3D Convection through an Electronics Box - Physics Setup

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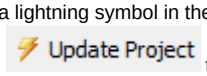
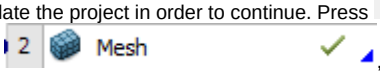
Physics Setup

Update Project

In the *Project Schematic* window, notice that there is a lightning symbol in the mesh box 

. This means that we need to update the project in order to continue. Press 

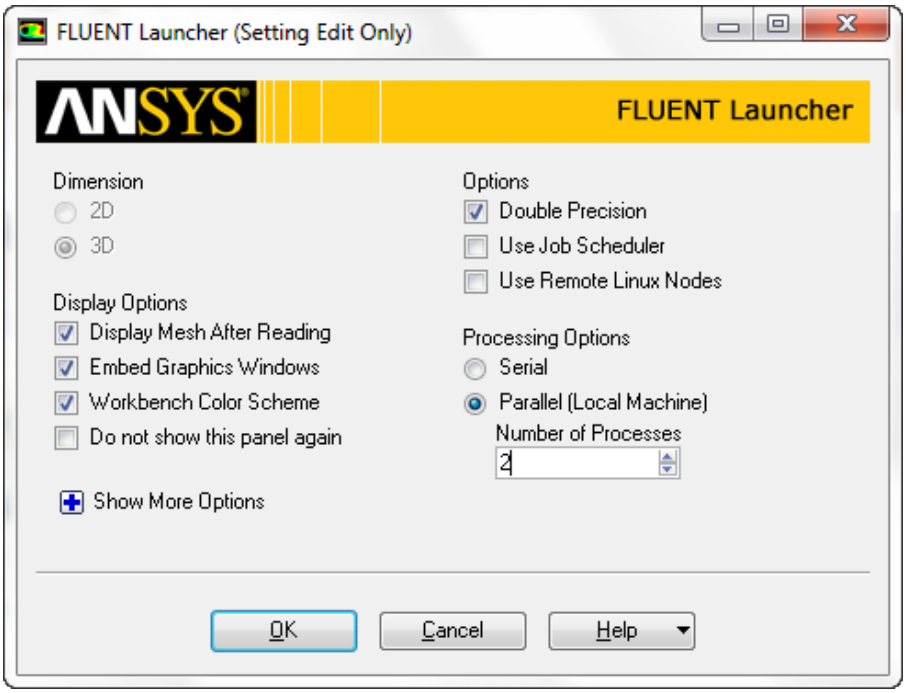
to apply the mesh. The lighting symbol should now be replaced by a green check mark 

, meaning we are ready to move on.

Launch FLUENT

To begin setup, double click 

. This will first launch a dialogue box with some options. Under *Options*, check the box marked ***Double Precision***, and under *Processing Options*, select ***Parallel*** and change the ***Number of Processes*** to ***2***.



Once the options are set, press ***OK*** to launch FLUENT.

Turn on Energy

The first thing that needs to be done is to tell FLUENT to solve for temperature. To do this, we need to turn on the Energy Equation. Under **Problem Setup**, select ***Models***. In the *Models* window, double click ***Energy***. The *Energy* window should pop up. Check the box next to ***Energy Equation*** and press ***OK***.

