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*Date: 29-9-2020*

Demo test plan

Propulsion system simulation

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2020

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# Aim & Hypothesis

## Aim

The aim of this test is to prove that the calculation chain can simulate the propulsion system.

## Hypothesis

If we build a calculation chain then a more efficient propulsion system can be designed.

# Variables

To determine the goals of our test, we define the variables that we’ll adjust to reach the goals.

|  |  |
| --- | --- |
| Limit | Keep constant at... |
| Ambient temperature | Lower limit of standard indoor temp  (25℃ ± 5℃) |
| Water composition | Pure water |
| Water flow velocity | All zero, no water flow |
| Water wave frequency |
| Water wave amplitude |
| Hydraulic pressure | Upper limit of the pressure under half a meter of pure water |
| Lubricant viscosity | Choose a suitable lubricant according to the research |

|  |  |
| --- | --- |
| Property | Vary and/or measure |
| Power input variables | |
| Motor input rotation speed | Vary & measure |
| Motor input torque | Vary & measure |
| Power transmission variables | |
| Transmission component (transmission shaft, gear) material | Measure |
| Transmission component (transmission shaft, gear) size | Vary & measure |
| Transmission component (transmission shaft, gear) shape | Vary & measure |
| Transmission component (transmission shaft, gear) contact friction | Vary & measure |
| Power output variables | |
| Propeller material | Measure |
| Propeller size | Vary & measure |
| Propeller shape | Vary & measure |
| Propeller surface smoothness degree (contact friction with water) | Vary & measure |
| Propeller rotation speed | Measure |
| Propeller torque | Measure |

# Tools

We divide the tools into two types. The first one is “testing tools” which are the tools requires to perform the test. The second one is “measuring tools”, which are the tools required to measure the given limits and properties.

|  |  |
| --- | --- |
| Testing tools | Demand |
| Computer | Windows 10 compatible |
| Excel | No limit |
| Keyboard | No limit |
| Torque sensor(propeller) | Waterproof & High temperature resistance |
| Rotation speed sensor(propeller) | Waterproof & High temperature resistance |

|  |  |
| --- | --- |
| Measuring tools | Demand |
| Thermometer | Waterproof & High temperature resistance |
| Lubricant label | Shows the parameter of the lubricant |
| Water pressure sensor | Waterproof & Can record data |
| Rotation speed sensor(motor) | Waterproof & High temperature resistance |
| Torque sensor(motor) | Waterproof & High temperature resistance |
| Sensor for surface roughness | Can test metal surfaces |
| Gear label | Shows the parameter of the Gear |
| Propeller label | Shows the parameter of the propeller |
| Shift label | Shows the parameter of the shift |
| speed sensor | Waterproof |

# Method

The method section within the demo test plan is a step-by-step overview of the system test plan which is consisted by actions that need to be performed during the test in order to conclude a result.

1. Power up laptop and open Excel.
2. Load in the: “Propulsion system simulation” file in Excel.
3. Type in current values to simulate the present propulsion system.
4. Modify the value of every single property.
5. Perform a simulation for every property value modification.
6. Compare the results of simulations before and after the modification to figure out their effects on propulsion system.
7. Choose property modification values which are benefit for the propulsion system improvement.
8. Design the new propulsion system with chosen values.
9. Simulate new propulsion system in excel.

# Expected results

This phase aims to define what a “good measurement” means and to check whether our design passes the test, or not.

The measurement should be carried out in a specific environment which is mentioned in “limits variables”. Measure under lower limit ambient temperature and upper limit water pressure with keeping the test environment as pure water and as less as possible interference from wind and waves and use specific lubricants. In this situation, the parameters of the ship are used as input to the calculation chain.

When we input ship’s velocity, gears’, shafts’ and bearings’ parameters, motor’s output torque and rotation speed and other parameters into the calculation chain, we calculate the output power of the propeller in specific conditions. After that, we calculate the output power of the propeller by measuring the output torque and the rotation speed of the propeller (measuring the data more than 3 times). There are some accidents beyond expectation, which we call “bad weather scenario’s”. The bad weather scenario will include situations like when the input velocity exceeds the maximum speed limitation, the lower & higher input voltage and so on. If all parameters are within control which means no input reaches out of limits, we call this the “good weather scenario”. No matter in the good & bad scenario the calculation chain can run and be verified by comparing the calculated output power with the measured output power, when the error does not exceed 30%, the experiment is considered successful.

If we measure the data less than three times, it may cause accidental errors which will make the experiment fail. When the results of the calculation chain have a huge gap between the actual measurement results, it indicates that there are problems with the design or measurement of the calculation chain. If the above situation occurs, it is considered that the experiment has failed and needs improvement.