

2117075

by Thomas Woods

Submission date: 24-Jan-2023 06:40PM (UTC+0000)

Submission ID: 196049898

File name: 17373_Thomas_Woods_2117075_180907_1023082450.pdf (1.67M)

Word count: 3275

Character count: 20257

Course: HNC Electrical and Electronic Engineering
Module: SGEE4005 Instrumentation and Integrated Automation Systems
Assignment: 1. Instrumentation for Automation Systems
Name: Thomas Woods
University number: 2117075
Date submitted: 24/01/2023.
Word count: 2544

Table of Contents

Table of Figures	3
Table of Tables	3
1. Work Plan for Lifelong Learning and Risk Assessment	4
2. System Investigation	5
Process Station Sub-system.....	5
Flow Control Loop.....	5
Temperature Control Loop	5
Level Control Loop.....	6
Water Recirculation Sub-system.....	6
3. Calibration of Pressure Sensor.....	7
4. Calibration of Temperature Sensor	8
5. Calibration of Level Sensor.....	9
6. Calibration of Position Sensors	10
7. Research	11
Industry 4.0	11
I-O Link.....	11
Level Sensor	11
Flow Sensor	12
Temperature Sensor.....	12
Distance Sensor	12
8. Health and Safety, Environmental, Maintenance and Reliability	13
9. Conclusions and Recommendations	14
10. Team Working.....	15
11. Citation List.....	16
12. Appendix.....	18

Table of Figures

Figure 1 - Temperature Control Loop 6

Figure 2 - Pressure Sensor Calibration Graph..... 7

Figure 3 - Temperature Sensor Calibration Graph 8

Figure 4 - Calibrated Level Sensor Graph 9

Figure 5 - System Risk Assessment..... 18

Table of Tables

Table 1 - Pressure Sensor Calibration Results..... 18

Table 2 - Temperature Calibration Results..... 19

Table 3 - Level Sensor Calibration Results 19

Table 4 - Position Sensor Right Table of Results 20

Table 5 - Position Sensor Left Table of Results..... 20

1. Work Plan for Lifelong Learning and Risk Assessment

The purpose of this assignment is to gain an understanding of the application of instrumentation and integrated automation systems which are commonly used within modern manufacturing industries. This assignment will be conducted within the college premises and will be conducted within the G8 laboratory. Within this laboratory it contains a CIM system (Computer Integrated Manufacturing). It has a varies amount of PLC's and HMI's which are built into the local stations. Each station contains a range of instrumentation and actuation devices. The purpose of the assignment will involve the focus on the process station and the water recirculation sub-system. *This is more of an introduction rather than a work plan.*

Prior to the system investigation being conducted an overall risk assessment was created. The risk assessment can be seen in the appendix. The purpose of the risk assessment is to help identify the risks and dangers that can be involved within overall. With the purpose of reducing or removing the overall risks identified.

2. System Investigation

For the system being investigated *there* that are three separate sensors used within the water recirculation sub-systems. These sensors include a flow sensor, a temperature sensor, and a level sensor.

Process Station Sub-system.

Flow Control Loop

Within the loop there is a flow controller (FC535). This controller creates a control variable. This voltage is connected to a pump amplifier (LY541). The PV for the loop comes from a flow transmitter (FT535). Within the loop there are two interlocks available these are V515 and V516. These interlocks are designed to ensure that the water can flow up to the correct tank (B1).

Temperature Control Loop

The temperature control loop is controlled with a temperature controller (TC511). This controller generates a constant voltage which is fed into a solid-state relay with the use of pulse wave modulation. This controls the heater for the loop. The PV for the control loop comes from a temperature transistor (TT511). The interlock for the control loop is provided by the level sensor (LS542) from the tank B1, this ensures that there is a certain amount of water within the tank. To ensure that the heating element doesn't burn out. To cool the tank after it has been heated. A cooling fan is used. Additionally, a combination of solenoid valves (V515, V516) is used to turn a pump on to add cold water to the system, reducing the temperature.

