**Testplan Bestand**

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Intro: in this word file, the feasability will be discussed for certain functions we find best suit the process. Should there be doubt about how the function works, or if the functions doesnt seem to fit the solution. There will be a discussion about how to test these functions.

**Test plan behaviour of valves**

The goal of this test is to determine how silicone valves behave when they are freely dumped into a container and shaken manually. The main aspects to be observed are:

* Do the valves stick to each other or to the container?
* What is the final orientation of the valves after shaking?

**Test setup**

Afbeelding met overdekt, Mengkom, tafel, gootsteen

Door AI gegenereerde inhoud is mogelijk onjuist.Four containers of approximately the same size were used, each made of a different material:

1. Metal container (tin)
2. Tupperware container (polypropylene)
3. Plastic container (polypropylene)
4. 3D-printed container (PLA)

Each container was filles with 10 valves (type BS150.010-254.03).

**Results**

Valves type BS150.010-254.03

* The valves rarely stuck to each other, regardless of the container type.
* In general, the valves tended to settle with the concave side facing downward and the convex side facing upward.
* In the metal container, valves resting on their concave side often stuck to the container surface.
* In the Tupperware container, the results were similar in terms of orientation, but no adhesion to the container was observed.
* In the plastic container, the valves showed slight adhesion, less than in the metal container but more than in the Tupperware container.
* The 3D-printed container produces results comparable tot the Tupperware container, with minimal or no sticking observed.

**Conclusion**

The material of the container influences the adhesion of the valves, particularly for metal surfaces, where more sticking occurred.

Across all the tests, the orientation behaviour was consistent, most valves naturally settled with the concave side downward.

**Test plan flexibility of valves**

The goal of this test is to determine how valves behave when push onto/through holes of different diameters in a test block using a needle. The question that can be asked:

* Does hole diameter affect whether the valve seals around the hole, partially enters, or is forced fully into the block?
* At what hole sized does the valve begin to deform of work its way into the block?

**Test setup**

A 3D-printed test block will be designed and manufactured with multiple holes of different diameters. The hole sizes will be selected based on the needle size used for the valve.

Each valve is placed flat on top of one of the holes in the block. A needle is then inserted manually through the centre of the valve and into the hole below. The test is performed by gradually pushing the needle downward until 10 mm is inserted into the valve. The operator performs the insertions at a consistent speed and angle. Observations are made regarding:

* The interaction between the valve and the hole (stay on top, partially enter or fully insert).

**Test plan transport slot**

For the most realistic concept a transport slot will be used to get the valves independently to the lubrication place. This will be realized by dropping the independent valves in the machine, after which the valves get in the transport slot. Here they roll down until a moving wall. After the lubrication process this wall will move away and the valve rolls into the final storage container.

For testing this transport slot will be 3D printed, this way the test can be done as cheap as possible. The downside is that the resisting force of the 3D printed material can be different than other materials. This will be taken into account after the tests are done. The most important result from the test:

* Do the valves roll? And under which angle do they roll best?

This first test will be done for one type of valve, the xxx valve. The results can be written down as follows:

Angle of slot: xx°

|  |  |
| --- | --- |
| Test nr. | Rolled thru? (Y/N) |
| 1 |  |
| 2 |  |
| 3 |  |
| n |  |
| Total | XX/30 |

The slot will be placed under a few different angles. A result of 80% rolling thru is considered as a pass of the test. This test needs to be done at least 30 times to be considered as a valid result.

When this test is considered as a pass and is considered realistic, the test can be done for different types of valves. After this the transport slot can be tested in combination with the ‘transport’ from storage to transport slot. For instance testing with different angle of the groove in the slot.

**Transport belt with brush backflow**

To get the valves from the metal container to the lubrication area, one could use a transport belt. The most glaring problem with this is that the transport belt, by itself, doesn’t distribute the valves. When the valves come into the lubrication area we want them to be presented one by one and not on top of each other or multiple at ones. For this there will be a brush on top of the belt. The brush is high enough to let singular valves through, however any valves on top of each other will be pushed back to the inlet by the brush and another transport belt. The valves that are able to pass the brush will be going on an slower transport belt to make sure that the valves enter the lubricating area one by one.

To be able to test if this method works for valves we will need to make a test setup where average amount of valves will be put on the transport belt. Afterwards the brush will be setup at the height needed to separate the valves. When the valves pass through the brush, after seeing the result, the brush height may be recalibrated. Also the amount of time needed to pass through all the valves will be measured, this is done to make sure that the valves don't take too long to pass through. After this is done for one type of valve and works within the desired parameters, other valves may be tested. **Testplan Vision**

To detect if the valve is present at the lubrication area, and in front of the needle we use a vision camera. This camera needs to be able to distinguish between multiple valves and see if they are present and correctly placed in front of the lubrication needle. The camera needs to be able to do this with a reflective background as the valve is lying between 2 layers of metal. The camera also needs to be able to stop the machine or execute a different command if the valve is lying incorrectly. To do this, we will need to write a script with the aforementioned specifications. The program also needs to be able to communicate with the machine.

Test Setup

First A program will be used in-sight explorer and a code will be written with the aforementioned specifics. Afterwards the vision camera will be place at 90 degrees above a valve the program will try to determine if there is a valve laying on the surface or not.