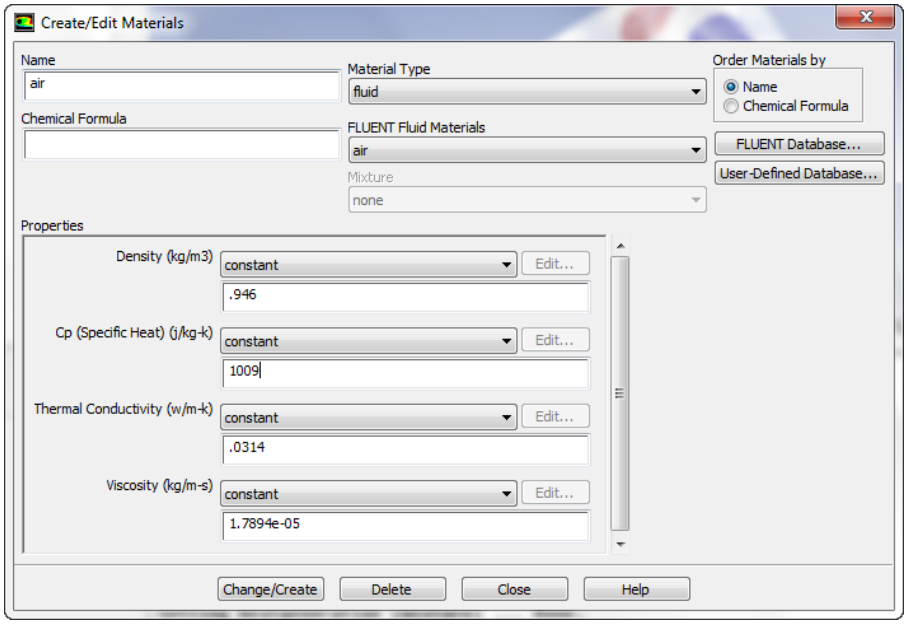
Materials

Next, we will create the materials we are using in the simulation and define their material properties. For reference, the material properties needed for this simulation are included in the table below.

Material	ABS plastic	Copper	Air
Density (kg/m^3)	1080	8800	0.946
Thermal Conductivity (W/mK)	0.188	391	0.0314
Specific Heat (J/kgK)	1260	385	1009

Air

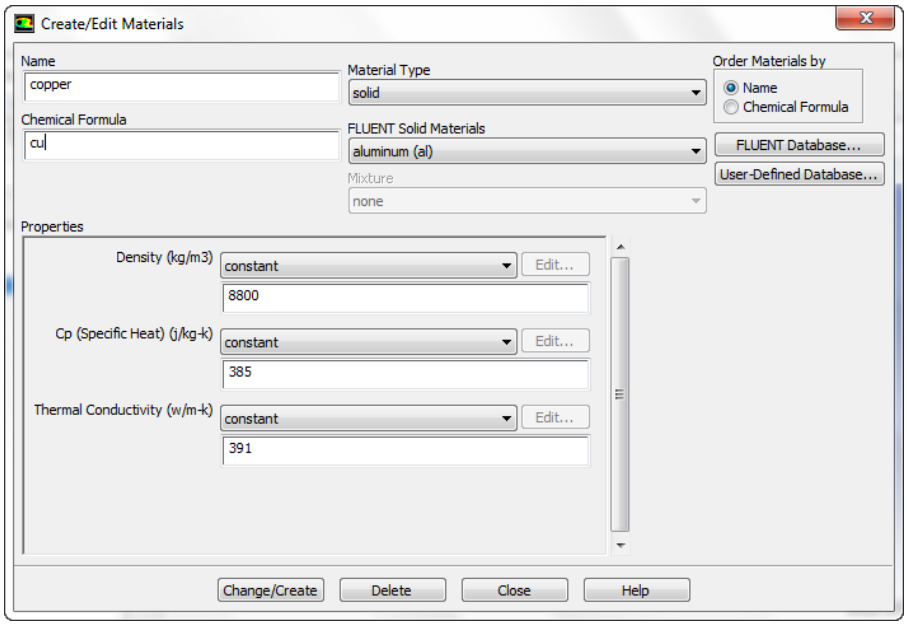
Under **Problem Setup**, select ***Materials***. In the *Materials* window under *Fluid* select ***Air***, and press ***Create/Edit...***. Define the material properties for air as shown in the table above.



When you are finished entering the material properties of air, press ***Change/Create*** and close the window.