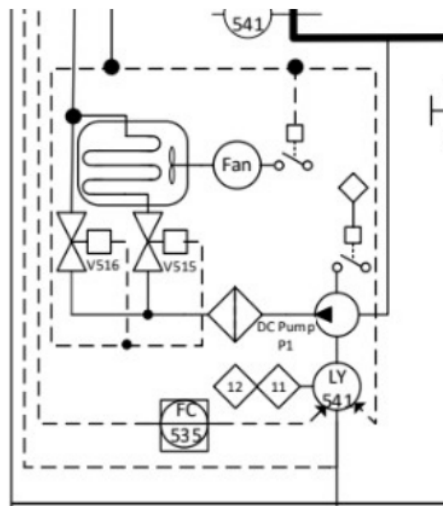


Figure 1 - Temperature Control Loop

(Williams, 2018)

Level Control Loop

The level in the tank B1 is controlled by a level controller (LC541). The values are detected by a level transistor (LT541). When the tank needs to be drained a solenoid valve is opened (V500). While the drain solenoid is open the pump out put value is reduced to control the water flow.

Water Recirculation Sub-system

For the water recirculation system, the output flow of the water is detected by a flow transistor (FT531). The flow of water within the system is controlled by the proportional valve (VF531). The flow controller (FC531) controls this valve. To control the water entering the tanks, there are a series of solenoid valves that can be opened or closed.

The brief asks you to investigate the sensors used in these subsystems

3. Calibration of Pressure Sensor

To calibrate the pressure sensor the pressure was manually incremented from 0Bar to the maximum value of 5Bar. While using increments of 0.5Bar. At these increments a voltage reading was determined and recorded onto a table. Once the maximum pressure value was achieved the pressure was then decreased by the decrement of 0.5Bar until 0Bar reached. The Multimeter during the calibration was connected in parallel with the system. This is to allow for the measurement of voltage without interrupting the system.

As shown below the graph was created from the results of the calibration as shown in the appendix. As can be seen the collected results follow a linear trend. Additionally, there is small variation between the rising and falling trend lines. The highest Hysteresis shown on table 1 within the calibration was -0.25. This shows the accuracy of the sensor is high.

Should be quoted as %FSD
What was the static sensitivity and how do your results compare with the manufacturer's data?

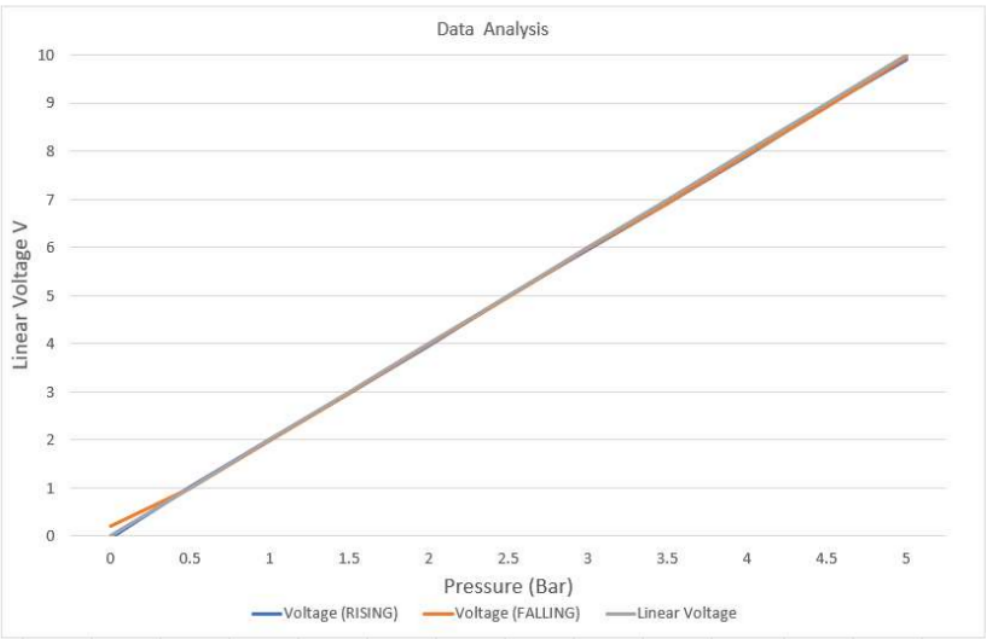


Figure 2 - Pressure Sensor Calibration Graph

4. Calibration of Temperature Sensor

For the calibration of the temperature sensor, increments of 10 degrees Celsius were used and the change in the current was measured against the temperature sensor. The incrementing temperature was increased until a maximum reading of 100 degrees Celsius is reached. The readings of the rising temperature were measured on a multimeter and the results were recorded onto a spreadsheet. Once the maximum temperature was reached the systems temperature was decremented by 10-degree intervals. The multimeter was required to be connected in series with the system to allow the measurement of the current. During the calibration there was a slight discrepancy with the sensor's temperature. When the sensor detects a temperature of 0 degrees. The output current is equal to 4mA. This shown by the temperature sensor calibration results table within the appendix.

