Axial Channel Water Jacket cooling

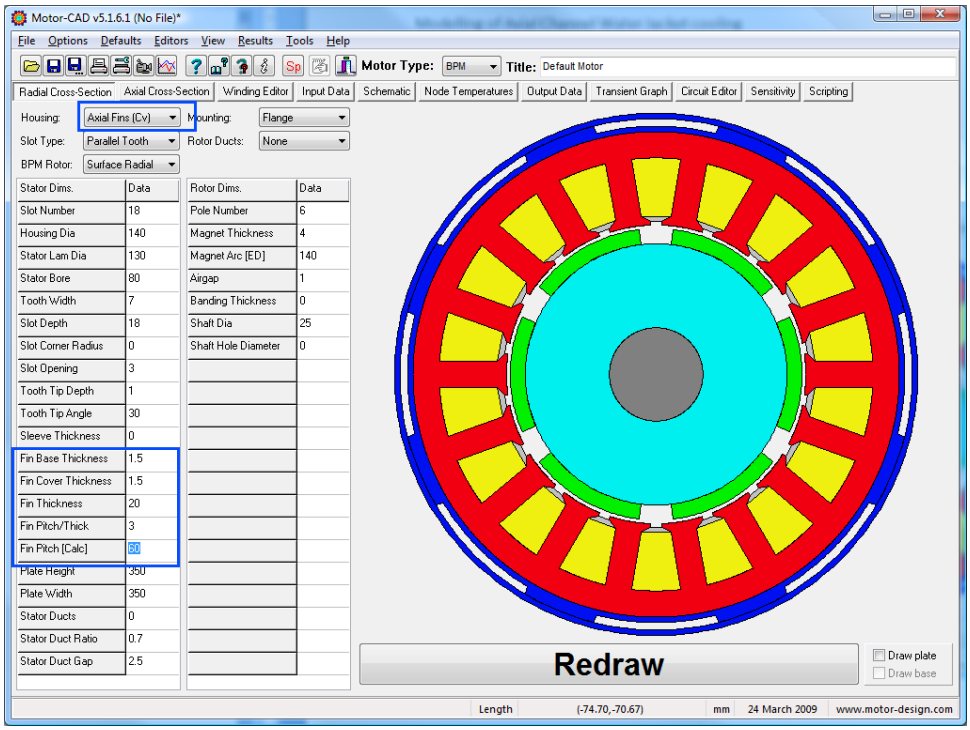
Description

This document gives a brief description of how to set up a Motor-CAD model for an axial channel water jacket cooled machine.

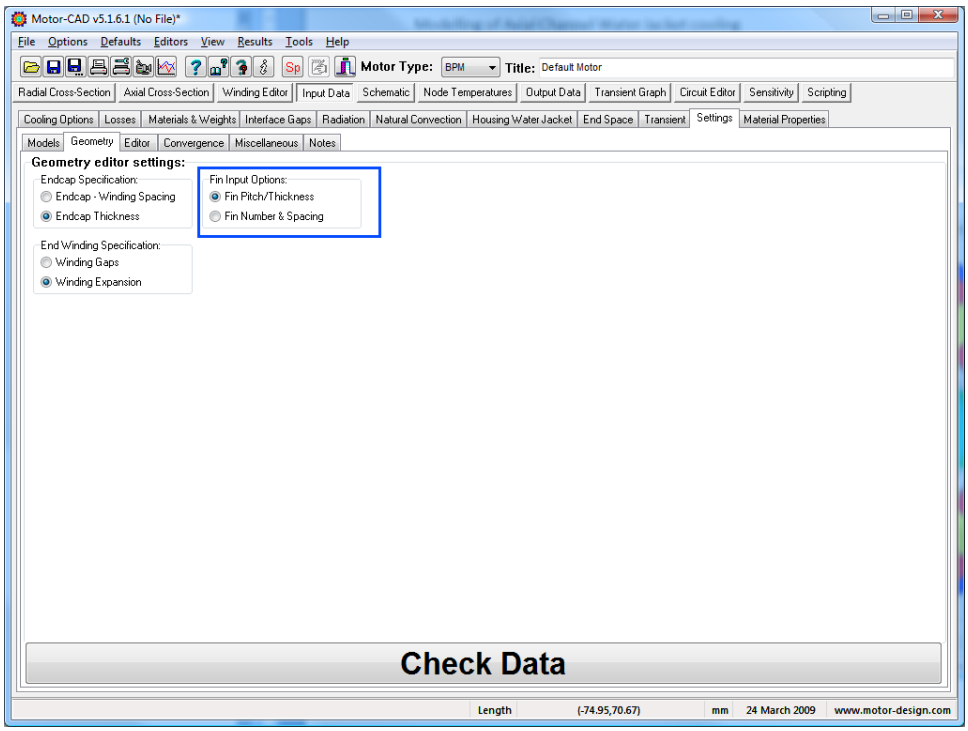
Setting up the housing and axial channels

The housing type should be set up to be covered axial fins as shown below.

