

RISK ASSESSMENT

ONLY VALID FOR DETAILED ACTIVITIES LISTED IN SECTION 5

1. Identification

Laboratory name: Trånslate	Room number: PFI(building 365) room 1311
User's name: Bjørn Lerberg	<input checked="" type="checkbox"/> Master <input type="checkbox"/> PhD <input type="checkbox"/> Post-Doc <input type="checkbox"/> SINTEF <input type="checkbox"/> Other:
User's e-mail: btlerber@stud.ntnu.no	User's Phone: 41418489
Supervisor: Håkon J. D. Johnsen	Supervisor's phone: 97648711
Project number: 987734	
Period: 07.02.2023- 01.07.23	

Description of the project and needs:
<p>Description: Rapid prototyping of non-imaging optics. Creating a lens with advanced geometric form, that still transmits light with limited scattering.</p> <p>Needs: The two 3d-printers w2p Solflex 650 and formlabs form 3 along with curing chamber and wash/rinse of 3d-printed part in isopropanol chamber. Possibly also fume hood(both chemical and the small soldering fume hood).</p>

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: 07.02.2023	Date: 07.02.2023

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Approved by:

	Signature:	Name:	Date:
Room responsible:			
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	Arve Skorstad	Operator	NR
Auditor for safety check	NR	Responsible for running the experiment	Bjørn Lerberg
Responsible for experimental and scientific content (Advisor)	Håkon J. D. Johnsen	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?	Yes
- If not, the work may have to be done under special conditions (evaluated in section 5)	NR
Does an expert have to check the start of the experiment?	No
- If yes, who?	NR

5. Description of the Activity

Using DLP and LCD resin 3d-printers to create transparent lenses for optical purposes. Including using designated uv-curing chambers.

This also includes coating the printed part with different coating techniques, like dip-coating or brush coating. Which requires a fume hood or sufficient ventilation. This also includes uv-curing the part in a light chamber and washing the part in isopropanol washer.

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 and post processing

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	x
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust		Severe noise	
Danger of pinching		Rotating parts	

Detailed risk evaluation:

Risks
1. Handling of resin and chemicals(further elaborated in section 5.2)
2. Faulty use of 3d-printer and other expensive equipment
3. Negatively affect others ongoing experiments
4. Hot surfaces
5. UV-light in curing chamber

Risk matrix of the activity before 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	Explained in chemical section, next chapter								
2	2	1	3	1	1	2	6	2	2
3	2	1	2	1	1	2	4	2	2
4	2	2	1	1	1	4	2	2	2
5	2	3	1	1	2	6	2	2	4

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

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

Description of other safety measurements:

1. Keep spills to a minimum, throw rags and cloth away immediately after cleaning a potential spill. Use labcoat when handling resin in operations that have a high probability of spillage.
2. Only use the equipment in ways that I am sure is correct. Acquire proper training before use. Plan use of equipment well and be prepared before using the equipment.
3. Be sure not use other peoples work benches or move their ongoing experiments. Tidy well after my experiments so others are not affected by my use of the lab.
4. Be familiarized with equipment before use, including reading manual, and following safety instructions.
5. If equipment is marked with warning labels, use certified appropriate poly-carbonate face shield or safety goggles depending on warning label. If lab is not equipped with appropriate equipment contact staff and postpone the operation. PS: The Formlabs cure chamber is totally enclosed and have no warnings of UV-light outside the container.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. Chemicals (explained in 5.2)	
2. Faulty use of printer	Acquire proper training and use only for designated purpose.
3. Affecting others ongoing experiments and work	Keep a clean workspace, and care for the neighbors.
4. Hot surfaces in curing chamber	Don't touch surfaces that can be hot, and familiarize myself with the equipment before use.
5. UV-light	Use appropriate personal protection if there is an open strong unshielded UV-source.

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		Explained in chemical section, next chapter							
2	1	1	3	1	1	1	3	1	1
3	1	1	2	1	1	1	2	1	1
4	2	2	1	1	1	4	2	2	1
5	1	3	1	1	2	3	1	1	2

5.2.1 Chemical Risk Assessment:

Only for activities involving the use of chemicals (except ethanol and acetone for cleaning).

This page **must be replicated** for each different chemical activity performed in the lab. Include all H-sentence and numbers for chemicals used. This can be found in the Safety Data Sheet og the specific chemical(SDS).

Activity: Cleaning 3d-printer and printed parts with isopropanol by hand, and in cleaning chamber meant for this purpose.

Chemicals used:	Isopropanol
Mixture:	1 liter, 40-99% concentration
Will the mixture be stored in the cabinet for several uses?	yes, already in lab

Risk	Prevention Measures
1. H225 Highly flammable liquid and vapour	Avoid electronics, open circuits and flames
2. H319 Causes serious eye irritation	Use safety glasses if needed
3. H336 May cause drowsiness or dizziness	Use in well ventilated area, and avoid inhalation.

Note: All H-sentences must be included as a risk, together with “general” risks when using the specific chemical.