Shown below in figure 2 is the graph that was generated from the results collects during the temperature sensor calibration. The result of the calibration is shown in the appendix as table 2. As can be seen the graph follows a linear trend. There are also very small variations in comparison of the linear values and the rising and falling values. This proves the accuracy of the sensor, as the sensor works under fine tolerances. From Table 2 in the appendix it shows

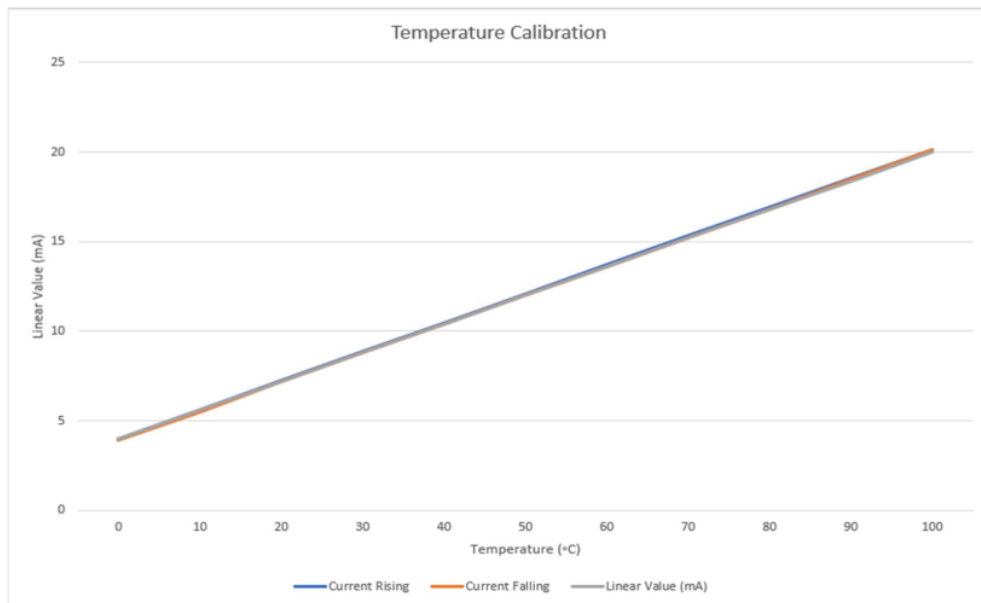


Figure 3 - Temperature Sensor Calibration Graph

Should be quoted as %FSD

that the highest hysteresis was 0.15 this shows that the errors within the system are small resulting in a higher accuracy.

What was the static sensitivity and how do your results compare with the manufacturer's data?

5. Calibration of Level Sensor

To calibrate the level sensor the level of the water tank was manually incremented from 7cm to the maximum value of 23cm. While following increments of 1cm. The level was altered with the use of a DC pump. At each of the increments a current reading was collected and stored into a table of results. Once the maximum level of the tank was achieved, the process was repeated but with the level of the tank falling of decrements of 1cm until the tank had reached 7cm again. At each increment the current was measured, this was done by connecting a multimeter in series with the system.

Shown below in figure 3 is the graph that was generated from the results collects during the level sensor calibration. The result of the calibration is shown in the appendix as table 3. As can be seen the graph follows a linear trend. There are also very small variations in comparison of the linear values and the rising and falling values. This proves the accuracy of the sensor, as the sensor works under fine tolerances. As can be seen within the graph is the offset. This offset was created due to the original position for the level sensor being 7cm.

