NTNU

Faculty of Engineering (IV)
Department of Mechanical and Industrial Engineering (MTP)

Date created 18.11.2020 Last Revision 23.09.2022

RISK ASSESSMENT

ONLY VALID FOR DETAILED ACTIVITIES LISTED IN SECTION 5

1. Identification

Laboratory name: Ubåten	**Room number:** Verksted Teknisk M43 and M43B
User's name: Bjørn Lerberg	☒Master ☐PhD ☐Post-Doc ☐SINTEF ☐Other:
User's e-mail: btlerber@stud.ntnu.no	**User's Phone:** 41418489
Supervisor: Håkon J. D. Johnsen	**Supervisor's phone:** 97648711
Project number: 70444096	
Period: 31.01.2023- 01.08.23	

Description of the project and needs:
Description: Rapid prototyping of non-imaging optics. Creating multiple lens prototypes with different production techniques. Mainly press molding and 3d-printing. **Needs:** I need the laboratory for creating prototyping jigs and 3d-printed molds. As well as using the hand-tools and power tools for simple prototyping. In case I want to utilize the laser cutter, I included this activity as well.

2. Signatures

The user and the supervisor are aware of all the risks involved in the lab activities that are going to be performed. Additionally, the user confirms that they will follow the preventive measures described in this form to minimize all the risks that have been identified.

User's signature	Supervisor's signature
Signature: 	Signature: 
Name: Bjørn Lerberg	Name: Håkon J. D. Johnsen
Date: 31.01.2023	Date: 31.01.2023

Approved by:

	Signature:	Name:	Date:
Room responsible:		Håvard Vestad	
Lab manager:			

Note: a pdf copy with all signatures shall be sent to everyone who has signed above.

3. Team (write "NR" if not relevant)

Project manager and organization (Student)	Bjørn Lerberg	Responsible for instrumentation	NR
Laboratory responsible	Håvard Vestad	Operator	Bjørn Lerberg
Auditor for safety check	NR	Responsible for running the experiment	Bjørn Lerberg
Responsible for experimental and scientific content (Advisor)	NR	Responsible for logging and storing experimental data	NR
Responsible for dimensioning load bearing and pressurized components	NR	Responsible for building the rig	NR

4. Administration

Answer: Yes, No or NR (Not relevant)

Is the work order signed? (only for external work)	NR
Has the operator the required courses/training on the equipment?	Yes
Has the operator followed the safety courses? **(Mandatory)**	Yes
Can the work be done alone?	No
- If not, the work may have to be done under special conditions (evaluated in section **5**)	Yes
Does an expert have to check the start of the experiment?	No
- If yes, who?	NR

5.1 Description of the Activity

Laser cutting

For each activity performed in the lab, health risks affecting the user or others need to be identified. For each risk identified, a preventive measure must be performed, and the final risk value calculated with the "risk matrix". Explanation of the "risk matrix" can be found in the last page of this form.

This page must be replicated for each different activity performed in the lab. Activities involving the use of chemicals must be filled out in the page titled "Chemical Risk Assessment" in section 5.2.

Activity: laser cutting jigs for production of prototypes

Risk overview: (mark with X the risk that applies for the activity)

Big loads		Danger of fire	X
Heavy lifting		Working at heights	
Hanging load		Hydraulic pressure	
Gas pressure		Water pressure	
High temperature	X	Low temperature	
Parts at high velocity		Chemicals, if yes; fill in sect. 5.2	
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust	X	Severe noise	
Danger of pinching		Rotating parts	

Detailed risk evaluation:

Risks
1. Invisible high-power laser
2. Fumes from wood combustion
3. small accumulated wooden pieces can catch fire

Risk	Probability (P) (1-5)	Consequence (C)				Risk value (P x C)
		Health (1-5)	Material values (1-5)	Environment (1-5)	Reputation (1-5)	
1	1	4				4
2	1	2				2
3	2	1	1			2

Risk matrix of the activity before any safety measures has been applied (Include corresponding color):

Required safety equipment (mark with X the risk that applies for the activity)**:**

Glasses		Safety shoes	
Helmet		Gloves	
Screen		Lifting equipment	
Ear protection		Hazard suit	
Harness ropes, other measures to prevent falling		Fume hood	
Lab coat			

