Worksheet				
PI/instructor: Bruce W. Barnett	Phone #: (850) 728–2988	Department: Manufacturing	Start Date: 11/21/2023	Revision: 1
Project: Team 510 – Danfoss IGV Functionality Test Fixture			Location(s): Danfoss Turbocor: 1769 E Paul Dirac Dr, Tallahassee, FL 32310	
Team member(s): Joseph Bechara Hunter Dabbs Tye Fountain Thiago Todesco			Phone #: (786) 482-3667 (321) 265-1648 (772) 485-0024 (760) 891-9630	Email: jab20l@fsu.edu hbd19b@fsu.edu twf20@fsu.edu tr21l@fsu.edu

Experiment Steps	**Location**	**Person assigned**	**Identify hazards or potential failure points**	**Control method**	**PPE**	**List proper method of hazardous waste disposal, if any.**	**Residual Risk**	**Specific rules based on the residual risk**
Metal Machining	COE Machine Shop	Thiago Todesco	Machines used could prove dangerous to the technician if proper protocol is not followed.	Ensure proper PPE is utilized and follow the instructions of the machines and operators.	Eye protection, ear protection, long pants, steel toe shoes.	N/A	HAZARD: 3 CONSEQ: Moderate Residual: Medium	Reference list on Page 11
Component Assembly	COE Senior Design Lab	Tye Fountain	Technician could be pinched, cut or pierced by components being torqued/mated	When assembling metal or sharp components, technicians should wear necessary PPE.	Eye protection, hand protection, pants and closed toed shoes.	N/A	HAZARD: 3 CONSEQ: Moderate Residual: Medium	Reference list on Page 11
Start Test (by pressing the start button)	Danfoss Turbocor: 1769 E Paul Dirac Dr, Tallahassee, FL 32310	Lisa	The metal might reflect the laser beam and hit the operator's eye.	A physical barrier will be placed to prevent the lasers from escaping the test boundary	N/A	N/A	HAZARD: 1 CONSEQ: Minor Residual: Low	Reference list on Page 11

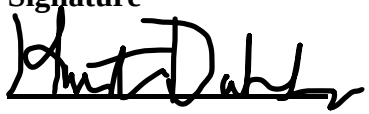
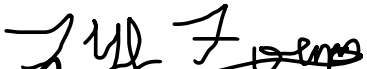
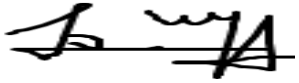
Stop Test	Danfoss Turbocor: 1769 E Paul Dirac Dr, Tallahassee, FL 32310	Lisa	N/A	N/A	N/A	N/A	HAZARD: 1 CONSEQ: Negligible Residual: Low	Reference list on Page 11
Wiring/Soldering	COE Senior Design Lab	Hunter Dabbs	Electrocution, burns, smoke inhalation (lead)	Take precautionary measures. Utilize a fan to blow lead fumes away from technician	Safety glasses	Residue must be placed in a properly labeled container	HAZARD: 2 CONSEQ: Minor Residual: Low	Reference list on Page 11
Computer-Aided Design (CAD)	Remote	Joseph Bechara	Eye strain	Take breaks to avoid eye fatigue	N/A	N/A	HAZARD: 1 CONSEQ: Negligible Residual: Low	Reference list on Page 11
3D Printing	Remote/Innovation Hub	Tye Fountain	N/A	N/A	N/A	N/A	HAZARD: 1 CONSEQ: Negligible Residual: Low	Reference list on Page 11
Coding	Remote	Hunter Dabbs	Eye strain	Take breaks to avoid eye fatigue	N/A	N/A	HAZARD: 1 CONSEQ: Negligible Residual: Low	Reference list on Page 11

Laser Cutting	COE Machine Shop	Jeremy Phillips	Skin and eye hazard from direct exposure to beam.	Follow manufacturer specifications, machine shop rules, and policies	Eye protection	N/A	HAZARD: 3 CONSEQ: Moderate Residual: Medium	Reference list on Page 11

Principal investigator(s)/ instructor PHA: I have reviewed and approved the PHA worksheet.

Name	Signature	Date	Name	Signature	Date
_____	_____	_____	_____	_____	_____

Team members: I certify that I have reviewed the PHA worksheet, am aware of the hazards, and will ensure the control measures are followed.

Name	Signature	Date
Hunter Dabbs		**11/21/2023**
Tye Fountain		**11/21/2023**
Thiago Todesco		**11/22/2023**
Joseph Bechara		**11/21/2023**

DEFINITIONS:

Hazard: Any situation, object, or behavior that exists, or that can potentially cause ill health, injury, loss or property damage e.g. electricity, chemicals, biohazard materials, sharp objects, noise, wet floor, etc. OSHA defines hazards as "*any source of potential damage, harm or adverse health effects on something or someone".* A list of hazard types and examples are provided in appendix A.