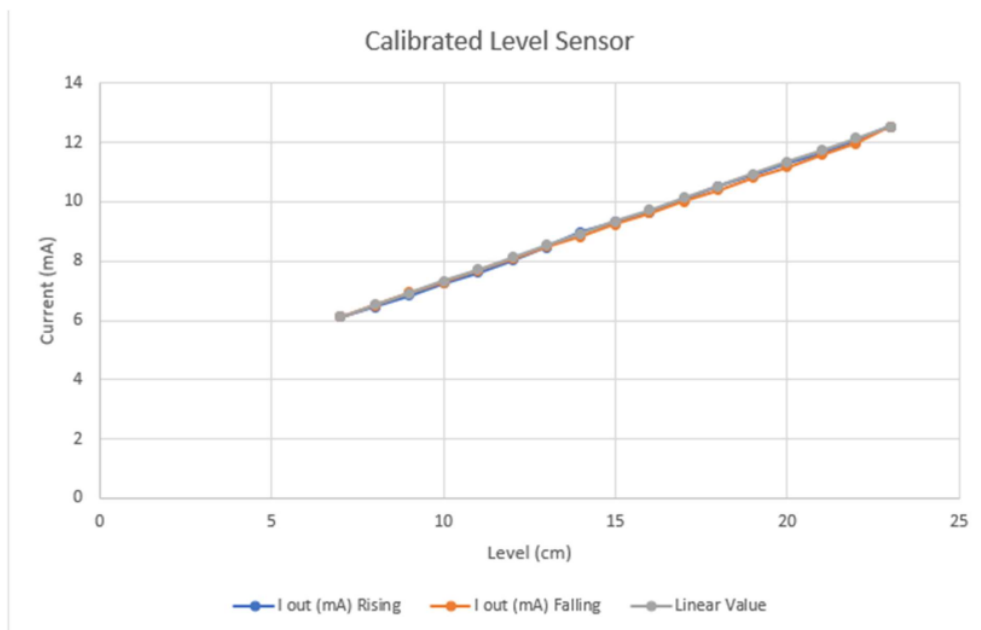


Figure 4 - Calibrated Level Sensor Graph

From Table 3 within the appendix it shows that the highest hysteresis values are 0.15. This proves that the sensor within the system is working to a high degree of accuracy.

Should be quoted as %FSD
What was the static sensitivity and how do your results compare with the manufacturer's data?

6. Calibration of Position Sensors

The position sensor for the system was a laser. To calibrate the sensor the distance was incremented by intervals of 100mm. This was done until the sensor had reached the end of the x axis travel. The movements were controlled with a DC motor. To test the accuracy of the sensor the values of the laser at each of the intervals was compared against a calibrated encoder. These errors were collected onto a spreadsheet for analysis. The differences between the laser and encoder values are due to the degree of accuracy the encoder has compared to the laser. The encoder can measure the position at increments of 0.1mm. Once the gantry has reached the end of the x axis travel. The process was repeated while travelling back to its original position. The current laser position sensor that is installed within the system is a 01D100. This is a photoelectric distance sensor, and it has the ability of measuring within a maximum range of 10m. Additionally, it has two switching outputs. One of the outputs can be programmed to work as an analogue output. A limitation for this sensor is that the working temperature range is limited between -10 and 60 degrees Celsius. This can restrict its use within hotter environments. For the calibration of the position sensor the highest hysteresis values that was recorded during the left and right motions shown is Table 4-5. Was -87.06. However, due to this hysteresis being located at much higher scale compared to the standard deviation. It is possible to consider this result as anomalous. Additionally, the accessibility for the calibration of this sensor is the advantage of a very repeatable test. However, the laser that is used within the system isn't very accurate, as the hysteresis errors for the calibration have an average that is quite large. [How do your results compare with the manufacturer's data?](#)

7. Research

Industry 4.0

Industry 4.0 allows for a larger amount of automation than that compared with the third industrial revolution. (i-SCOOP, 2019). The uses of industry 4.0 allows it to be applied to a range of levels within the manufacturing process. Posey states that “some manufacturers apply Industry 4.0 concepts to external resources such as supply chains, thereby enabling them to better anticipate supply disruptions, while also making it easier to source all of the materials used in the manufacturing of a product.” (2021, p. 4) According to TIBCO (2022) it's the delivery of interconnected automated global workflows that automate processes to improve quality and increase machinery availability. (2022). The advantages that industry 4.0 is it allows for a remote access to a system from online. This grants any authorised person to monitor the system from any location.

