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: Tribology	**Room number:** 104 Verkstedteknisk
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: 987734100	
Period: 23.02.2023- 01.08.23	

Description of the project and needs:
Description: Rapid prototyping of non-imaging optics. Creating a lens with a advanced geometric form, that still transmits light with limited scattering. Then measuring the performance of the lens, including surface characterization. **Needs:** IFM microscope for 3d surface mapping of a lens, to characterize profile. Mitutoyo Profilometer to measure roughness of a specimen. The specimens to be considered are made of photopolymerization resins otherwise known as 3d-print resins.

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: 23.02.2023	Date: 23.02.2023

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	Hamid Khanmohammadi
Laboratory responsible	Ida Wadseng Worum	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
-	

5.1.1 Description of the Activity

Using IFM Microscope to characterize different geometrical properties of a surface. And general use of lab.

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: IFM microscope

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. 5.2	
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust		Severe noise	
Danger of pinching		Rotating parts	

Detailed risk evaluation:

Risks
1. Damaging lens, during moving operations and focusing operations of the microscope
2. Other experiments being disrupted
3. General personal safety

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

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	
Lab coat	x		

Description of other safety measurements:

Don't use the moving operations of the microscope while being distracted by other people, or doing multiple activities the same time.

Always have an eye one the lens and the computer monitor while moving or focusing the telescope, to avoid crashing the telescope.

Don't move other experiments, and keep a clean and tidy workspace, so that its easy for other to use the lab at the same time.

Use the required PPE in the lab.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. Crashing the telescope	Use in a responsible way, and pay attention to the operations of the equipment.
2. Disrupting other experiments	Keep a tidy workplace, don't disrupt others workspace.
3. General lab safety	Be aware of your environment, and use required PPE

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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	2	1	3	1	1	2	6	2	2
2	1	1	2	1	1	1	2	1	1
3	1	2	1	1	1	2	1	1	1

5.1.2 Description of the Activity

Measuring surface roughness and profile with profilometer and IFM Microscope

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: Profilometer

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. 5.2	
Sudden acceleration at fracture/failure		Pre-tensioned components	
Dangerous dust		Severe noise	
Danger of pinching		Rotating parts	

Detailed risk evaluation:

Risks
1. Damage equipment from faulty use

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	2	1	3	1	1	2	6	2	2

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	
Lab coat	x		

Description of other safety measurements:

This is finely tuned precision instrument. The profile needle and sensors can suffer damage if exerted to impacts or rough handling.

Be careful in use especially when taking out and in from package.

The surface needle moves during operation, be sure that the whole movement off the needle is free of obstacles.

Always have a steady surface to place the profilometer during use, to prevent tipping over equipment.

Risk after preventative and corrective measures:

Risks	Preventative and corrective measures
1. Damage equipment	Use in a responsible way.

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	1	3	1	1	1	3	1	1

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	NR	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…	NR
Possible interference from other activities	Yes	Possible interference towards other activities	NR
Troubles in acquisition and storage	NR	Fire in the laboratory	

7. Calibration of equipment

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

Equipment	Date (dd.mm.yy)

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?	NR
Is the data acquisition equipment identified?	Yes
Are the original data stored safely without modification?	Yes
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?	Yes

9. Conclusion

Both the profilometer and the Alicona IFM Microscope are equipment that is generally low- risk equipment for the health of the user. In contrast, damaging the equipment itself, would affect not only the cost of the equipment, but also postpone all the users of the equipment in their

experiments. Therefore it is of great importance to take care of the equipment during use, so accidents or damage to equipment is avoided.

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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.