Copper

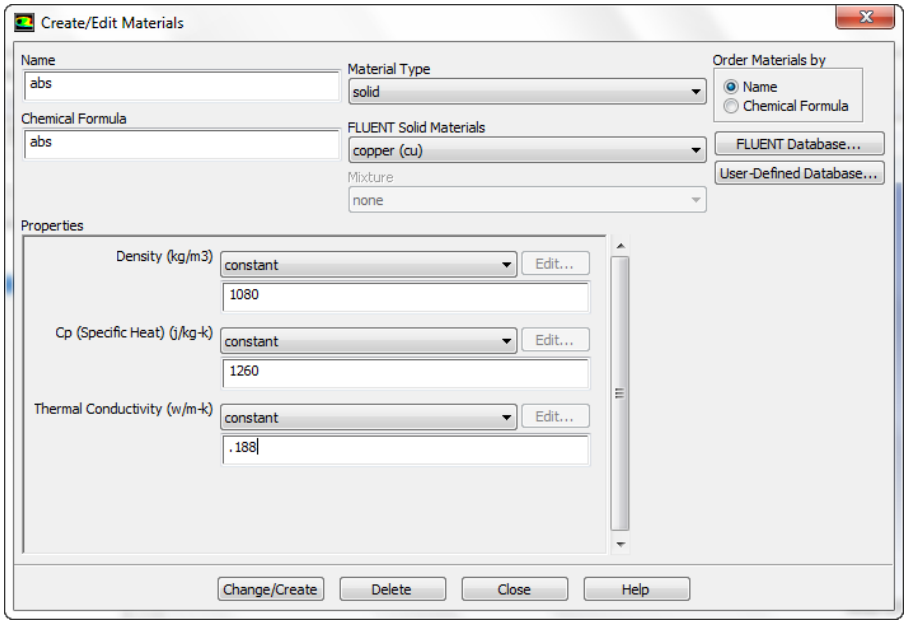
Now, highlight ***aluminum*** in the *material properties* window and select ***Create/Edit...***. We are not using aluminum in this simulation, so we need to change the name and the properties to reflect copper. In the popup window, change the ***Name*** to `Copper`, and the ***Chemical Formula*** to `Cu`. Also, change the material properties to the values shown in the chart above.



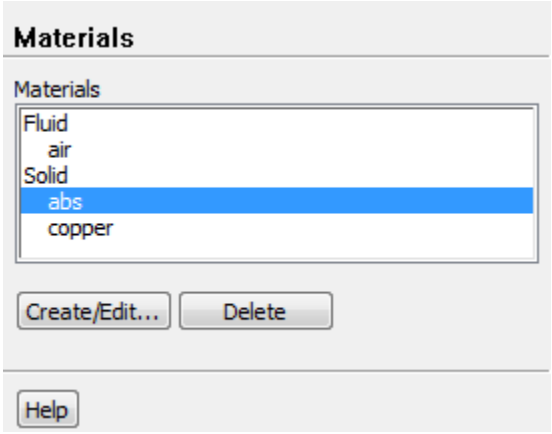
Now, press ***Change/Create***. You will be asked if you want to overwrite aluminum, press ***Yes***. You may now close the popup window.

ABS Plastic

Now, we need to create a new material. In the *Materials* window, highlight ***Solid*** and press ***Create/Edit...***. Notice that the material properties for copper appear in the popup window. This is OK, but we need to remember that we do not want to overwrite the copper data. Rename the new material ABS and for simplicity, also enter the ***Chemical Formula*** as ABS. Enter the material properties for ABS as shown in the table above.



When the material properties are entered correctly, press ***Change/Create***. The popup will appear asking us if we want to overwrite the material properties for copper. We do not want to overwrite copper, so press ***No***. This should create ABS as a new material in the material list.



Boundary Conditions

Now, we need to enter the boundary conditions for this problem. In the *Outline*, select ***Boundary Conditions*** to bring up the boundary conditions window.

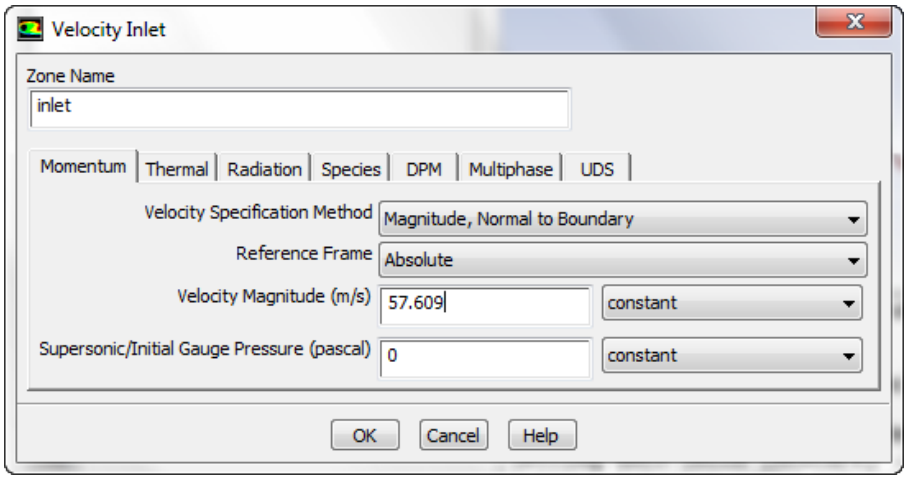
Inlet

In the *Boundary Conditions* window, select ***Inlet***. Check to make sure that the ***Type*** has correctly defaulted to ***Velocity-Inlet*** and press ***Edit...***. In the ***Momentum*** Tab, we will specify the velocity of the incoming air. Knowing that the inlet feed rate is 35 ft^3/min and that the diameter of the holes is 4.72 inches, we can solve for the inlet speed.

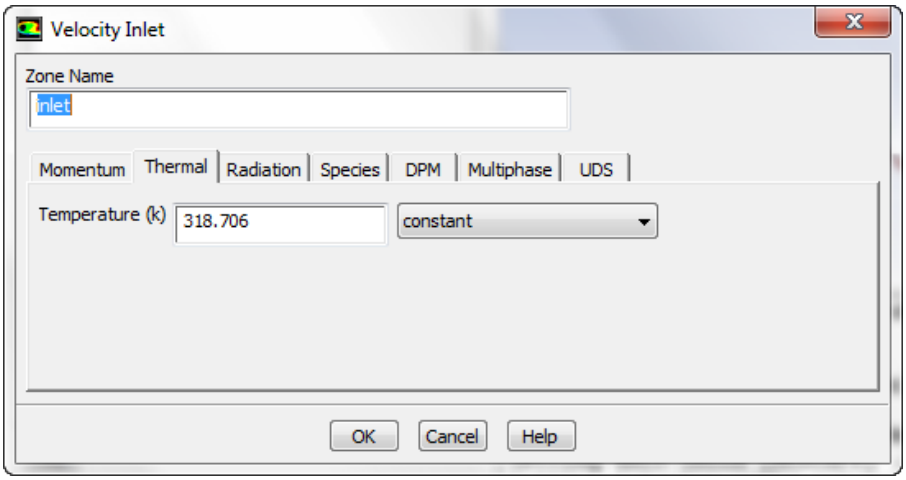
$$flow = 35\frac{ft^3}{minute} = 1008\frac{in^3}{s}$$

$$u = \frac{1008\frac{in^3}{s}}{\left(\frac{4.72}{2}in\right)^2\pi} = 57.609\frac{in}{s}$$

Input the speed into the ***Velocity Magnitude***. Please note that the units for the ***Velocity Magnitude*** should be in/s and not m/s as in the picture.