I-O Link

Control states that ""(2023)

A common tool that is implemented into industries is I-O link integrated components. “IO-Link is a powerful standard, an increasingly dep ~~Incorrectly cited, this is not the Harvard Method~~ on protocol used to communicate with sensors and/or actuators.” (Comtrol, 2023). IO-Link was first developed in the year 2006. Once the development was completed a wide range of companies were involved these can include. According to Foundation ~~some common companies that has~~ implemented I-O Link into their products are IFM, WAGO, Sick, Siemens. (2023). Commonly within an IO-Link system there will be an IO-Link master that controls all the slave units within the system. An IO-Link master device can contain multiple channels or ports this means that “An IO-Link device can be connected to each port, meaning IO-Link is a point to point communication and not a Fieldbus.” (Jowett, 2019) ~~Incorrectly cited, this is not the Harvard Method~~
Jowett states that ""(2019)

Level Sensor

For the level sensor a suitable replacement would be an IFM LR2750. This sensor has the capability of working of running with a median temperature of -40 – 150°C. (IFM , 2017). The benefits that this sensor brings to the system is that it has I-O Link capability. It has an analogue output of 4 -20mA which is invertible and scalable. (IFM . 2017). It also comes in a ~~Correctly cited~~

variety of the probe lengths this will allow the sensor to fully detect the level of the tank from full to empty.

Flow Sensor

For the flow sensor within the system a suitable replacement is an IFM SA5000 this sensor can work under the temperature range that is present. The output function is "normally open / normally closed; (parameterisable)." (IFM, 2021). It also has an analogue output of 4 – 20mA which is also scalable. IFM states that the probes length is 45mm (IFM, 2021) which will be a suitable length for the system.

Why are you quoting here?
Why aren't you quoting here?
Your citation method is not consistent and rather random

Temperature Sensor

For the temperature sensor within the system a suitable replacement is an IFM TN2511. This sensor has the capability to operate with the necessary temperature range. Additionally, it has an analogue current output of "4-20mA" (IFM TN2511, 2021). It also has a probe length of 45mm which is compatible with the system present. This sensor is suitable for purpose as the working temperature range is within tolerance of the systems temperature.

Distance Sensor

For the distance sensor within the system a suitable replacement would be the UGT592 ultrasonic sensor. It has a sensing range of 40 to 300mm (IFM, 2021). It also has an output function of "normally open / normally closed, (parameterisable)." (IFM, 2021)

8. Health and Safety, Environmental, Maintenance and Reliability

One of the potential environmental hazards within the system is the use of a very diluted sulfuric acid. When the acid has become contaminated it must be disposed of in the correct manner following all health safety guidelines. Such as suitably rated acid protection gloves. Additionally, when the acid is being disposed it needs to be managed correctly and removed using the necessary COSHH regulations. A way to minimise the environmental hazard would be to only exchange the acid for new. When the acid has become contaminated or the pH is no suitable, for the disposal of the acid it would be recommended to neutralise it with a countering alkaline. Such as Caustic Another, environmental issue with the system is the high energy consumptions with the different sub-systems while running. One of the main systems that has a high energy consumption is the heating tank. This is due to the heating element being used to increase the temperature of the water from room temperature to 100 degrees Celsius.

For the maintenance of the system, it should be conducted on set periods. These checks can include the investigation of the valves within the system to ensure they are working correctly. Another maintenance check would be motor/ pump inspection. These checks should consist of continuity checks of the phases to ensure that the motor is not beginning to breakdown. Also, insulation resistance checks should be carried out to ensure that there are no possible shorts within the wiring or the windings. With regular maintenance checks being conducted. It will help to increase the reliability of the overall system as issues will be identified before they become a problem.

What diagnostic facilities already exist?

9. Conclusions and Recommendations

Through the development of this assignment, a larger understanding and knowledge was developed. The implementation of the understanding of calibrating various sensor and meters. Another key source of information that was learned during this assignment was the numerous benefits that IO-Link capable devices and industry 4.0 can have on different working environments and their ability to monitor and maintain different equipment. Another piece of knowledge that was developed during this assignment was the extraction of relevant information from different documents and data-sheets, this allows to quickly and accurately extract information that is suitable for the task.

You need to improve your writing style as it is rather awkward.

From the calibrations that were carried out each of the sensor were compared in their tolerances for their accuracy. The only sensor that performed within its tolerance of errors was the temperature sensor. However, this is likely due to the method of calibration, as the sensor was evaluated against no other calibrated source. Whereas the position sensor was compared to a pre-calibrated line encoder with a much higher degree of accuracy.