The number and size of the fins can be set using the parameters given. The fin pitch is calculated from the fin thickness and fin pitch/thickness ratio.

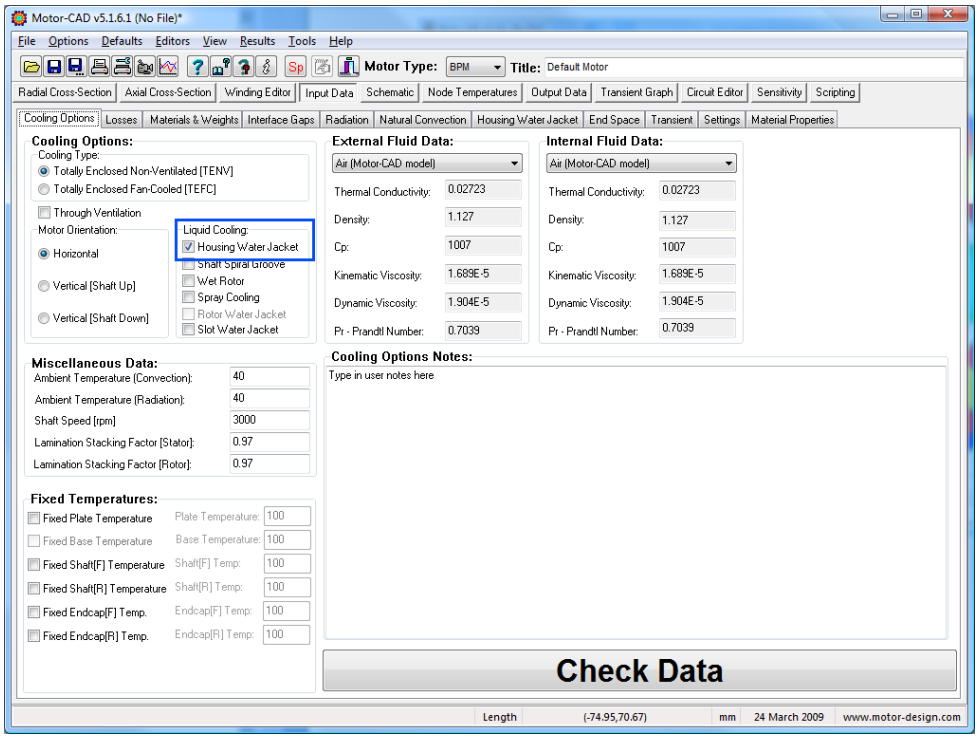


The fin size can also be set using fin number and spacing by setting the option shown below.

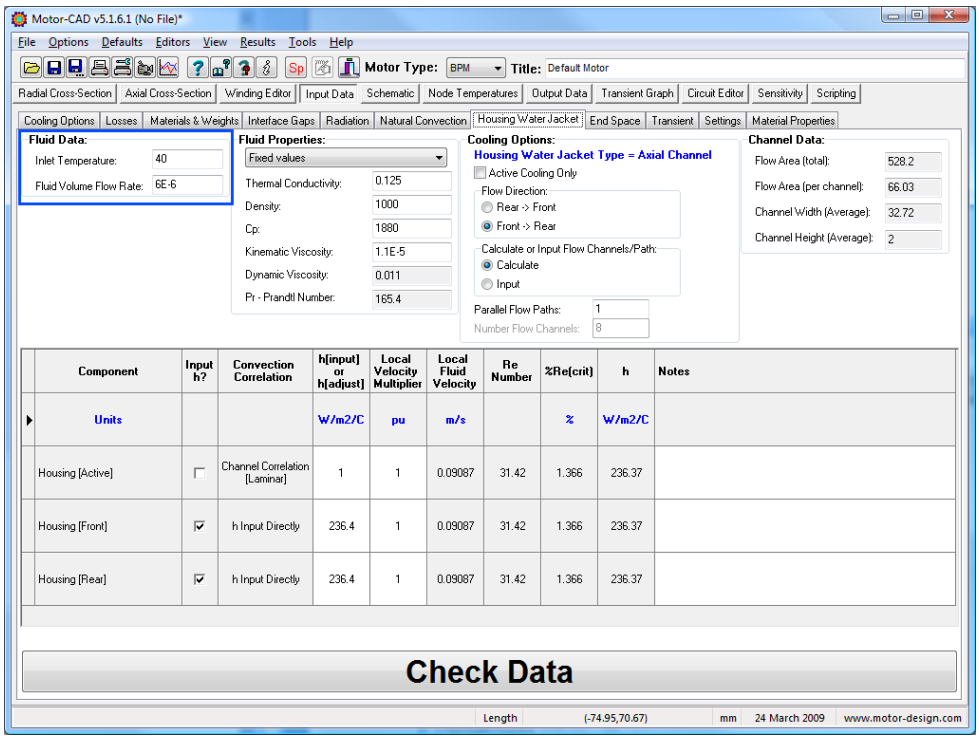


Setting the water jacket fluid and flow rates

The water jacket cooling option shown below should be set.

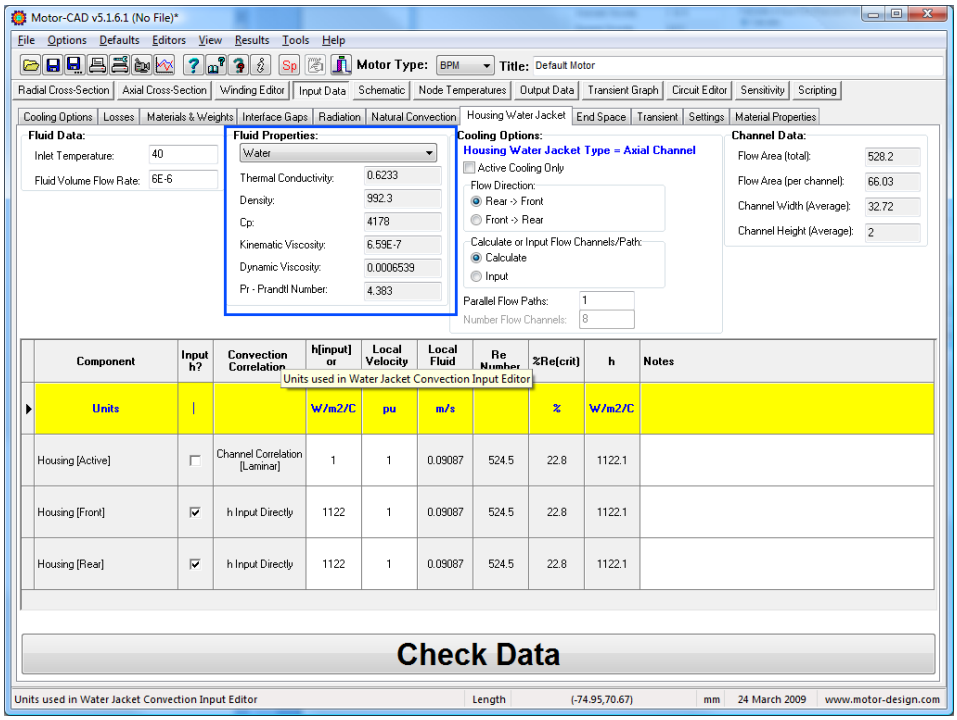


The fluid inlet temperature and flow rate is set as shown below.

