Motor-CAD Software Tutorial:

Axial Channel Water Jacket Cooling

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1. Description
This document gives a brief description of how to set up a Motor-CAD model for an axial channel water jacket cooled machine.
2. Setting up the housing and axial channels

For this example the default machine will be used and only a limited number of parameters adjusted.

The housing and cooling definition options are only available in the thermal context (menu- >Model->Thermal).

The housing type can then be set as 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.
3. 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.
4. 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.
5. 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 **Number Flow Channels** box.

The number of paths is set using the **Parallel flow paths** edit box. In this model if the value is set to 8 then all the 8 channels will be in parallel.

In this machine we will have a serpentine flow path so will set the **Parallel flow paths** = 1. The flow fill be serpentine passing through the 8 channels in this model in series.
The flow is indicated in the radial and axial cross section views as shown below.
It can be useful at this stage to check the fluid velocities to ensure that the fluid velocity is achievable. As a guide the maximum velocity for air is about 20m/s and the maximum velocity for water is about 5m/s.
The heat transfer sheet gives the heat transfer calculation values for the different flow paths. It gives an indication of the flow state laminar, transitional or turbulent, the heat transfer coefficients calculated and the surface areas being cooled.
6. Running a steady state thermal calculation

The steady thermal calculation for this machine is then run using the options shown below:
7. Viewing the results

The power removed from the machine by the water jacket is shown in the steady state schematic.
The fluid temperatures and other housing water jacket values are shown in the output data sheet as shown below.

The heat dissipated in the housing water jacket is also given in the output sheets:
8. Conclusions
This tutorial gives a brief introduction to the modelling of axial housing water jackets in Motor-CAD. More details of the calculations made and the options for coupling different cooling systems can be found in the Motor-CAD manual.