This sentence says nothing

For possible recommendation to the system that could be carried out in the future. Would be to replace some of the sensors within the system with IO-Link control technology. With IO-Link being integrated into the system it would allow for better control of over the system and to effectively maintain the operation. Another recommendation to the system that would be beneficial would be to implement of industry 4.0. With this implemented correctly it would allow for the monitoring of the system through a separate network. This is a fundamental step for industrial operations as the system will be able to be monitored from an external site.

Try reading your paragraphs out loud. Then you will be able to improve the way you write. Ask someone else to read them and suggest a better way.

10. Team Working

For the various calibrations that were conducted the implementation of team working was a beneficial and crucial aspect. With the use of teamwork, it allowed for different ideas from different backgrounds to be implemented into the tasks. This creates an inclusive and equal working environment. Another benefit of teamworking is while any work is being carried out different mistakes can be identified before they can cause problems. The work for the overall project was distributed amongst the team equally. This was to keep the workload fair and equal. During the team working activities the rolls of each member were alternated during each of the calibrations. This allowed for each member of the team to have the equal opportunity to work on each part of the calibration.

11. Citation List

Control, 2023. *What is IO-Link*. [Online]

Available at: <https://comtrol.com/io-link-master-gateways/what-is-io-link>

[Accessed 17 January 2023].

Foundation, O., 2023. *IO-Link*. [Online]

Available at: [https://opcfoundation.org/markets-collaboration/io-](https://opcfoundation.org/markets-collaboration/io-link/#:~:text=Founded%20in%202006%2C%20it%20is,implements%20a%20master%2Fdevice%20architecture.)

[link/#:~:text=Founded%20in%202006%2C%20it%20is,implements%20a%20master%2Fdevice%20architecture.](https://opcfoundation.org/markets-collaboration/io-link/#:~:text=Founded%20in%202006%2C%20it%20is,implements%20a%20master%2Fdevice%20architecture.)

[Accessed 17 January 2023].

IFM , 2017. *IFM LR2750 Level Sensor*. [Online]

Available at: file:///C:/Users/TW217543/Downloads/LR2750-02_EN-GB.pdf

[Accessed 22 November 2022].

IFM TN2511, 2021. *IFM Temperature sensor wiht display*. [Online]

Available at: [file:///H:/My%20Downloads/TN2511-00_EN-GB%20\(1\).pdf](file:///H:/My%20Downloads/TN2511-00_EN-GB%20(1).pdf)

[Accessed 23 November 2022].

IFM, 2021. *IFM SA5000 Flow Sensor*. [Online]

Available at: [file:///C:/Users/TW217543/Downloads/SA5000-01_EN-GB%20\(1\).pdf](file:///C:/Users/TW217543/Downloads/SA5000-01_EN-GB%20(1).pdf)

[Accessed 22 November 2022].

IFM, 2021. *IFM UGT592 ultrasonic sensor*. [Online]

Available at: file:///H:/My%20Downloads/UGT592-00_EN-GB.pdf

[Accessed 23 November 2022].

i-SCOOP, 2019. *i-SCOOP*. [Online]

Available at: <https://www.i-scoop.eu/industry-4-0/>

[Accessed 23 November 2022].

Jowett, J., 2019. *What is IO-Link*. [Online]

Available at: <https://realpars.com/io-link/>

[Accessed 17 January 2023].

Posey, B., 2021. *SearchERP*. [Online]

Available at: <https://www.techtarget.com/searcherp/definition/Industry-40>

[Accessed 23 November 2022].

Slick Digital Sensors, 2018. *Slick Ultra Sonic Data Sheet*. [Online]

Available at: <https://docs.rs-online.com/7ba5/0900766b816851f0.pdf>

[Accessed 22 November 2022].

TIBCO, 2022. *What is Industry 4.0?*. [Online]

Available at: <https://www.tibco.com/reference-center/what-is-industry-40>

[Accessed 22 November 2022].

Williams, J., 2018. *Process Ris System - Process Tank*. [Online]

Available at: <https://classroom.google.com/w/NTQ1ODUxNTkzNDA4/t/all>

[Accessed 17 January 2023].

