# Sudden Expansion - Numerical Solution

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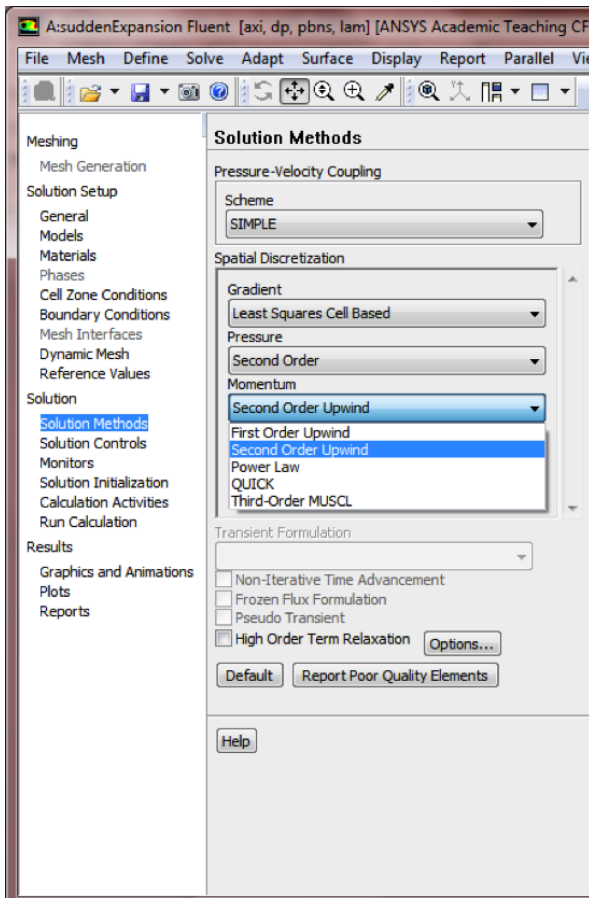
## Numerical Solution

### Second Order Scheme

A second-order discretization scheme will be used to approximate the solution. In order to implement the second order scheme click on *Solution Methods* then click on *Momentum* and select *Second Order Upwind* as shown in the image below.



### Set Initial Guess

Here, the flow field will be initialized to the values at the inlet. In order to carry out the initialization click on *Solution Initialization, Standard Initialization*, and click on *Compute from* and select *inlet* as shown below.
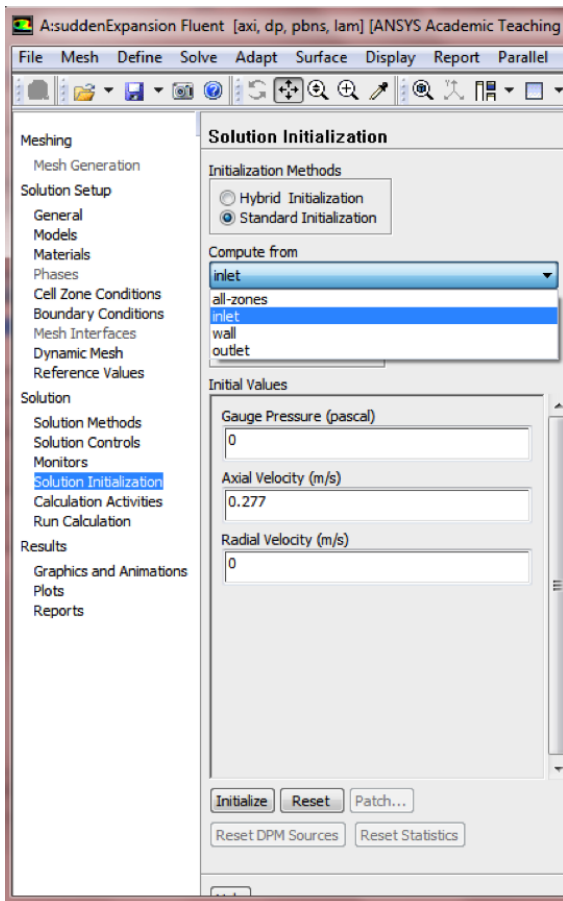
Then, click the **_Initialize_** button, [Initialize]. This completes the initialization.