Description of other safety measurements: Turn on fume extractor before use and don't look into the laser operational area other than through the safety glass.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1.	
2.	
3. wood leftovers can catch fire	Remove excessive wood leftovers

Risk matrix of the activity after safety measures has been applied:

Risk	Probability (P) (1-5)	Consequence (C)				Risk value (P x C)
		Health (1-5)	Material values (1-5)	Environment (1-5)	Reputation (1-5)	
1	1	1				1
2	1	1				1
3	1	2				2

5.2 Description of the Activity

Using soldering stations, power tools and hand tools

For each activity performed in the lab, health risks affecting the user or others need to be identified. For each risk identified, a preventive measure must be performed, and the final risk value calculated with the "risk matrix". Explanation of the "risk matrix" can be found in the last page of this form.

This page must be replicated for each different activity performed in the lab. Activities involving the use of chemicals must be filled out in the page titled "Chemical Risk Assessment" in section 5.2.

Activity: soldering small mecatronic circuits, using power- and hand-tools to process materials and assemblies.

Risk overview: (mark with X the risk that applies for the activity)

Big loads		Danger of fire	X
Heavy lifting		Working at heights	
Hanging load		Hydraulic pressure	
Gas pressure		Water pressure	
High temperature	X	Low temperature	
Parts at high velocity		Chemicals, if yes; fill in sect. 5.2	
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust	x	Severe noise	
Danger of pinching		Rotating parts	x

Detailed risk evaluation:

Risks
1. Soldering can cause fire, toxic fumes and burnt skin
2. power-tools can cause physical harm, like severe cuts
3. Hand tools can cause minor injuries

Risk	Probability (P) (1-5)	Consequence (C)				Risk value (P x C)
		Health (1-5)	Material values (1-5)	Environment (1-5)	Reputation (1-5)	
1	2	4	2	1	2	8
2	2	3				6

3	2	2				4

Risk matrix of the activity before any safety measures has been applied (Include corresponding color):

Required safety equipment (mark with X the risk that applies for the activity)**:**

Glasses	X	Safety shoes	
Helmet		Gloves	
Screen		Lifting equipment	
Ear protection		Hazard suit	
Harness ropes, other measures to prevent falling		Fume hood	X
Lab coat			

Description of other safety measurements:

1. The lab is equipped with fume hoods for soldering activities and timers, so the soldering stations are time-limited. Soldering should be done with safety glasses.

2. Power tools are to be used in a responsible way. Use safety glasses for operations where there is chance of high velocity chards or chips during the operation.

3. Hand tools should be used the way intended.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. Soldering	Use safety glasses, fume hood and mounted timers
2. power tools	Responsible use and correct safety measures
3. hand tools	Use the tools their intended way.

Risk matrix of the activity after safety measures has been applied:

Risk	Probability (P) (1-5)	Consequence (C)				Risk value (P x C)
		Health (1-5)	Material values (1-5)	Environment (1-5)	Reputation (1-5)	
1	1	1				1
2	2	2				2
3	1	1				1

5.2.1 Description of the Activity

3d-printing

For each activity performed in the lab, health risks affecting the user or others need to be identified. For each risk identified, a preventive measure must be performed, and the final risk value calculated with the "risk matrix". Explanation of the "risk matrix" can be found in the last page of this form.

This page must be replicated for each different activity performed in the lab. Activities involving the use of chemicals must be filled out in the page titled "Chemical Risk Assessment" in section 5.2.

Activity: 3d-printing to create molds and fixtures for prototyping. This includes cleaning the 3d-printer build plate with ethanol.

Risk overview: (mark with X the risk that applies for the activity)

Big loads		Danger of fire	
Heavy lifting		Working at heights	
Hanging load		Hydraulic pressure	
Gas pressure		Water pressure	
High temperature		Low temperature	
Parts at high velocity		Chemicals, if yes; fill in sect. 5.3.2	NR
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust		Severe noise	
Danger of pinching		Rotating parts	

Detailed risk evaluation:

Risks
1. Highly flammable liquid and vapor
2. causes eye irritation

Risk matrix of the activity <u>before</u> any safety measures has been applied (Include corresponding color):

Risk	**Probability (P) (1-5)**	**Consequence (C)**				**Risk value (P x C)**
		Health (1-5)	**Material values (1-5)**	**Environment (1-5)**	**Reputation (1-5)**	
1	2	2	2			4
2	2	2				4