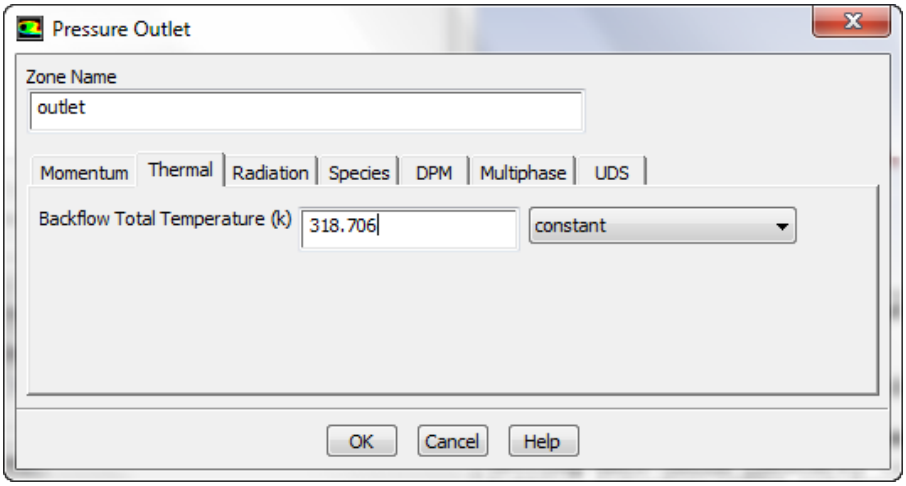


Next, click on the ***Thermal Tab***. We need to input the temperature of the incoming air. The ambient air is 114 degrees Fahrenheit. FLUENT only accepts temperatures in Kelvin. 114 degrees Fahrenheit = 318.706 Kelvin. Input the ambient temperature, and press ***OK***



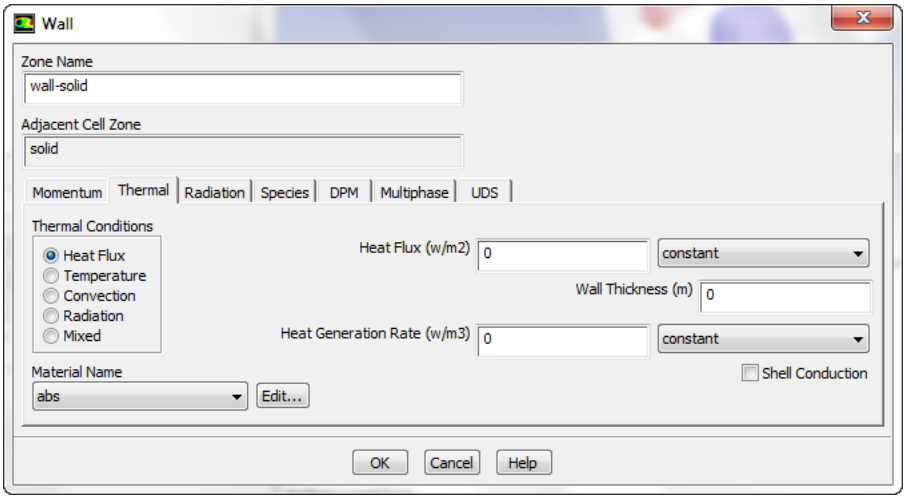
Outlet

In the *Boundary Conditions* window, select ***Outlet***. Check to make sure that the ***Type*** is set to ***Pressure-Outlet*** and press ***Edit...***. In the ***Momentum*** tab, the ***Gauge Pressure (pascal)*** should be set to `0`. Next, click on the ***Thermal*** tab. Change the ***Backflow Total Temperature*** to `318.706` Kelvin and press ***OK***.



Wall

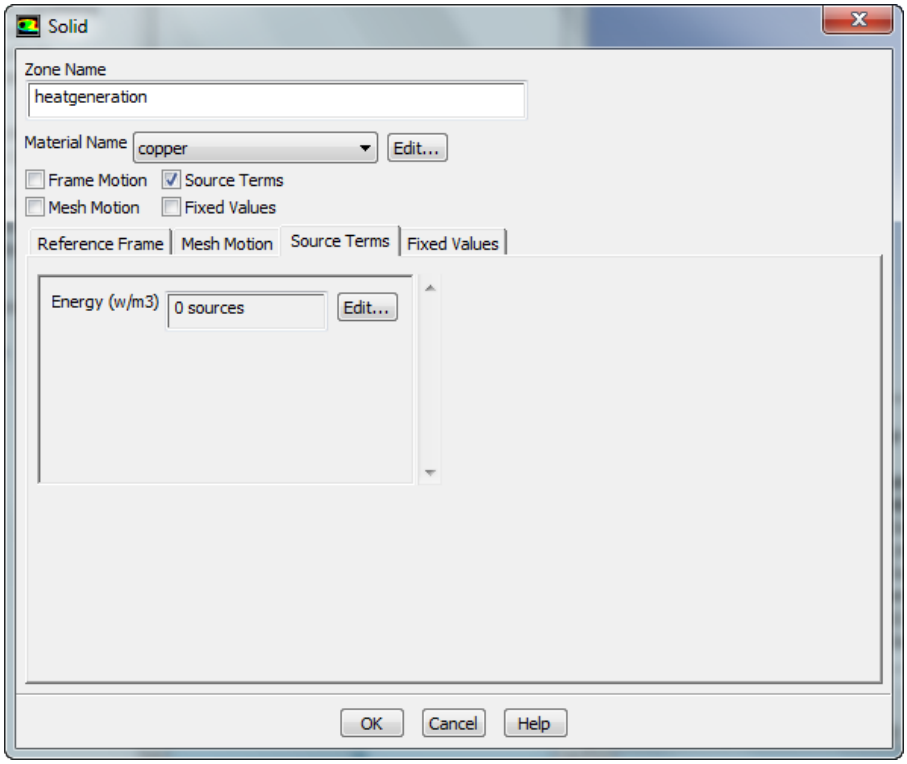
Next, we need to specify the wall material as ABS plastic. In the *Boundary Conditions* menu, select ***wall-solid*** and press ***Edit...***. Select the ***Thermal*** tab, and change the ***Material*** to ***ABS***.