## 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'll iterate the solution until the residual for each equation falls below 1e-6. In order to specify the residual criteria **_(Click)_** **_Monitors > Residuals > Edit..._**, as shown in the image below.
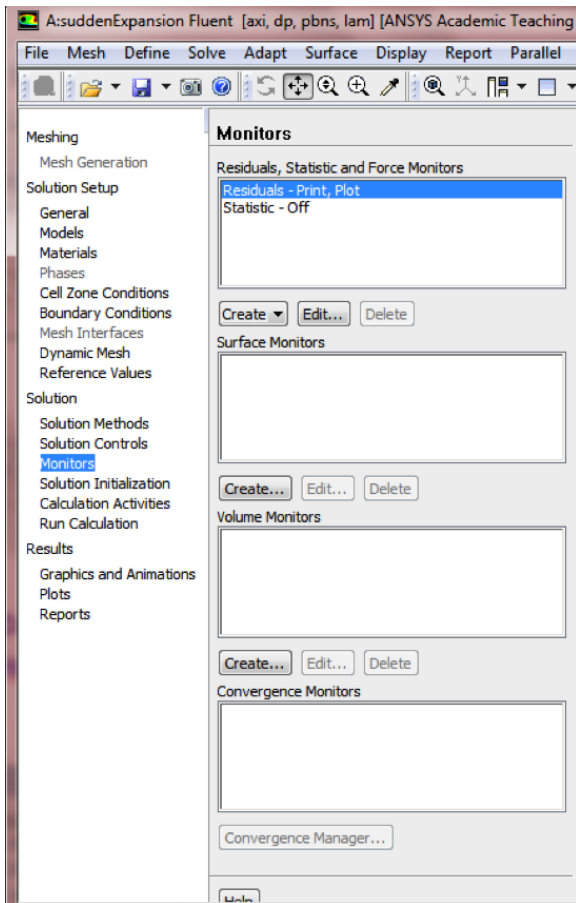
Next, change the residual under **Convergence Criterion** for **continuity**, **x-velocity**, and **y-velocity**, all to 1e-6, as can be seen below.
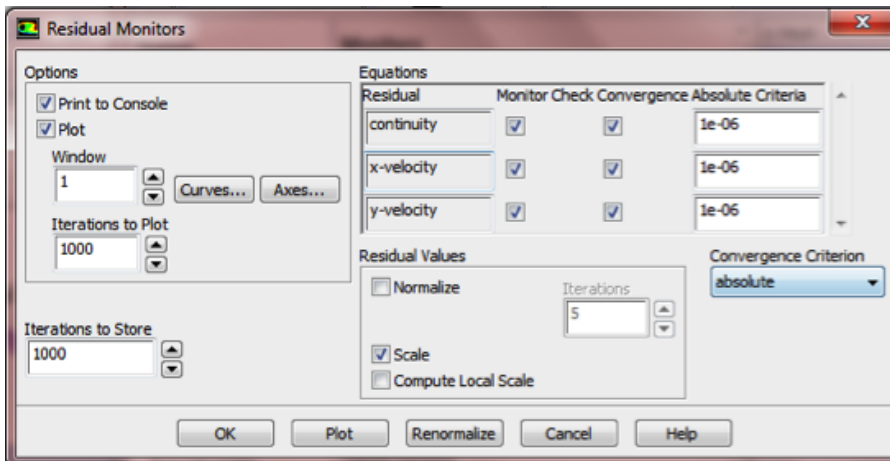


Lastly, click **OK** to close the **Residual Monitors** menu.

