Test Plan

Dylan Patterson
Jonna Jämte
Karl Asklund
Lucas Sevelin
Martin Ling
Theodor Vallgren

November 23, 2023

Version 1.0

Status

Reviewed	Martin Ling	2023-10-05
Approved	Lars Eriksson	2023-10-09

Project Identity

Group E-mail: tsrt10-evap@groups.liu.se

Homepage: https://tsrt10.gitlab-pages.liu.se/2023/aurobay

Orderer: Lars Eriksson, Linköpings universitet
Phone: +46 (0)13-28 44 09
E-mail: lars.eriksson@liu.se

Customer: Fredrik Wemmert, Aurobay
Phone: N/A
E-mail: fredrik.wemmert@aurobay.com

Supervisor: Oskar Lind Jonsson
Phone: N/A
E-mail: oskar.lind.jonsson@liu.se

Course Responsible: Daniel Axehill
Phone: +46 (0)13-28 40 42
E-mail: daniel.axehill@liu.se

Participants of the group

Name	**Responsible**	**E-mail**
Dylan Patterson	Responsible for the quality (QS)	dylpa851@student.liu.se
Jonna Jämte	Responsible for the testing (TST)	jonja121@student.liu.se
Karl Asklund	Responsible for the Documentation (DOC)	karas744@student.liu.se
Lucas Sevelin	Responsible for software (SWR)	lucse807@student.liu.se
Martin Ling	Project leader (PL)	marli498@student.liu.se
Theodor Vallgren	Responsible for the design (DES)	theva365@student.liu.se

CONTENTS

DOCUMENT HISTORY

Version	Date	Changes made	Sign	Reviewer
0.1	2023-09-15	First draft.	Group	Theodor Vallgren
1.0	2023-10-05	First Iteration	Group	Martin Ling

1 INTRODUCTION

The experiments stated in this document will firstly be executed in order to gain an overall understanding of the system and later on issued to study the more narrow behaviors of the EVAP-system, in order to gain the knowledge needed to model the system later on. The testing will be carried out in a safe environment by utilizing out provided test bench with the following schematic:

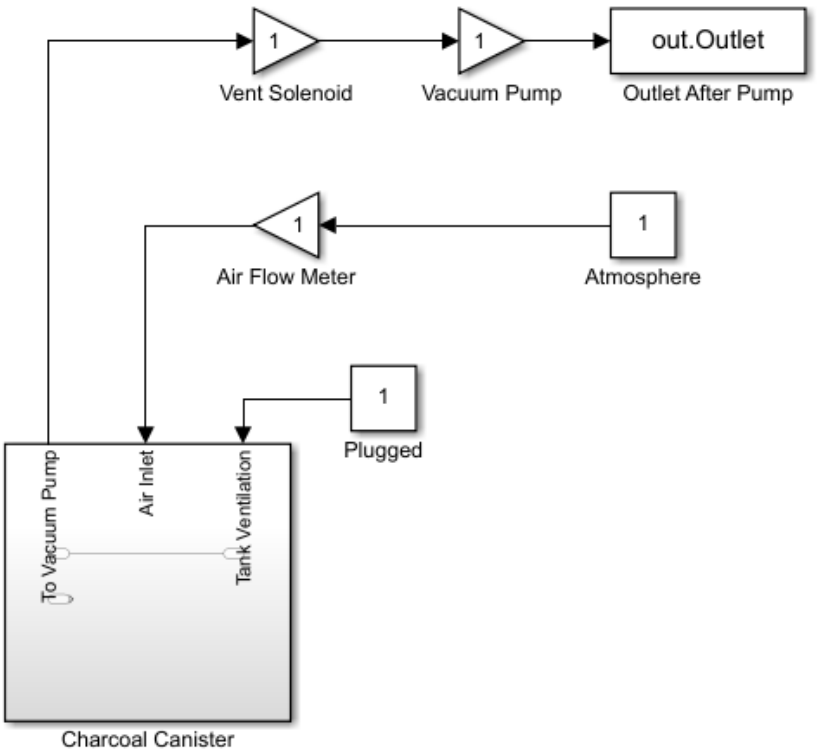

Figure 1: Our standard test rig schematic

The placements of the sensors can be seen in Figure 2. This will be the main setup and depending on the sensors used for the different experiments the placement will refer to the positioning in this figure. The placements of temperature sensors is chosen so that data from the whole canister is obtained at the same time. This is because there might be some temperature-gradients in the canister during purging. There will be two mass flow sensors, one at the inlet and one at the outlet of the canister. The pressure-sensor will be set after the outlet on the canister. There is also an airflow sensor which the test rig uses as feedback for the controller. This sensor data can be extracted if needed.

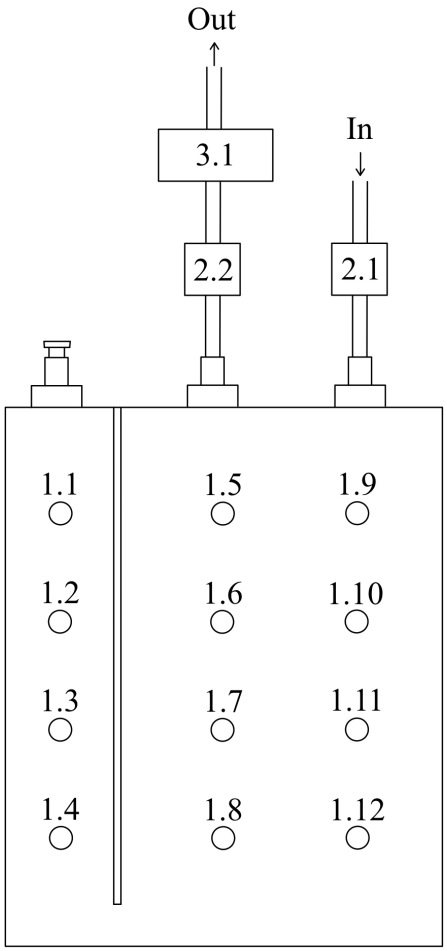

Figure 2: Sensor positions for the test rig. KOLLA ATT DETTA STÄMMER

Table 1: Types of sensors

Number	Type of sensor
1.1 - 1.12	Temperature
2.1 - 2.2	Flow
3.1	Pressure

2 TESTS

In this section, each test is planned in tables. Each test is described by the requirements of relevance, which week the test will occur, a brief description of the test, the goal of the test, and who is responsible for the test.
This is made to ensure that all of the requirements are full filled.

2.1 Introduction to the test rig

In this section, only one test is planned. The goal of the test is to understand the functionality of the test rig.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
0	-	39	Standard setup with Aurobay and the group	Knowledge about the test rig	Group and Aurobay

Table 2: Introductory test

2.2 Tests on hardware

Here tests are planned from which a deeper understanding of the hardware is to be obtained.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
1	4,13,28	40	Test of connections to hardware setup. **Procedure:** Connect the canister to the lab setup and make sure that all sensors are connected with standard connections and that they are easy to follow. Make sure that the sensors measure reasonable values.	The lab setup is easy to use.	Jonna
2	9	40	The canister can be emptied using the intake manifold airflow. **Procedure:** Run a test with the canister and measure the outlet airflow.	Empty a canister with an airflow.	Jonna
3	14,16	42	Make sure that the wiring is connected but not permanently. **Procedure:** Check if the wiring is color matched and easy to follow and can be disconnected easily.	Have an easy to understand lab setup.	Jonna
4	7	-	Don't change the carbon canister. **Procedure:** Use a standard canister without modifications.	No difference in model and tests.	Everyone