Hazard control: Hazard control refers to workplace measures to eliminate/minimize adverse health effects, injury, loss, and property damage. Hazard control practices are often categorized into following three groups (priority as listed):

1. **Engineering control:** physical modifications to a process, equipment, or installation of a barrier into a system to minimize worker exposure to a hazard. Examples are ventilation (fume hood, biological safety cabinet), containment (glove box, sealed containers, barriers), substitution/elimination (consider less hazardous alternative materials), process controls (safety valves, gauges, temperature sensor, regulators, alarms, monitors, electrical grounding and bonding), etc.
2. **Administrative control:** changes in work procedures to reduce exposure and mitigate hazards. Examples are reducing scale of process (micro-scale experiments), reducing time of personal exposure to process, providing training on proper techniques, writing safety policies, supervision, requesting experts to perform the task, etc.
3. **Personal protective equipment (PPE):** equipment worn to minimize exposure to hazards. Examples are gloves, safety glasses, goggles, steel toe shoes, earplugs or muffs, hard hats, respirators, vests, full body suits, laboratory coats, etc.

Team member(s): Everyone who works on the project (i.e. grads, undergrads, postdocs, etc.). The primary contact must be listed first and provide phone number and email for contact.

Safety representative: Each laboratory is encouraged to have a safety representative, preferably a graduate student, in order to facilitate the implementation of the safety expectations in the laboratory. Duties include (but are not limited to):

- Act as a point of contact between the laboratory members and the college safety committee members.
- Ensure laboratory members are following the safety rules.
- Conduct periodic safety inspection of the laboratory.
- Schedule laboratory clean up dates with the laboratory members.
- Request for hazardous waste pick up.

Residual risk: Residual Risk Assessment Matrix are used to determine project's risk level. The hazard assessment matrix (table 1) and the residual risk assessment matrix (table2) are used to identify the residual risk category.

The instructions to use hazard assessment matrix (table 1) are listed below:

1. Define the workers familiarity level to perform the task and the complexity of the task.

2. Find the value associated with familiarity/complexity (1 – 5) and enter value next to: HAZARD on the PHA worksheet.

Table 1. Hazard assessment matrix.

		Complexity		
		Simple	Moderate	Difficult
Familiarity Level	Very Familiar	1	2	3
	Somewhat Familiar	2	3	4
	Unfamiliar	3	4	5

The instructions to use residual risk assessment matrix (table 2) are listed below:

1. Identify the row associated with the familiarity/complexity value (1 – 5).
2. Identify the consequences and enter value next to: CONSEQ on the PHA worksheet. Consequences are determined by defining what would happen in a worst case scenario if controls fail.
    a. Negligible: minor injury resulting in basic first aid treatment that can be provided on site.
    b. Minor: minor injury resulting in advanced first aid treatment administered by a physician.
    c. Moderate: injuries that require treatment above first aid but do not require hospitalization.
    d. Significant: severe injuries requiring hospitalization.
    e. Severe: death or permanent disability.
3. Find the residual risk value associated with assessed hazard/consequences: Low –Low Med – Med– Med High – High.
4. Enter value next to: RESIDUAL on the PHA worksheet.

Table 2. Residual risk assessment matrix.

Assessed Hazard Level	Consequences				
	Negligible	Minor	Moderate	Significant	Severe
5	Low Med	Medium	Med High	High	High
4	Low	Low Med	Medium	Med High	High
3	Low	Low Med	Medium	Med High	Med High
2	Low	Low Med	Low Med	Medium	Medium
1	Low	Low	Low Med	Low Med	Medium

Specific rules for each category of the residual risk:

Low:

- Safety controls are planned by both the worker and supervisor.
- Proceed with supervisor authorization.

Low Med:

- Safety controls are planned by both the worker and supervisor.
- A second worker must be in place before work can proceed (buddy system).
- Proceed with supervisor authorization.

Med:

- After approval by the PI, a copy must be sent to the Safety Committee.
- A written Project Hazard Control is required and must be approved by the PI before proceeding. A copy must be sent to the Safety Committee.
- A second worker must be in place before work can proceed (buddy system).
- Limit the number of authorized workers in the hazard area.

Med High:

- After approval by the PI, the Safety Committee and/or EHS must review and approve the completed PHA.
- A written Project Hazard Control is required and must be approved by the PI and the Safety Committee before proceeding.
- Two qualified workers must be in place before work can proceed.

- Limit the number of authorized workers in the hazard area.

High:

- The activity will not be performed. The activity must be redesigned to fall in a lower hazard category.