12. Appendix

Risk Assessment				
Risks	Description	Severity	Precautions	Persons affected
Electrical Shocks	control voltage within system	4	Don't work on live equipment	Student
moving machinery	overhead gantry and conveyer	4	ensure distance is kept when machine is in operation	Student
Acid Present	Sulphuric acid in bathing unit	6	Suitable PPE to be worn around unit.	Student
Compressed air	Pressurised units may cause harm to users	2	Ensure air is isolated when working on the system.	Student

Severity/Consequence			
	Slightly harmful (1)	Harmful (2)	Extremely harmful (3)
Likelihood			
Highly unlikely (1)	Trivial risk (Score 1)	Tolerable risk (Score 2)	Moderate risk (Score 3)
Unlikely (2)	Tolerable risk (Score 2)	Moderate risk (Score 4)	Substantial risk (Score 6)
Likely (3)	Moderate risk (Score 3)	Substantial risk (Score 6)	Intolerable risk (Score 9)

Figure 5 - System Risk Assessment

Task3						
Measured and Pressure (Bar)	Output Voltage (Volts)		Linear Value (Volts)	Non-linearity error (Volts)		Hysteresis Error (Volts)
	Rising	Falling		Rising	Falling	
0	-0.03	0.22	0	-0.03	0.22	-0.25
0.5	1.02	1.01	1	0.02	0.01	0.01
1	2	1.98	2	0	-0.02	0.02
1.5	2.98	2.98	3	-0.02	-0.02	0
2	3.97	3.99	4	-0.03	-0.01	-0.02
2.5	4.99	4.98	5	-0.01	-0.02	0.01
3	5.95	5.97	6	-0.05	-0.03	-0.02
3.5	6.93	6.93	7	-0.07	-0.07	0
4	7.91	7.94	8	-0.09	-0.06	-0.03
4.5	8.95	8.91	9	-0.05	-0.09	0.04
5	9.9	9.95	10	-0.1	-0.05	-0.05

Table 1 - Pressure Sensor Calibration Results

Task 4

Measuredeand Temperature (°C)	Output Current (mA)		Linear Value (mA)	Non-linearity error (mA)		Hysteresis Error (mA)
	Rising	Falling		Rising	Falling	
0	4	3.9	4	0	-0.1	0.1
10	5.62	5.5	5.6	0.02	-0.1	0.12
20	7.24	7.2	7.2	0.04	0	0.04
30	8.85	8.8	8.8	0.05	0	0.05
40	10.47	10.4	10.4	0.07	0	0.07
50	12.09	12	12	0.09	0	0.09
60	13.71	13.6	13.6	0.11	0	0.11
70	15.33	15.2	15.2	0.13	0	0.13
80	16.95	16.8	16.8	0.15	0	0.15
90	18.56	18.5	18.4	0.16	0.1	0.06
100	20.1	20.1	20	0.1	0.1	0

Table 2 - Temperature Calibration Results

Level (cm)	I out (mA) Rising	I out (mA) Falling	Linear Value	Error Rising	Error Falling	Hysteresis Error
0	4.02	4.02	0	4.02	4.02	0
7	6.12	6.12	6.12	0	0	0
8	6.46	6.5	6.521875	-0.061875	-0.021875	-0.04
9	6.84	6.93	6.92375	-0.08375	0.00625	-0.09
10	7.24	7.29	7.325625	-0.085625	-0.035625	-0.05
11	7.6	7.69	7.7275	-0.1275	-0.0375	-0.09
12	8.02	8.07	8.129375	-0.109375	-0.059375	-0.05
13	8.47	8.48	8.53125	-0.06125	-0.05125	-0.01
14	8.98	8.83	8.933125	0.046875	-0.103125	0.15
15	9.32	9.23	9.335	-0.015	-0.105	0.09
16	9.65	9.63	9.736875	-0.086875	-0.106875	0.02
17	10.06	10.02	10.13875	-0.07875	-0.11875	0.04
18	10.54	10.4	10.540625	-0.000625	-0.140625	0.14
19	10.9	10.8	10.9425	-0.0425	-0.1425	0.1
20	11.3	11.18	11.344375	-0.044375	-0.164375	0.12
21	11.64	11.58	11.74625	-0.10625	-0.16625	0.06
22	12.1	11.96	12.148125	-0.048125	-0.188125	0.14
23	12.55	12.55	12.55	0	0	0