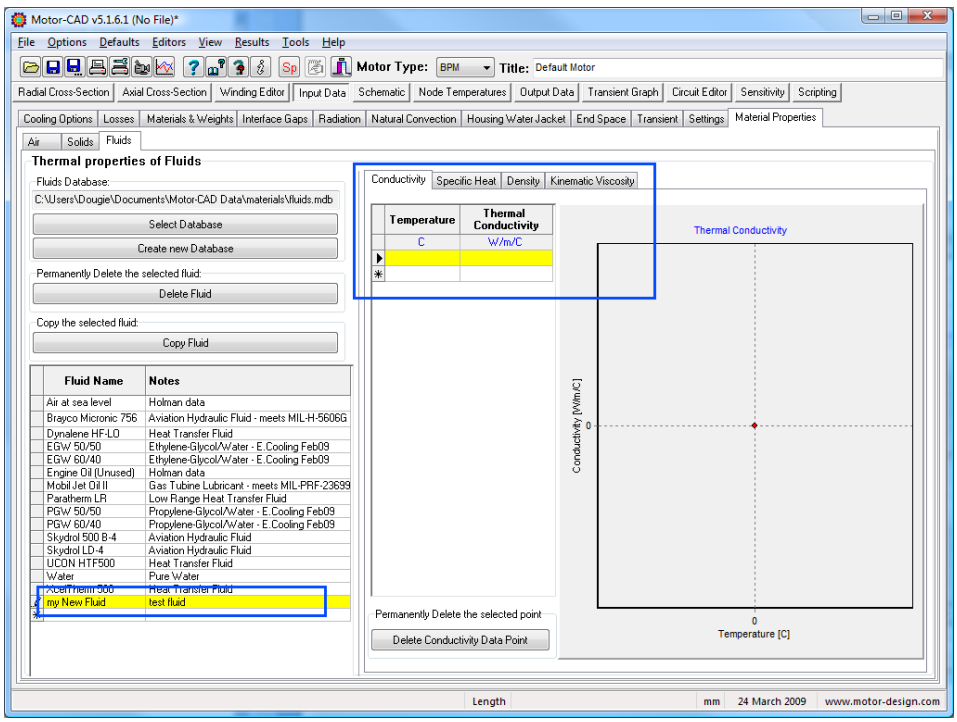


Setting up the fluid properties

The fluid properties can be set at fixed values in the table shown below or a fluid selected from the fluids database. If the fluid is selected from the fluid database then the variation in fluid properties with temperature will be considered by Motor-CAD.

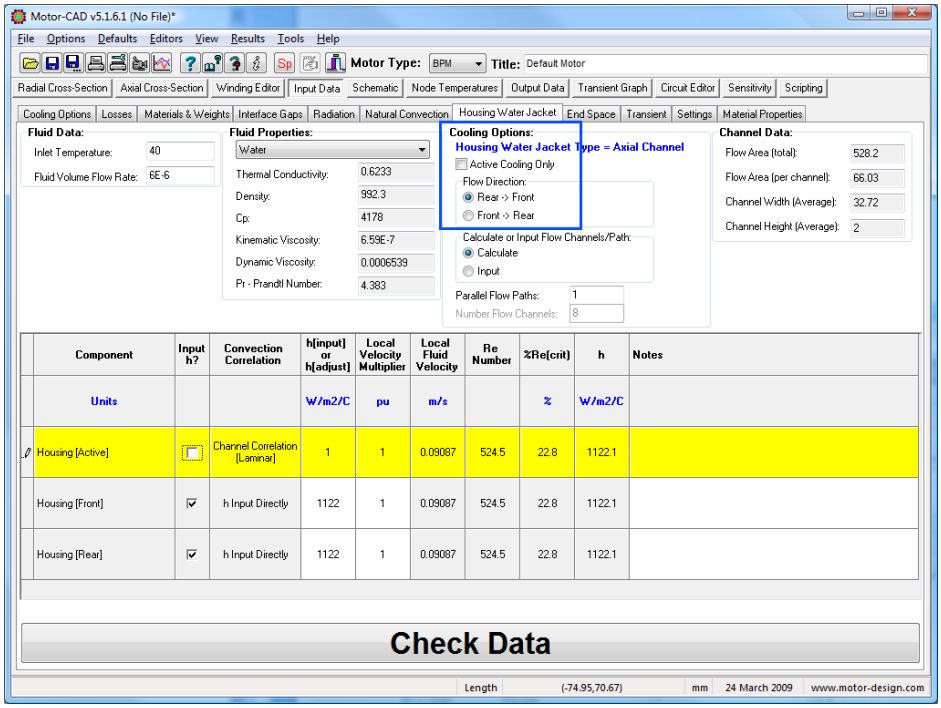


If the cooling fluid being used is not in the fluid database then a new fluid can be created in the fluid database editor as shown below. An existing fluid can be copied and then modified using the “Copy Fluid” button or a new fluid can be created by entering the name in the list box as shown below and then adding the fluid properties to the tables.