## Execute Calculation

Prior, to running the calculation the maximum number of iterations must be set. To specify the maximum number of iterations click on **Run Calculation** then set the **Number of Iterations** to 1000, as shown in the image below.
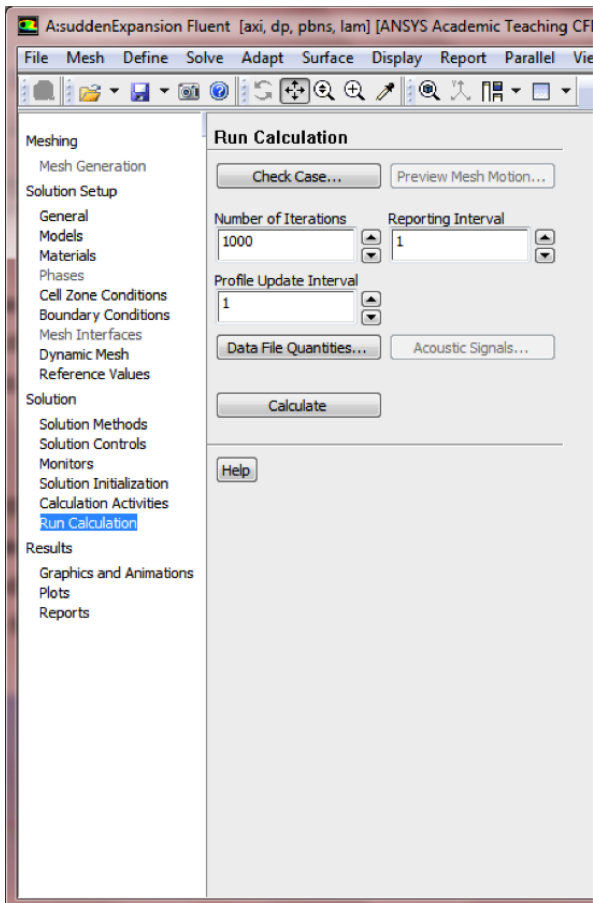
As a safeguard save the project now. Now, click on **Calculate** two times in order to run the calculation. The residuals for each iteration are printed out as well as plotted in the graphics window as they are calculated. After running the calculation, you should obtain the following residual plot.
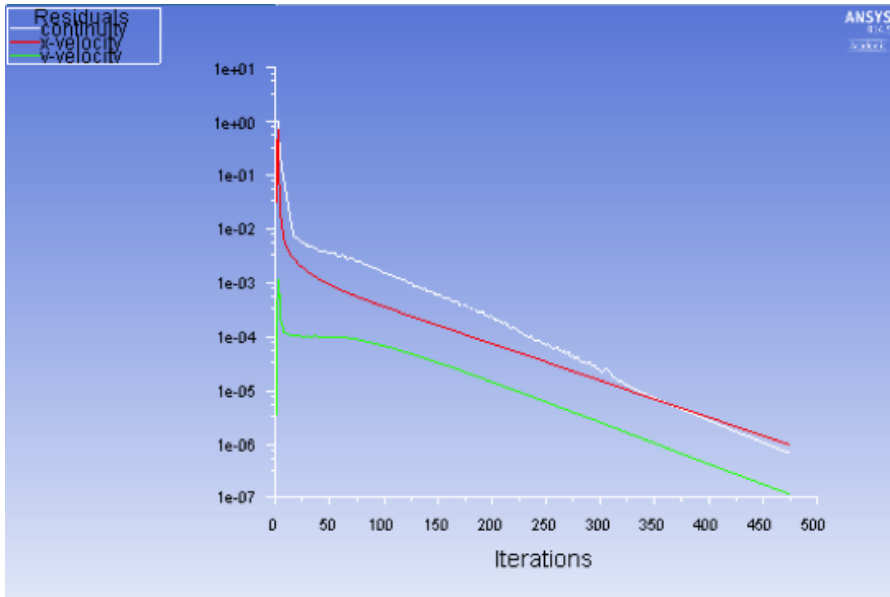


The residuals fall below the specified convergence criterion of 1e-6 in about 473 iterations, as shown below. Actual number of convergence steps may vary slightly.

```
    472   7.1711e-07   1.0157e-06   1.2395e-07   0:00:38   528
 !  473 solution is converged
    473   7.0347e-07   9.9975e-07   1.2188e-07   0:00:30   527
 I
```

At this point, save the project once again.


**Go to Step 6: Numerical Results**

Go to all FLUENT Learning Modules