Required safety equipment (mark with X the risk that applies for the activity)**:**

Glasses		Safety shoes	
Helmet		Gloves	
Screen		Lifting equipment	
Ear protection		Hazard suit	
Harness ropes, other measures to prevent falling		Fume hood	
Lab coat			

Description of other safety measurements:

1. Don't use ethanol on open circuits or close to open circuits that can create sparks. Example dismount the build plate on the 3d-printer before wiping with isopropanol.
2. Use safety glasses if there is a risk of getting isopropanol in the eyes.
3. Use in a well ventilated area and avoid directly breathing in the fumes.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. flamabillity	Dismount build plate for cleaning
2. Squirt	Use safety glasses where needed

Risk matrix of the activity <u>after</u> safety measures has been applied:

Risk	Probability (P) (1-5)	Consequence (C)				Risk value (P x C)
		Health (1-5)	Material values (1-5)	Environment (1-5)	Reputation (1-5)	
1	1	2				2
2	2	2				4

6 Sources for mistakes/errors

Is the following considered? Answer: Yes, No or NR (Not relevant)

Loss of electricity	Yes	Voltage surge	NR
Electrical earth failure	Yes	Insufficient power of the machine	NR
Climate control in the room (temperature, humidity, etc…)	NR	Water jet	NR
Unstable pressure or hydraulic force	NR	Unintended interruption of power supply	Yes
Are load and displacement limits established?	NR	Leakage of pipes, hoses, joints, etc…	NR
Possible interference from other activities	Yes	Possible interference towards other activities	Yes
Troubles in acquisition and storage	NR	Fire in the laboratory	Yes

7 Calibration of equipment

If a calibration of the equipment is performed during the activity, please indicate the date:

Equipment	Date (dd.mm.yy)
NR	NR

8 Traceability

Answer: Yes, No or NR (Not relevant)

Are all experimental materials known and traceable?	NR
Is there a plan for marking all specimens?	NR
Is the data acquisition equipment identified?	NR
Are the original data stored safely without modification?	NR
Is there a back-up procedure for the data (hard disk crash)?	NR
Is there a plan for storing samples after testing?	NR
Is there a plan for disposing of old samples?	NR

9 Conclusion

This is a general risk analysis for getting access to a student lab on NTNU, and no specific elaboration is needed for the use of standard equipment, with the exception of a laser cutter.

NTNU
Faculty of Engineering (IV)
Department of Mechanical and Industrial Engineering (MTP)

Date created 18.11.2020 Last Revision 23.09.2022

Risk matrix explanation

		Health	Material values	Reputation	Environment
Grade	1	Minor injury/strain that requires simple treatment. Reversible injury. Short recovery time.	Operational shutdown, or shutdown of activities <1 day.	Little effect on credibility and respect.	Negligible injury and short recovery time.
	2	Injury/strain that requires medical treatment. Reversible injury/strain. Short recovery time.	Operational shutdown, or shutdown of activities <1 week.	Negative effect on credibility and respect.	Minor injury and short recovery time.
	3	Serious injury/strain that requires medical treatment. Lengthy recovery time.	Operational shutdown, or shutdown of activities <1 month.	Reduced credibility and respect.	Minor injury and lengthy recovery time.
	4	Serious injury/strain that requires medical treatment. Possible disability /permanent disability.	Operational shutdown > 1/2 year. Shutdown of activities up to 1 year.	Credibility and respect considerably reduced.	Long-lasting injury. Lengthy recovery time.
	5	Death or disability / permanent disability.	Operational shutdown, or shutdown of activities >1 year.	Credibility and respect considerably and permanently reduced.	Very long-lasting and irreversible injury.

Consequence (C)						
	Very serious	5	10	15	20	25
	Serious	4	8	12	16	20
	Moderate	3	6	9	12	15
	Little	2	4	6	8	10
	Very little	1	2	3	4	5
		Very little	**Little**	**Medium**	**Big**	**Very big**
		Probability (P)				

Red	Unacceptable risk. Measures need to be implemented.
Yellow	Medium risk. Measures need to be considered.
Green	Acceptable risk. Measures can be considered.

Add the color of the risk matrix that corresponds with the value you have placed in your personal risk matrix.