

Gearing calculation test plan

Propulsion system simulation

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# Aim & Hypothesis

## Aim

The aim of this test is to verify the simulated mathematical model of the gearing calculations.

## Hypothesis

The gearing simulation has the same output as the calculations.

# Variables

These are the constants and variables that will be used during the test.

|  |  |
| --- | --- |
| Constants simulation | Keep constant at... |
| Battery level computer | Constant power source. |
| All input variables | Real positive numbers & ISO-notation. |

## Inputs

The limits stated are the limits of the real world. If values out of this range are entered, the outputs will be unreliable.

|  |  |
| --- | --- |
| Inputs | Range |
| Motor power output [W] | 0 - 8800 |
| Motor torque output [Nm] | 0 - 40 |
| Motor rotation speed output [rpm] | 0 - 2400 |

## Outputs

These are the outputs that will be monitored and will be used to see variations or changes in the system.

|  |  |
| --- | --- |
| Outputs | Range |
| Gearing power output [W] | 0 - 8800 |
| Gearing torque output [Nm] | 0 - 40 |
| Gearing rotation speed output [rpm] | 0 - 2400 |

# Tools

|  |  |
| --- | --- |
| Testing tools | Demand |
| Computer | Windows 10 compatible |
| Excel | Newest version |
| Keyboard | No limit |
| Mouse | No limit |
| Calculator | Basic calculator |
| Pen & Paper | Basic pen & paper |
| Mathematical model | Consists of formulas |

# Method

The simulation will be compared to the actual calculations to see if they are the same.

## 4.1 Steps

1. Put the different values from 2.1 in the simulation
2. Note the outputs
3. Calculate the outputs based on the mathematical model (7.Appendix) using pen, paper and calculator
4. Note the answers.
5. Compare the two answers.

# 5.Expected results

The expected outputs are according to the mathematical models and between the range stated in the table 2.2

# 6.Conclusion

If the outputs have the same values as their calculated counterparts, the test is considered as passed. If not, the test is considered as failed.

# 7.Appendix

The energy loss on the gear consists of the meshing between the gears and the gear churning loss. In the gear component, the loss of these two parts will be calculated.

## 7.1 gear friction power loss

= load gear losses (kW).

=friction force (kN).

=relative velocity (m/s).

### 7.1.1 Friction force

=Normal force of tooth surface[N].

=Friction coefficient.

=Gear circumferential force [N].

=Index circle pressure angle, standard gear is.

T=Torque [N\*m].

d=Index circle diameter of driving wheel [m].

### 7.1.2 Relative velocity

The sliding speed is the relative speed of the common contact point between the paired gear teeth in the transverse plane. (Gear Rolling & Sliding velocity) The sliding speed can be approximated as

=Addendum radius[m].

=Deddendum radius[m].

= Angular velocity[rpm].

=Index circle pressure angle, standard gear is.

## 7.2 Gear churning loss

Because of lubricate, the gear will face resistance when it is rotating, resulting in energy loss.

=Modulus.

=Number of teeth.

=Lubricant density[].

d=Index circle diameter of driving wheel [m].

=Rotation speed[rpm].

=9.8.

= Lubricant viscosity.

= Gear immersion depth ratio [0.21].

= Tooth width ratio.