To test if the vision camera setup is working, we will put one type of valve below the camera at a time. And take many pictures from different angles, this way the program can imprint the data from the valves into its systems. Afterward we will need to put the valves back under the camera to see if it can detect them. Afterwards troubleshooting can commence. The Vision experiment will be successfully completed when the vision program can determine if the valve is correctly placed below it, 99% of the time.

Material needed:

Desired Valve

Laptop

Vision camera

Connection cord

Vision program

VS Code

The Results of the test can be transcribed below, the test will be a succes if the vision program can see if there is a valve below with a 99% accuracy:

Test plan Bowl feeder

To test if a bowlfeeder would be a sufficient solution for the sorting of the valves, there needs to be a test. In this chapter we will look at test description.

The goal of the test is to see if a bowl feeder is a solution to sort different kinds of valves and feed them to the next part of the machine 1 by 1.

Materials needed:

* Bowl feeder
* Valves
* Correct slit

Test setup:

Throw 30 to 50 valves into the bowl feeder.

Turn on the bowl feeder

Describe the behaviour of the valves

Check if all the valves go through the exit 1 by 1 and the same orientation

Testplan

Main Function: Feed valves

Sub Function:

Main Functions: Feed Valves

Sub Function: See Valves

Solutions:

Vision

Distance Sensor

Light Sensor

Weight Sensor

Main Functions: Feed Valves

Sub Function: Offer Valve

Solutions:

Robot (Pneumatic)

Robot (gripper)

Transport belt

Main Functions: Feed Valves

Sub Function: Offer Valve

Solutions:

Transport Slot

Valve Sheet

Independent Valve

Main Functions: Pick Valves

Sub Function: Mechanism Valve Picking

Solutions:

XYZ

6-axis robot

Gravity

Main Functions: Pick Valves

Sub Function: Tool

Solutions:

Gripper

Vacuum

Main Function: Lubricating Valves

Sub Function: Mechanism needle

Solutions:

Pneumatic Cilinder

Electric actuator

Hydraulic cylinder

Main Function: Lubricating Valves

Sub Function: Lubricate needle

Solutions:

Needle in oil Jar

Oil on needle

Main Function: Lubricating Valves

Sub Function: Lubricate Valve

Solutions:

Needle Stationairy

Valve Stationairy

Main Function: Lubricating Valves

Sub Function: Secure Valve

Solutions:

Clamp

Vacuum

Counter push

Main function: Pick valves

Subfunction: Tool

Gripper and vacuum

The tools to get the valves/sheets into position. These are used to move the valves into a predetermined position.

**Main function: Lubricate valves**

**Subfunction: Secure valve**

After the valve is lubricated and the needle is retracting there will be an object that is placed on the side of the valve where the needle can go through. This will prevent the valve from sticking to the needle and/or the wall. If the valve doesn’t stick to the needle and/or wall it will fall. This option will be feasible if there are no cases of the valves sticking to the needle and/or wall. The most important thing to consider in this testing is going to be the friction between materials.

* Do the release the needle and don’t stick to the wall?

To test this the xxx valve will go through the system.

|  |  |
| --- | --- |
| Test nmr. | Released from frame? (Y/N) |
| 1 |  |
| 2 |  |
| 3 |  |
| n |  |
| Total |  |

When this test is considered as a pass and is considered realistic, the test can be done for different types of valves.

**Main function: Dispose valves**

**Subfunction: Moving valves**

Dropping the valves/sheets into an final storage directly under the needle from the lubricating process. To test if this option is feasible the trajectory of the valves need to be monitored. The valves will have to land in a certain area to end up in the final storage. The minimal requirement of this step will be that all the valves fall into the dimension of the container. Important things are the point(s) where the valve loses contact with the material it’s connected to, the center point of weight.

To test this the previous systems will be used. The valves will go into freefall at a certain point and will have a target area (the surface of the existing container).

* Do the valves fall into the targeted area?

To test this x amount of the xxx valve will go through the system.

|  |  |
| --- | --- |
| Test nmr. | Landed correctly? (Y/N) |
| 1 |  |
| 2 |  |
| 3 |  |
| n |  |
| Total |  |

The final container will be directly placed under the position where the valve will break contact with the step before it. The target is to get all the valves in the final container.

When this test is considered as a pass and is considered realistic, the test can be done for different types of valves. Afterwards the distance between the two point can be decreased or increased to see if it yield better results.

**Main function: Pick valves**

**Subfunction: Tool**

To determine whether silicone valves can be reliably picked up using pneumatic suction cups, a testing process has to be carried out. The goal of this test is to find out under which conditions the suction cups can best grip, move, and release the silicone valves without causing any damage or deformation.

**Test plan**

The test setup consist of a pneumatic suction cup mounted on a robotic arm. The robot needs to perform a repetitive pick-and-place motion: picking up a silicone valve from a flat surface, lifting it, moving it, and placing it down again.

This test will be carried out with one type of valve, and tested on the other types once the first type of valve has passed the test. Because the dimensions of the valves are different per type, it may be necessary to adjust the suction on the pneumatic suction cup.

**Results**

For every valve 95% has to be successfully transferred to the designated position and not get damaged or deformed. The results of the practical test are shown below:

|  |  |  |
| --- | --- | --- |
| Type of valve | Pressure (kPa) | Successful? (Y/N) |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |