

# FLUENT - Forced Convection over a Flat Plate step 5

## Problem Specification

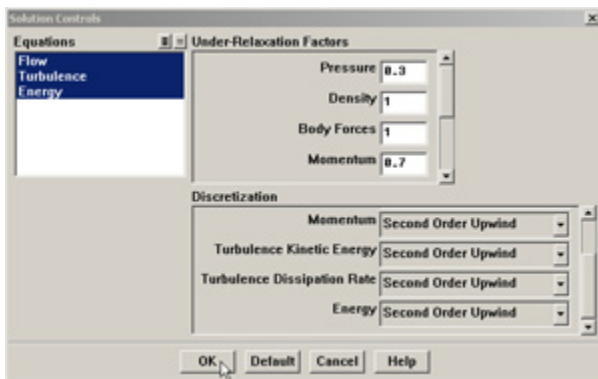
1. Create Geometry in GAMBIT
2. Mesh Geometry in GAMBIT
3. Specify Boundary Types in GAMBIT
4. Set Up Problem in FLUENT
5. **Solve**
6. Analyze Results
7. Refine Mesh

## Step 5: Solve!

We'll use a second-order discretization scheme.

Main Menu > Solve > Controls > Solution...

Change **Density**, **Momentum**, **Turbulence Kinetic Energy**, **Turbulence Dissipation Rate**, and **Energy** all to **Second Order Upwind**. Leave **Pressure** and **Pressure-Velocity Coupling** set to the default methods (**Standard** and **SIMPLE**, respectively). The other **Pressure** and **Pressure-Velocity Coupling** methods are useful for flows with particular characteristics not present in our problem.



[Higher Resolution Image](#)

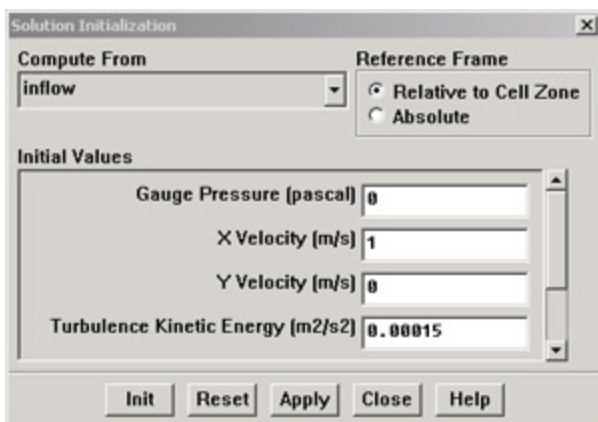
Click **OK**.

## Set Initial Guess

Initialize the flow field to the values at the inflow:

Main Menu > Solve > Initialize > Initialize...

In the *Solution Initialization* window that comes up, choose **inflow** under *Compute From*. The **X Velocity** for *all* cells will automatically be set to 1 m/s, the **Y Velocity** to 0 m/s and the **Gauge Pressure** to 0 Pa. These values have been taken from the inflow boundary condition.



Click **Init**. This completes the initialization. Then click **Close**.

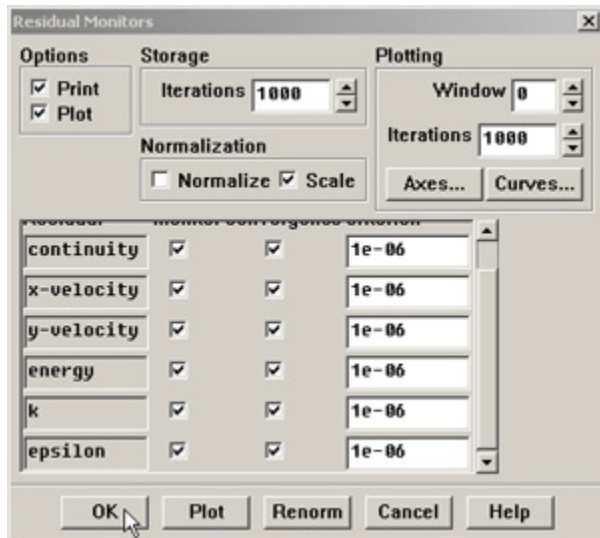
## Set Convergence Criteria

FLUENT reports a residual for each governing equation being solved. The residual is a measure of how well the current solution satisfies the discrete form of each governing equation. We will iterate until the residual for each equation falls below  $1e-6$ .

**Main Menu > Solve > Monitors > Residual...**

Change the residual under **Convergence Criterion** for **continuity**, **x-velocity**, and **y-velocity**, **energy**, **k**, and **epsilon** all to  $1e-6$ .

Also, under **Options**, select **Print** and **Plot**. This will print the residuals in the main window and plot the residuals in the graphics window as they are calculated.



Click **OK**.

This completes the problem specification. Save your work:

**Main Menu > File > Write > Case...**

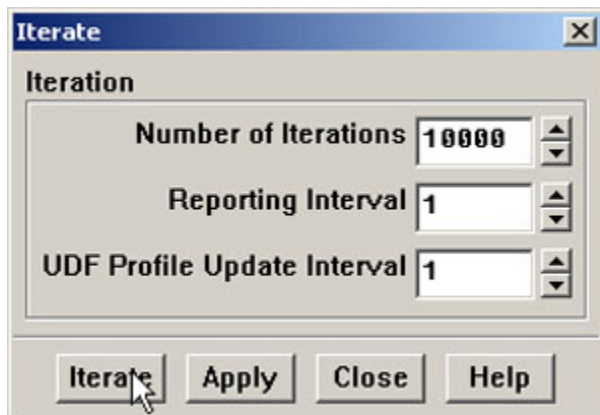
Type in `plate.cas` for **Case File**. Click **OK**. Check that the file has been created in your working directory. If you exit FLUENT now, you can retrieve all your work at any time by reading in this case file.

## Iterate Until Convergence

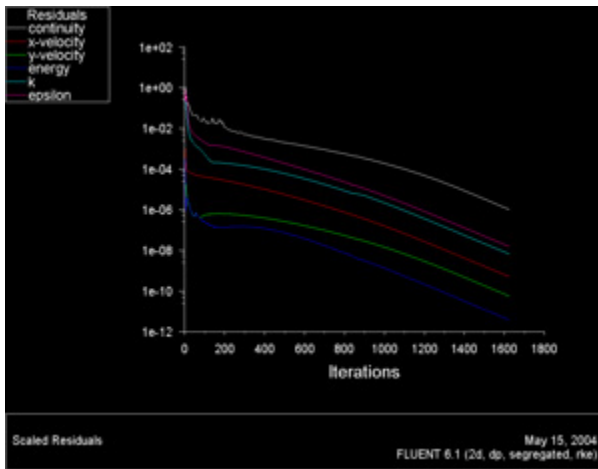
Start the calculation by running 10,000 iterations. The solution will converge before 10,000 iterations are performed, which will stop the iteration process.

**Main Menu > Solve > Iterate...**

In the *Iterate* Window, change the **Number of Iterations** to 10000. Click **Iterate**.



The residuals for each iteration are printed out as well as plotted in the graphics window as they are calculated.



[Higher Resolution Image](#)

The residuals fall below the specified convergence criterion of  $1e-6$  in approximately 1623 iterations.

iter	continuity	x-velocity	y-velocity	energy	k	epsilon	time/iter
1600	1.1595e-06	5.9992e-10	6.6181e-11	4.4681e-12	2.8278e-09	1.8228e-08	2:00:14 98292
1601	1.1484e-06	5.9441e-10	6.5428e-11	4.4088e-12	2.8021e-09	1.8059e-08	1:38:59 98292
1602	1.1374e-06	5.8890e-10	6.4680e-11	4.3478e-12	2.7750e-09	1.7891e-08	1:19:11 98291
1610	1.1265e-06	5.8339e-10	6.3930e-11	4.2873e-12	2.6436e-09	1.7726e-08	1:00:21 98290
1611	1.1155e-06	5.7788e-10	6.3180e-11	4.2271e-12	2.5929e-09	1.7561e-08	0:51:01 98289
1612	1.1046e-06	5.7236e-10	6.2430e-11	4.1670e-12	2.5428e-09	1.7399e-08	0:41:00 98288
1613	1.0936e-06	5.6738e-10	6.1680e-11	4.1070e-12	2.4928e-09	1.7238e-08	0:31:00 98287
1614	1.0826e-06	5.6212e-10	6.0930e-11	4.0470e-12	2.4428e-09	1.7078e-08	0:21:00 98286
1615	1.0716e-06	5.5691e-10	6.0180e-11	3.9870e-12	2.3928e-09	1.6918e-08	0:11:00 98285
1616	1.0606e-06	5.5165e-10	5.9430e-11	3.9270e-12	2.3428e-09	1.6758e-08	0:01:00 98284
1617	1.0496e-06	5.4645e-10	5.8680e-11	3.8670e-12	2.2928e-09	1.6598e-08	0:00:00 98283
1618	1.0386e-06	5.4119e-10	5.7930e-11	3.8070e-12	2.2428e-09	1.6438e-08	1:38:06 98282
1619	1.0276e-06	5.3599e-10	5.7180e-11	3.7470e-12	2.1928e-09	1.6278e-08	1:19:11 98281
1620	1.0166e-06	5.3073e-10	5.6430e-11	3.6870e-12	2.1428e-09	1.6118e-08	1:00:21 98280
1621	1.0056e-06	5.2547e-10	5.5680e-11	3.6270e-12	2.0928e-09	1.5958e-08	0:51:01 98279
1622	9.9462e-07	5.2021e-10	5.4930e-11	3.5670e-12	2.0428e-09	1.5798e-08	0:41:00 98278
1623	9.8358e-07	5.1495e-10	5.4180e-11	3.5070e-12	1.9928e-09	1.5638e-08	0:31:00 98277

[Higher Resolution Image](#)

Save the solution to a data file:

**Main Menu > File > Write > Data...**

Enter `plate.dat` for **Data File** and click **OK**. Check that the file has been created in your working directory. You can retrieve the current solution from this data file at any time.

Go to [Step 6: Analyze Results](#)

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