Appendix A: Hazard types and examples

Types of Hazard	Example
Physical hazards	Wet floors, loose electrical cables objects protruding in walkways or doorways
Ergonomic hazards	Lifting heavy objects Stretching the body Twisting the body Poor desk seating
Psychological hazards	Heights, loud sounds, tunnels, bright lights
Environmental hazards	Room temperature, ventilation contaminated air, photocopiers, some office plants acids
Hazardous substances	Alkalis solvents
Biological hazards	Hepatitis B, new strain influenza
Radiation hazards	Electric welding flashes Sunburn
Chemical hazards	Effects on central nervous system, lungs, digestive system, circulatory system, skin, reproductive system. Short term (acute) effects such as burns, rashes, irritation, feeling unwell, coma and death. Long term (chronic) effects such as mutagenic (affects cell structure), carcinogenic (cancer), teratogenic (reproductive effect), dermatitis of the skin, and occupational asthma and lung damage.
Noise	High levels of industrial noise will cause irritation in the short term, and industrial deafness in the long term.
Temperature	Personal comfort is best between temperatures of 16°C and 30°C, better between 21°C and 26°C. Working outside these temperature ranges: may lead to becoming chilled, even hypothermia (deep body cooling) in the colder temperatures, and may lead to dehydration, cramps, heat exhaustion, and hyperthermia (heat stroke) in the warmer temperatures.
Being struck by	This hazard could be a projectile, moving object or material. The health effect could be lacerations, bruising, breaks, eye injuries, and possibly death.
Crushed by	A typical example of this hazard is tractor rollover. Death is usually the result
Entangled by	Becoming entangled in machinery. Effects could be crushing, lacerations, bruising, breaks amputation and death.

High energy sources	Explosions, high pressure gases, liquids and dusts, fires, electricity and sources such as lasers can all have serious effects on the body, even death.
Vibration	Vibration can affect the human body in the hand arm with `white-finger' or Raynaud's Syndrome, and the whole body with motion sickness, giddiness, damage to bones and audits, blood pressure and nervous system problems.
Slips, trips and falls	A very common workplace hazard from tripping on floors, falling off structures or down stairs, and slipping on spills.
Radiation	Radiation can have serious health effects. Skin cancer, other cancers, sterility, birth deformities, blood changes, skin burns and eye damage are examples.
Physical	Excessive effort, poor posture and repetition can all lead to muscular pain, tendon damage and deterioration to bones and related structures
Psychological	Stress, anxiety, tiredness, poor concentration, headaches, back pain and heart disease can be the health effects
Biological	More common in the health, food and agricultural industries. Effects such as infectious disease, rashes and allergic response.

Project Hazard Control- For Projects with Medium and Higher Risks

Name of Project:		**Date of submission:**
Team member	**Phone number**	**e-mail**
Hunter Dabbs	(321) 265-1648	hbd19b@fsu.edu
Tye Fountain	(772) 485-0024	twf20@fsu.edu
Thiago Todesco	(760) 891-9630	tr21l@fsu.edu
Joseph Bechara	(786) 482-3667	jab20l@fsu.edu
Faculty mentor	**Phone number**	**e-mail**
Shayne McConomy	(850) 410-6624	smcconomy@eng.famu.fsu.edu

Rewrite the project steps to include all safety measures taken for each step or combination of steps. Be specific (don't just state "be careful").

When the machine shop is being utilized all safety protocol must be followed and proper PPE should be worn. This is important to know as machines used could prove dangerous to the technician if proper protocol is not followed.

Laser cutting is dangerous. To avoid accidents the proper PPE should be used. Technicians certificated in the matter should be the ones using this type of machine, as they will be able to know which type of materials are able to be cut and follow the required safety protocol.

Different 3D printing materials have different requirements depending on toxicity of the fumes emitted. If a plastic is being utilized that emits toxic fumes, then an enclosure and air circulation must be implemented. The team has access to a printer with these capabilities and will be able to print in these materials if necessary.

When operating soldering equipment, users must follow proper PPE regulations (Lab rated eyewear) and use the solder fume extractor. These practices prevent operators from being burned with the soldering equipment and reduce the fumes being inhaled by the user. Operators should also take several minute soldering breaks every 15 minutes to reduce prolonged time exposed to fumes.

Thinking about the accidents that have occurred or that you have identified as a risk, describe emergency response procedures to use.

In the case that a person is exposed to the lasers for a prolonged period, which should be highly unlikely, the individual should seek immediate medical attention by calling 911. The risks for exposure to lasers are total vision or bleeding from burns to the eye.

In the case that a person is burned during the use of soldering equipment, they should seek first aid and treat the burn immediately. For severe burns, the user should call 911. Once treatment is complete, the user should then fill-out and submit an incident report form to their instructor.

In the case that a user is injured during the operation of the machine shop, they should seek immediate first aid or call 911 if the injury is severe. Afterwards, an incident report should be filled-out and submitted to machine shop personnel.

List emergency response contact information:

- Call 911 for injuries, fires or other emergency situations
- Call your department representative to report a facility concern

Name	Phone number	Faculty or other COE emergency contact	Phone number
Hunter Dabbs	**(321) 265-1648**	**Shayne McConomy**	**(850) 410-6624**
Tye Fountain	**(772) 485-0024**	**Keith Larson**	**(850) 410-6108**

Thiago Todesco	**(760) 891-9630**	**Jeremy Phillips**	**(850) 410-6113**
Joseph Bechara	**(786) 482-3667**		

Safety review signatures

Team member	Date	Faculty mentor	Date
Joseph Bechara	**11/21/2023**		
Hunter Dabbs	**11/21/2023**		
Tye Fountain	**11/21/2023**		
Thiago Todesco	**11/21/2023**		

Report all accidents and near misses to the faculty mentor.