Table 3: Hardware tests

2.3 Tests on software

These tests are done to ensure that the self-made measuring system works as intended.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
5	5,8,18,19,20	40	Read the sensor data correctly. **Procedure:** Check in the Arduino code if the output from the sensors is reasonable. Both temperature, flow, and pressure.	The sensor data can be read and stored.	Lucas
6	15	46	Make sure that the Arduino and Raspberry Pi can communicate via WI-FI. **Procedure:** Connect the Arduino and Raspberry Pi with WI-FI and run the program.	The Arduino can send measurement data in real-time to the Raspberry PI.	Lucas
7	17,18,19	40	Make sure that the sensors can measure a full engine cycle. **Procedure:** Run a full engine cycle and measure the sensor data.	The sensor data can be read and saved for a whole engine cycle and all types of sensors used.	Lucas
8	21,22	49	Easy to use measurement system. **Procedure:** Write a user manual for the measuring system.	Easy to use for someone without knowledge about the system.	Theodor

Table 4: Software tests

2.4 Test of performance

These tests are done to reach the requirements connected to performance and variables.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
9	6	49	The model can send the control signals to the controller. **Procedure:** Connect the model and the controller in Simulink (or similar program).	Get control signals to the controller in real-time.	Karl
10	10,11	49	The model should be as accurate as possible. **Procedure:** Compare the model with measurement data for a known drive cycle.	The measurement and model data are accurate enough for a full drive cycle.	Dylan
11	12	49	The model can handle different engine parameters. **Procedure:** Test different engine parameters in the model.	The model works for different engine sizes.	Martin
12	23,24,25,26	49	Controller limitations in the model. **Procedure:** Run the model and make sure the regulator fulfills the requirements specified.	All requirements are fully filled.	Martin
13	1,2,3	48	Ensure that the model is dependent on the requirements. **Procedure:** Make sure that the expected output is given by the chosen input.	The model works for these inputs.	Dylan

Table 5: Performance tests of the model

2.5 Tests of usability

These tests are for the usability of the test equipment and the model that is created.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
14	27,38	50	The written code should follow the Google style guide and be accessible through a GIT-repository. **Procedure:** Check that the Google style guide is fully filled and that the code is accessible for authorized personnel.	The code reaches the standard and can be accessed by authorized personnel.	Lucas
15	29	47	The test should be repeatable. **Procedure:** A test protocol shall be written in order to repeat the experiments.	The experiments are repeatable by a person with knowledge about the system.	Jonna
16	36	51	Easy to use model. **Procedure:** The supervisor simulates the model without external help.	The supervisor can use the model.	Karl

Table 6: Usability

2.6 Tests for safety requirements

These tests are for the safety of the usage of the equipment.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
17	31,32,33	39	Safe experiments with safety protocol. **Procedure:** Write and sign a safety protocol. Follow the protocol for each experiment.	All experiments can be conducted safely.	Jonna
18	34,35	-	Safe experiments and authorized personnel. **Procedure:** Always follow the safety protocol and have authorized personnel on site when executing experiments.	Safe experiments according to the safety control.	Karl

Table 7: Test of safety requirements

2.7 Miscellaneous tests

These are the miscellaneous tests.

Test Nr	Req. Included In Test	Planned Week	Description	Goal	Responsibility
19	30,37	-	Time distribution and individual responsibility. **Procedure:** The Project leader checks that the time economy for each group member meets the requirements.	Each member passes the course.	All group members.
20	39	49	All error messages in the model shall be in English. **Procedure:** Use English when writing code.	Usability for most people	Dylan
21	~~57~~, 58, ~~59~~	44	In order to keep the secrecy of the model each member should follow req. 58. **Procedure:** Read and always follow req. 58.	No classified information is leaked	All group members.

Table 8: Miscellaneous

2.8 Requirements not covered by tests

Note that some requirements are not covered by the above-mentioned tests. These requirements will be covered by completing different milestones and documents initialized by the course and our own goal-setting.

These requirements are 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56.