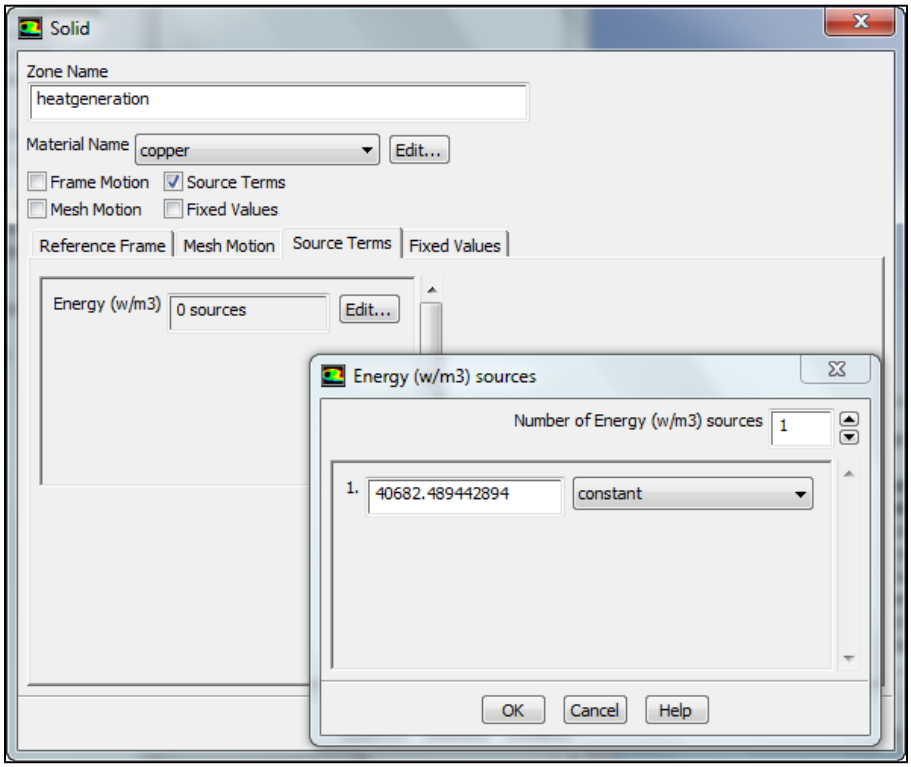
When finished, press ***OK***

Heat Generation

In the *Outline* window, select ***Cell Zone Conditions***. Under *Zones*, select ***HeatGeneration*** and press ***Edit***. Change the material name to ***Copper***. Check the box next to ***Source Terms***, then select the Source Terms Tab.



In the Source Terms tab, select ***Edit***. Change the number of Energy Sources to ***1***, then use the pull down menu and select constant. Enter the heat generation as 40682 w/m^3.



When finished, press ***OK***.

Reference Values

Now that we are done defining the boundary conditions, we need to specify reference values. In the *Outline*, select ***Reference Values***. Underneath ***Compute From***, select ***Inlet***.

Go to Step 5: Numerical Solution

Go to all FLUENT Learning Modules