Chemical disposal procedure:
The chemical is stored permanently at the lab, rags and paper cloth is disposed in trash bins.

Risk matrix of the chemical activity before safety measures:

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	3	2	3	1	1	6	9	3	3
2	2	2	1	1	1	4	2	2	2
3	2	1	1	1	1	2	2	2	2

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

Glasses	X	Safety shoes	
Helmet		Gloves	X
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. Locate eye flushing station in case of potential accident.
2. Use glasses if necessary, and be sure to use in a well-ventilated area.
3. Be sure to locate potential ignition sources before using chemical. Be familiar where fire blanket and fire extinguisher is located, and if the fire extinguisher is capable of handling chemical fires.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. Flammability	Avoid use if there is any ignition source
2. Eye irritation	Consider using protective eyewear
3. Drowsiness	Use only in well ventilated are or fume hood.

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	2	3	1	1	2	3	1	1
2	1	2	1	1	1	2	1	1	1
3	1	1	1	1	1	1	1	1	1

Comments: Supplementary comments regarding the risk matrixes

5.2.2 Chemical Risk Assessment:

Only for activities involving the use of chemicals (except ethanol and acetone for cleaning).

This page **must be replicated** for each different chemical activity performed in the lab. Include all H-sentence and numbers for chemicals used. This can be found in the Safety Data Sheet of the specific chemical(SDS).

Activity: Handling 3d-printing resins, including printing and coating with resin.

Chemicals used:	Formlabs high temp v2 resin and other similar resins, with the same H-statements.	
Mixture:	1 L	
Will the mixture be stored in the cabinet for several uses?	yes	

Risk	Prevention Measures
1. H319 Causes serious eye irritation	Use safety glasses/shield during operations where one can spill resin.
2. H317 May cause an allergic skin reaction	Use gloves and wash skin thoroughly after handling with soap.
3. H411 Toxic to aquatic life with long lasting effects	Collect spillage, don't release to environment,
4. H315 causes skin irritation	Wash skin thoroughly after handling.
5. H318 causes serious eye damage	Wear protective gloves/protective clothing/eye protection/face protection:
6. H335 May cause respiratory irritation	Avoid breathing gas/mist/vapors/spray

Note: All H-sentences must be included as a risk, together with "general" risks when using the specific chemical.

Chemical disposal procedure:
Uncured resin shall be cured, and then disposed in regular trash(restavfall). Regular sunlight cures the resin, which means that rags and cloth from potential spills should be cured in sunlight before disposing.

Risk matrix of the chemical activity before safety measures:

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	3	2	1	1	2	6	3	3	6
2	2	1	1	1	1	2	2	2	2
3	2	1	1	2	1	2	2	4	2
4	2	1	1	1	1	2	2	2	2
5	3	4	1	1	2	12	3	3	6
6	2	3	1	1	1	6	2	2	2

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

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

Description of other safety measurements:

Avoid use if proper personal protection isn't present. Use in well ventilated area for operations, where resin is allowed to outgas to the environment. The printer is a closed volume, the outgassing from the printer is therefore limited, though the room have to have a active ventilation to minimize risk of concentrated exposure.

Safety responses:

P302 + P352: IF ON SKIN (or hair) : Wash with plenty of soap and water

P305 + P351 + P338: IF IN EYES : Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310: IF SWALLOWED : Immediately call a POISON CENTER or doctor/physician

P333 + P313 : If skin irritation or rash occurs: Get medical advice/attention

P362 : Take off contaminated clothing and wash before reuse

P391 : Collect spillage

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. eye irritation	Use protective glasses(or shield)
2. skin reaction	Use gloves
3. toxic to aquatic life	Minimize spills, and dispose properly
4. skin irritation	Use coat and gloves
5. eye damage	Always use protective shield
6. respiratory irritation	Use in well ventilated area, don't create mists of chemical.

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	2	1	1	1	2	1	1	1
2	1	1	1	1	1	1	1	1	1
3	1	1	1	2	1	1	1	2	1
4	2	1	1	1	1	2	2	2	2
5	1	4	1	1	2	4	1	1	2
6	2	3	1	1	1	6	2	2	2

Comments:

Line 3, toxic to aquatic life is assumed that only small amount are released to the environment, if not the consequence would have a higher score.

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	NR
Are load and displacement limits established?	NR	Leakage of pipes, hoses, joints, etc...	Yes
Possible interference from other activities	Yes	Possible interference towards other activities	Yes
Troubles in acquisition and storage	Yes	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?	Yes
Is there a plan for marking all specimens?	Yes
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?	Yes
Is there a plan for disposing of old samples?	Yes

9. Conclusion

I will use Trånslate for creating 3d-printed objects and post-processing them. The equipment I need I have been told might be moved during the semester. This will affect my experiments I have contacted the relevant staff, for further planning(Christer Westum Elverum).

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An additional note I would like to add is that faulty or defected equipment should not be use before it has been inspected by trained personel.

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.