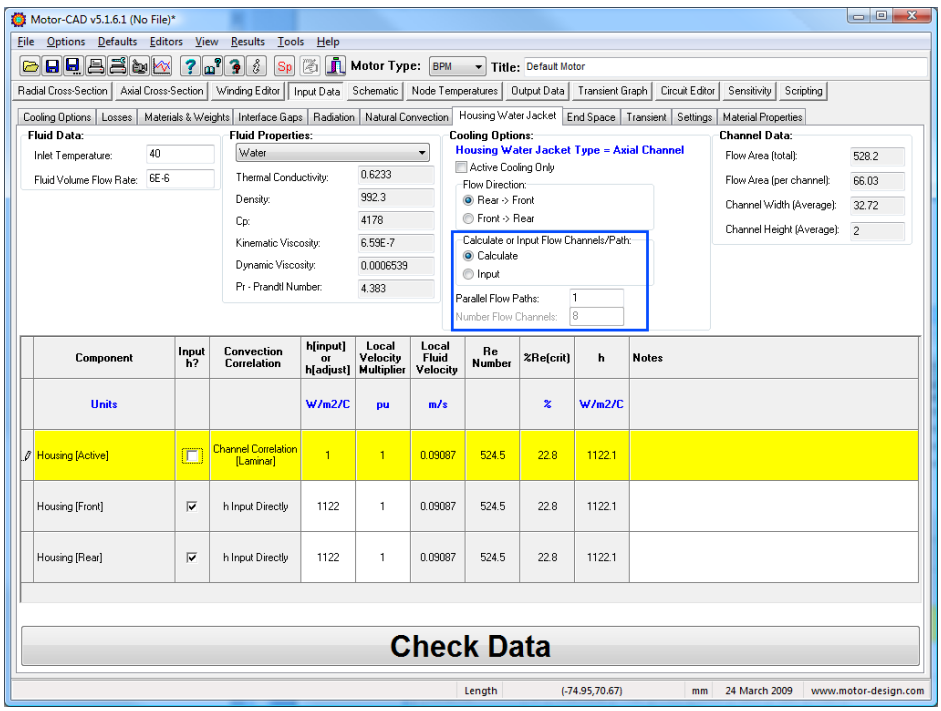
Defining the flow paths

There are different cooling options available to select the cooling area and the flow direction as shown below.



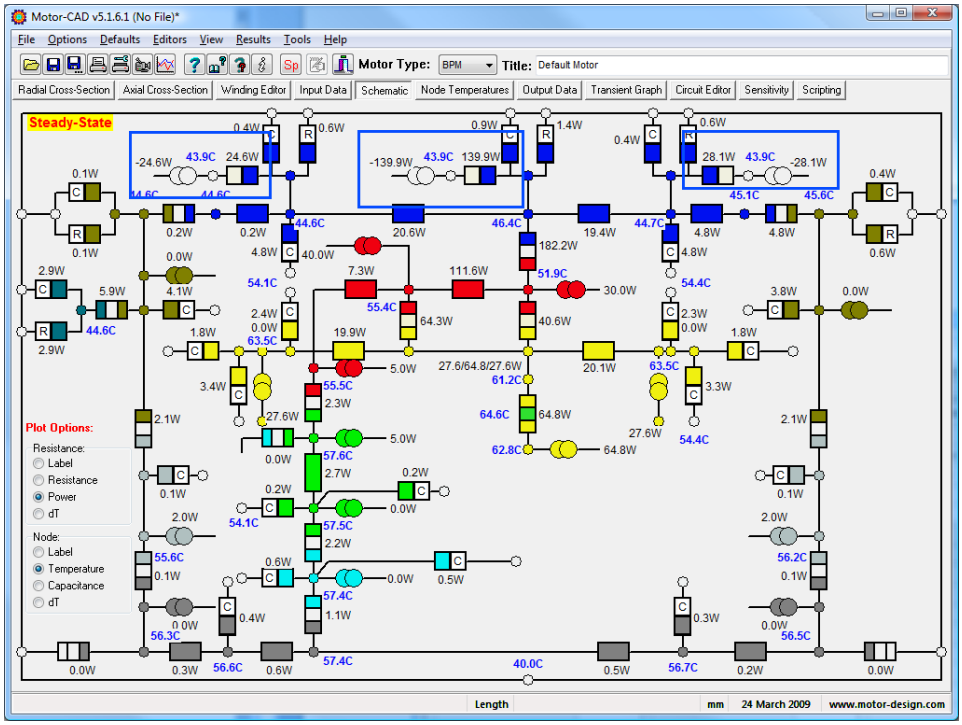
With the “calculate” option set the number of flow channels is calculated automatically from the geometry and shown the the “Number Flow Channels” box.

