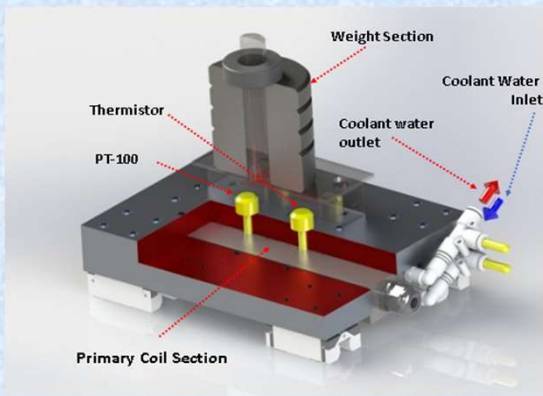


## Simulation and Testing of Temperature Behavior in Flat Type Linear Motor Carrier

### Project overview

Temperature behaviour of Flat Type Linear Motor Carrier is simulated and verified with actual temperature measurements, and the usefulness of the applied methodology is evaluated. Simulation consists of two parts: (1) Estimation of power losses in heat generation, and (2) steady state heat transfer analysis at estimated power losses. Electric power losses are calculated based on the power loss equations, given in motor documentation. Heat transfer analysis is carried out with calculated power losses, at moderate convection coefficient of the air. Simulations and experimental evaluation prove that temperature behaviour of the linear motor carrier can be estimated precisely using this methodology.

### Empirical research

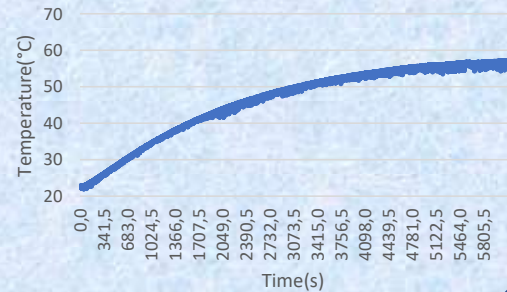


Continuous duty cycle:

- Total mass 15.6 kg
- Velocity 30000 mm/min
- Acceleration 30 m/s<sup>2</sup>
- 150 mm movements
- 0.2 s break between movements

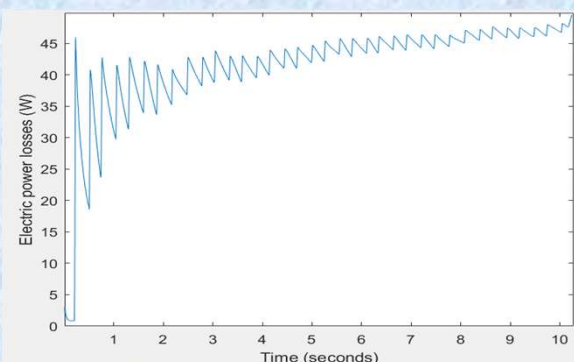
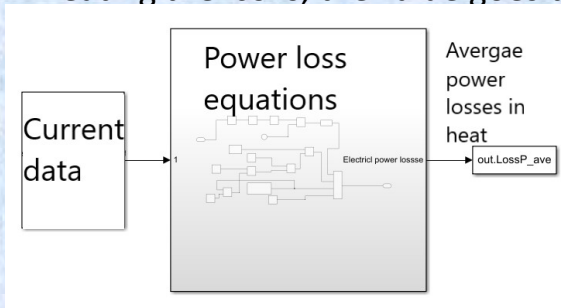
Results

- Starting temperature 23 °C
- Final temperature 57 °C
- Cycle duration 1h 42min

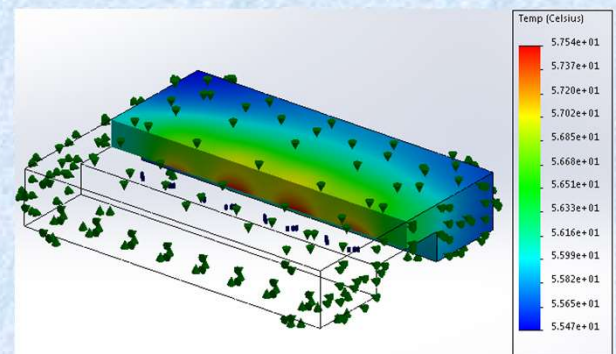


### Simulation

Simulink model gives the average power losses in heating the coils, the value goes to 49.86 W



FEM analysis with simulated heat loss power from Simulink



Steady state heat transfer FEM analysis with Solidworks:

- Heat power of 50 W applied to the carrier bottom surface
- Air convection coefficient of  $11 \frac{W}{m^2 K}$  assumed for carrier surface

Temperature at the carrier surface reaches 57 °C maximum