Table 3 - Level Sensor Calibration Results

Encoder	Laser right	Encoder - Offset	Laser - Offset	Error
7.2	207.9	0	0	0
107.9	300.74	100.7	92.84	-7.86
207.7	403.2	200.5	195.3	-5.2
305.5	508.67	298.3	300.77	2.47
409.4	614.96	402.2	407.06	4.86
505.4	716.72	498.2	508.82	10.62
605.8	821.19	598.6	613.29	14.69
705.1	920.84	697.9	712.94	15.04
805	1017.46	797.8	809.56	11.76
905.4	1019.04	898.2	811.14	-87.06
1007.1	1220.9	999.9	1013	13.1
1106.3	1318.33	1099.1	1110.43	11.33
1205.5	1414.35	1198.3	1206.45	8.15
1308.7	1521.85	1301.5	1313.95	12.45

Table 4 - Position Sensor Right Table of Results

Encoder	Laser left	Encoder - Offset	Laser - Offset	Error
1308.7	1521.85	0	0	0
1208.1	1419.38	100.6	102.47	-1.87
1107.8	1319.67	200.9	202.18	-1.28
1006.7	1218.2	302	303.65	-1.65
906.16	1118.21	402.54	403.64	-1.1
808	1019.74	500.7	502.11	-1.41
709.8	923.38	598.9	598.47	0.43
608.2	818.48	700.5	703.37	-2.87
510.2	716.57	798.5	805.28	-6.78
409.8	608.21	898.9	913.64	-14.74
308	505.96	1000.7	1015.89	-15.19
207.7	411.44	1101	1110.41	-9.41
107.3	303.26	1201.4	1218.59	-17.19
7.2	207.79	1301.5	1314.06	-12.56

Table 5 - Position Sensor Left Table of Results

FINAL GRADE

GENERAL COMMENTS

Instructor

59/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

Text Comment. This is more of an introduction rather than a work plan.

PAGE 5

Text Comment. there

PAGE 6

Text Comment. The brief asks you to investigate the sensors used in these subsystems

PAGE 7

Text Comment. Should be quoted as %FSD

Text Comment. What was the static sensitivity and how do your results compare with the manufacturer's data?

PAGE 8

Text Comment. Should be quoted as %FSD

Text Comment. What was the static sensitivity and how do your results compare with the manufacturer's data?

PAGE 9

Text Comment. Should be quoted as %FSD

Text Comment. What was the static sensitivity and how do your results compare with the manufacturer's data?

PAGE 10

Text Comment. How do your results compare with the manufacturer's data?

PAGE 11

Text Comment. (2022)

Text Comment. ^

QM

Incorrectly cited, this is not the Harvard Method

Text Comment. Control states that ""(2023)

QM

Incorrectly cited, this is not the Harvard Method

QM

Incorrectly cited, this is not the Harvard Method

QM

Incorrectly cited, this is not the Harvard Method

Text Comment. Jowett states that ""(2019)

QM

Correctly cited

PAGE 12

Text Comment. why are you quoting here?

Text Comment. Why aren't you quoting here?

Text Comment. Your citation method is not consistent and rather random

Text Comment. why use " " marks here?

Text Comment. why are you quoting here?

PAGE 13

Text Comment. What diagnostic facilities already exist?

PAGE 14

Text Comment. You need to improve your writing style as it is rather awkward.

Text Comment. This sentence says nothing

Text Comment. This sentence make no sense, it probaby belongs to the previous sentence

Text Comment. Try reading your paragraphs out loud. Then you will be able to improve the way you write. Ask someone else to read them and suggest a better way.

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

GRADING FORM: NEW CSG-RUBRIC

THOMAS WOODS

59

1. ENGAGEMENT WITH LITERATURE



A good research section with evidence of reading from a wide range of sources. However, you are inconsistent in your citations and do not follow the Harvard method. However, your listing of citations is correct. 10/20

10

2. KNOWLEDGE AND UNDERSTANDING



Good knowledge demonstrated in your system investigation, explanation of calibration procedure and environment/maintenance section. However, you could have investigated the sensors in the system. 12/20

12

3. COGNITIVE AND INTELLECTUAL



Good analysis of results and conclusions/recommendation presented. However, for each sensor, you have not given the static sensitivity and you have not compared your results with the manufacturer's data. 11/20

11

4. PRACTICAL APPLICATION



Good use of calibration equipment and presentation of results. 15/20

15

5. TRANSFERABLE SKILLS



A good risk assessment and explanation of team working. Report is well structured and presented

11

with clear diagrams. Word count not exceeded.
However, your writing style is awkward. You
should read your work out loud or ask someone to
offer suggestions. 11/20