Hazard Analysis
Measuring Microstructure Changes During Thermal Treatment

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Table 1: Revision History

Date	**Developer(s)**	**Change**
Oct 13, 2022	Abdul Nour Seddiki	Integrated the Template + Added System Boundaries and Components
Oct 14, 2022	Edwin Do	Add introduction, scope and purpose of HA
Oct 19, 2022	Joseph Braun	Added Hardware and Software Requirements
Oct 19, 2022	Joseph Braun	Added FMEA Table
Oct 19, 2022	Edwin Do	Add roadmap
Oct 19, 2022	Timothy Chen	Critical Assumptions
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1 Introduction

This document is the hazard analysis for Team 30 (ReSprint) Capstone project. This project collaborates with the Department of Materials Engineering to measure the microstructure changes of samples during thermal treatment.

For this document, a hazard will be defined as a scenario where the conditions of a system and environment constitutes the potential of harm to someone or something.

2 Scope and Purpose of Hazard Analysis

The purpose of this hazard analysis is to document any potential unsafe behaviour in this project. This includes risks in this project that can arise from using either the software or hardware components. For each hazard identified, this document will outline one or more methods to help mitigate the hazard.

The scope will be limited to identifying the possible hazards from the system's components, methods of mitigation, potential causes, and any resulting security or safety requirements.

3 System Boundaries and Components

This hazard analysis is conducted on the system that consists of the following components:

1. Thermally treated samples
2. The current source
3. A temperature sensor
4. The nanovoltmeter
5. Interfaces between above devices and control computer
6. The control computer
7. The software application that will be installed on the control computer

These components comprise the system in question. And they each are also considered the boundaries for this system. Some of the components mentioned are not controllable by ReSprint team, such as the thermally treated samples and all of the measurement devices and hardware including the current source, the temperature sensor, the nanovoltmeter, the communication interfaces and the control computer. Therefore, the only component controllable by ReSprint team is the software application and its sub-systems.

4 Critical Assumptions

The following is a list of assumptions to protect ourselves during the development of ReSprint from unforeseen hazards:

- Thermal treated samples will be contained in a safe area away from the control computer and operator.
- Current source device will be used as intended and will not be misuse by the operator.
- Wires will not come loose during operation by the operator.
- Data collected from the samples will be saved correctly on the control computer.
- Plugs and wires are attached correctly into the devices and control computer.

5 Failure Mode and Effect Analysis

The next two pages contain the Failure Mode and Effect Analysis (FMEA) Table.

Table 2: FMEA Table

Component	**Failure Mode**	**Effects of Failure**	**Causes of Failure**	**Recommended Action**	**Req.**	**Ref.**
Current Source	Current source does not provide current	Nanovoltmeter cannot measure voltage across sample	a. Setup error b. Hardware failure	a. Troubleshoot current source setup b. Replace current source	a. HWR1 b. HWR2	H1-1
Nanovoltmeter	Nanovoltmeter does not read voltage across sample	Voltage data cannot be communicated to App	a. Setup error b. Hardware failure	a. Troubleshoot nanovoltmeter b. Replace nanovoltmeter	a. HWR1 b. HWR2	H1-2
Temperature Sensor	Temperature sensor does not read temperature of the sample	Temperature data cannot be communicated to App	a. Setup error b. Hardware failure	a. Troubleshoot temperature sensor setup b. Replace temperature sensor	a. HWR1 b. HWR2	H1-3
Serial Connection	App does not receive data from hardware	Data cannot be communicated to App	a. Setup error b. Hardware failure	a. Troubleshoot serial connection b. Replace serial connection cable	a. HWR1 b. HWR2	H1-4
Windows App	App cannot be installed on control computer	User cannot utilise the App	a. Compatibility error	a. App shall be designed to be compatible with the operating system on the control computer	a. SWR1	H2
	App is not ergonomic for user	User cannot utilise the App without causing harm	a. Graphics change brightness too rapidly b. Graphics contain colours that are too bright	a. App shall not change screen brightness unless the user chooses b. Graphics shall be designed with dimmed or neutral colours	a. SFR1 b. SFR2	H3

Table 3: FMEA Table continued

Component	**Failure Mode**	**Effects of Failure**	**Causes of Failure**	**Recommended Action**	**Req.**	**Ref.**
Windows App	App does not receive data	Resistivity of sample cannot be calculated	a. Setup error b. Hardware failure c. Software connection error	a. Refer to H1 b. Refer to H1 c. Check that software is accessing the correct serial port	a. HWR1 b. HWR2 c. SWR2	H4
	Calculated values are not correct	User receives inaccurate results	a. User altered measurements through interface b. Software does not calculate values correctly	a. Prevent user from altering measurements received from hardware b. Check that formulas for calculation used by software are correct	a. SCR1 b. SWR3	H5
User	User sustains physical injury while interacting with hardware components	User cannot utilise the App; Legal ramifications	a. User is not trained to interact with hardware components	a. Ensure that authorised users are properly trained to interact with hardware components safely	a. SFR3	H6
	App is modified by unauthorised user	App no longer functions as required	a. Unauthorsied user has gained access to App	a. Ensure that only authorised users are permitted to access the App	a. SCR2	H7

6 Safety and Security Requirements

Safety Requirements

SFR1. Graphics shall avoid changing of brightness at rapid rate to take account for users prone to seizures.

SFR2. Colours should avoid brightness that can be damaging to users' eyes.

SFR3. Untrained users should not need to interact with any electronic equipment to avoid potential injury.

Security Requirements

SCR1. Interface shall prevent any modifications or injections of data from the user.

SCR2. Only authorized users are allowed to modify concealed calculations, settings and/or parameters.

Hardware Requirements

HWR1. All hardware components must be properly setup and configured to perform their required functions.

HWR2. All hardware components must be functioning properly i.e. not faulty.

Software Requirements

SWR1. The App must be designed to be compatible with the operating system running on the control computer. The operating system used may be changed over the course of the project.

SWR2. The App must be able to identify and connect to the correct serial port so that it is able to receive data from the hardware.

SWR3. The App must perform the resistivity calculations and any other required calculations using the correct formulae.

7 Roadmap

As part of this project, the safety requirements that we will address includes not using any colours and/or graphics that may cause harm or discomfort to the users and that the application along with its equipments will be functional.

In addition, hardware-related requirements mentioned in the table above will be addressed up to the day of the final deliverable for the scope of this project. Any other requirement may be included in the Proof of concept or the final deliverable which are on November 14 2023 and March 20 2023 respectively.

Certain requirements will not be included as part of the capstone timeline. These requirements include ensuring that any future users will have sufficient training before interacting with the project and that the app should not be modified by an unauthorized user. They should be implemented in the future by whoever oversees the use of this capstone.