The number of paths is set using the “parallel flow paths” edit box. With value set at 1 then the flow fill be serpentine passing through the 8 channels in this model in series. In this model if the value is set to 8 then all the 8 channels will be in parallel.

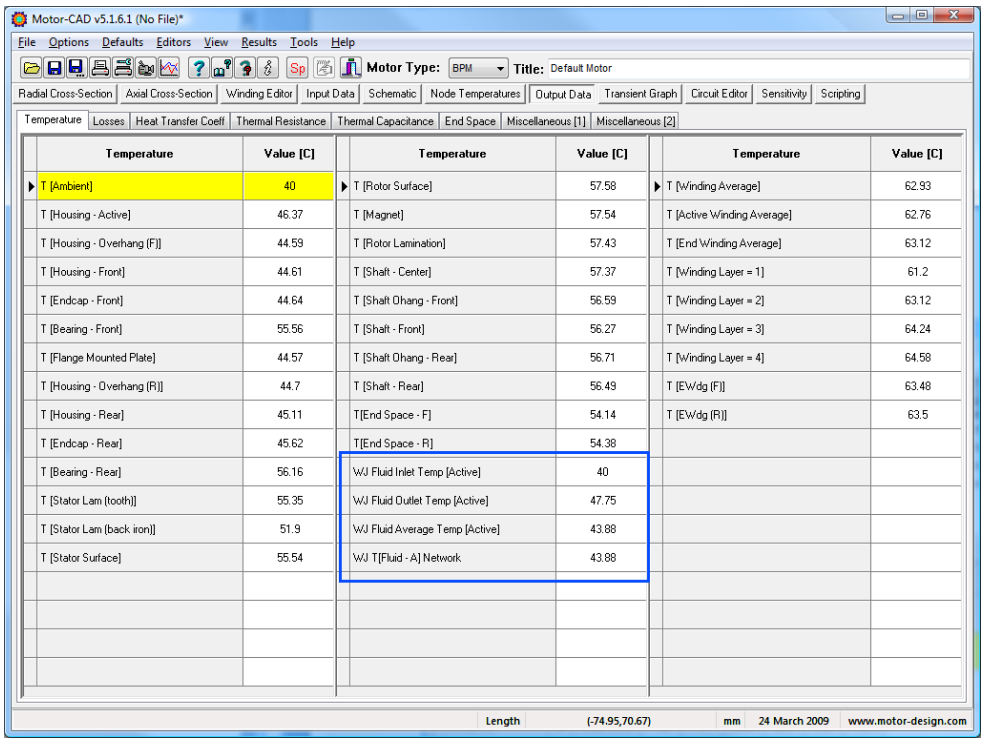


Viewing the results

The power removed from the machine by the water jacket is shown in the steady state schematic.



The fluid temperatures are shown in the output data sheet as shown below.



Temperature	Value [C]	Temperature	Value [C]	Temperature	Value [C]
T [Ambient]	40	T [Rotor Surface]	57.58	T [Winding Average]	62.93
T [Housing - Active]	46.37	T [Magnet]	57.54	T [Active Winding Average]	62.76
T [Housing - Overhang (F)]	44.59	T [Rotor Lamination]	57.43	T [End Winding Average]	63.12
T [Housing - Front]	44.61	T [Shaft - Center]	57.37	T [Winding Layer = 1]	61.2
T [Endcap - Front]	44.64	T [Shaft Ohang - Front]	56.59	T [Winding Layer = 2]	63.12
T [Bearing - Front]	55.56	T [Shaft - Front]	56.27	T [Winding Layer = 3]	64.24
T [Flange Mounted Plate]	44.57	T [Shaft Ohang - Rear]	56.71	T [Winding Layer = 4]	64.58
T [Housing - Overhang (R)]	44.7	T [Shaft - Rear]	56.49	T [EWdg (F)]	63.48
T [Housing - Rear]	45.11	T[End Space - F]	54.14	T [EWdg (R)]	63.5
T [Endcap - Rear]	45.62	T[End Space - R]	54.38		
T [Bearing - Rear]	56.16	WJ Fluid Inlet Temp [Active]	40		
T [Stator Lam (tooth)]	55.35	WJ Fluid Outlet Temp [Active]	47.75		
T [Stator Lam (back iron)]	51.9	WJ Fluid Average Temp [Active]	43.88		
T [Stator Surface]	55.54	WJ T[Fluid - A] Network	43.88		