Mesh Resolution Study For Pipe With Nozzle Weld Beads

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1/12/2012

Location of the Interested Weld

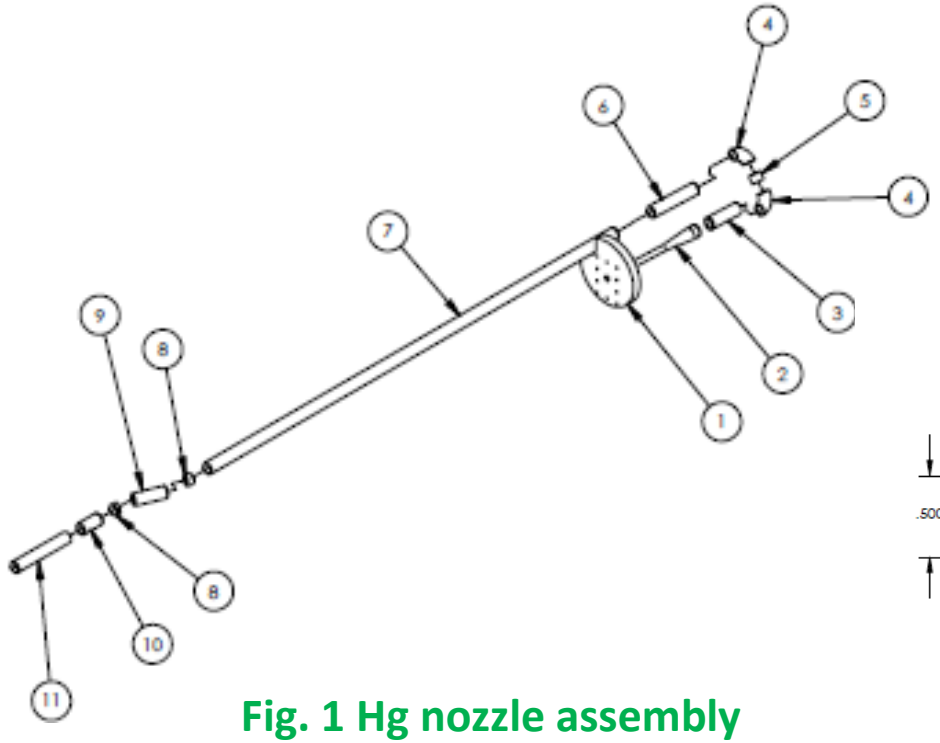


Fig. 1 Hg nozzle assembly

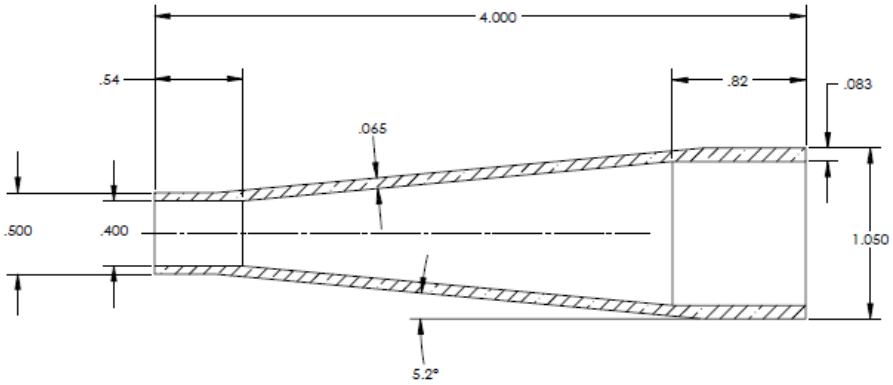


Fig. 2 Dimensions of item 2 (unit: inch)

Location of interests: welded-joint between items 2 and 3;
item 2: Ti-6Al-4V; item 3: Ti Grade 2.

Surface Topology of the Weld Bead

- To understand the effect of bead geometry on the turbulence level of the flow at pipe exit.
  - Flat surface
  - Whole azimuthal weld with semi-circle cross section
    - Major radius = 0.884”
    - Minor radius = 1/16”
  - Partial azimuthal weld with semi-circle cross section
    - only has 30^o of azimuth from -15^o to $+15^o$ relative to “up”

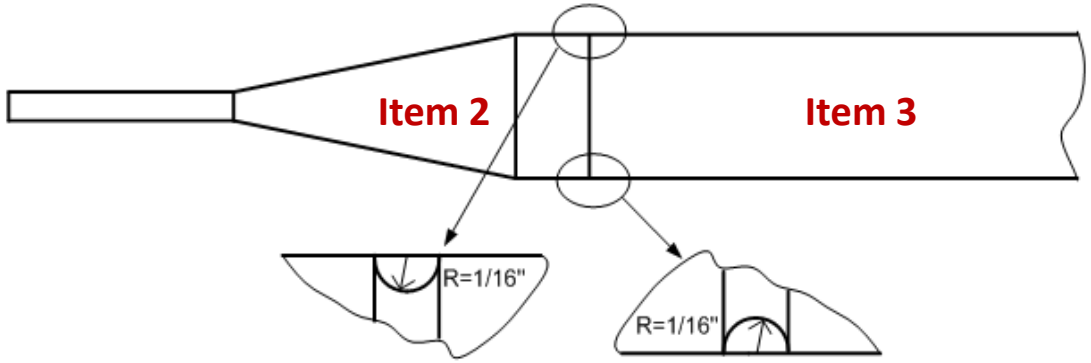
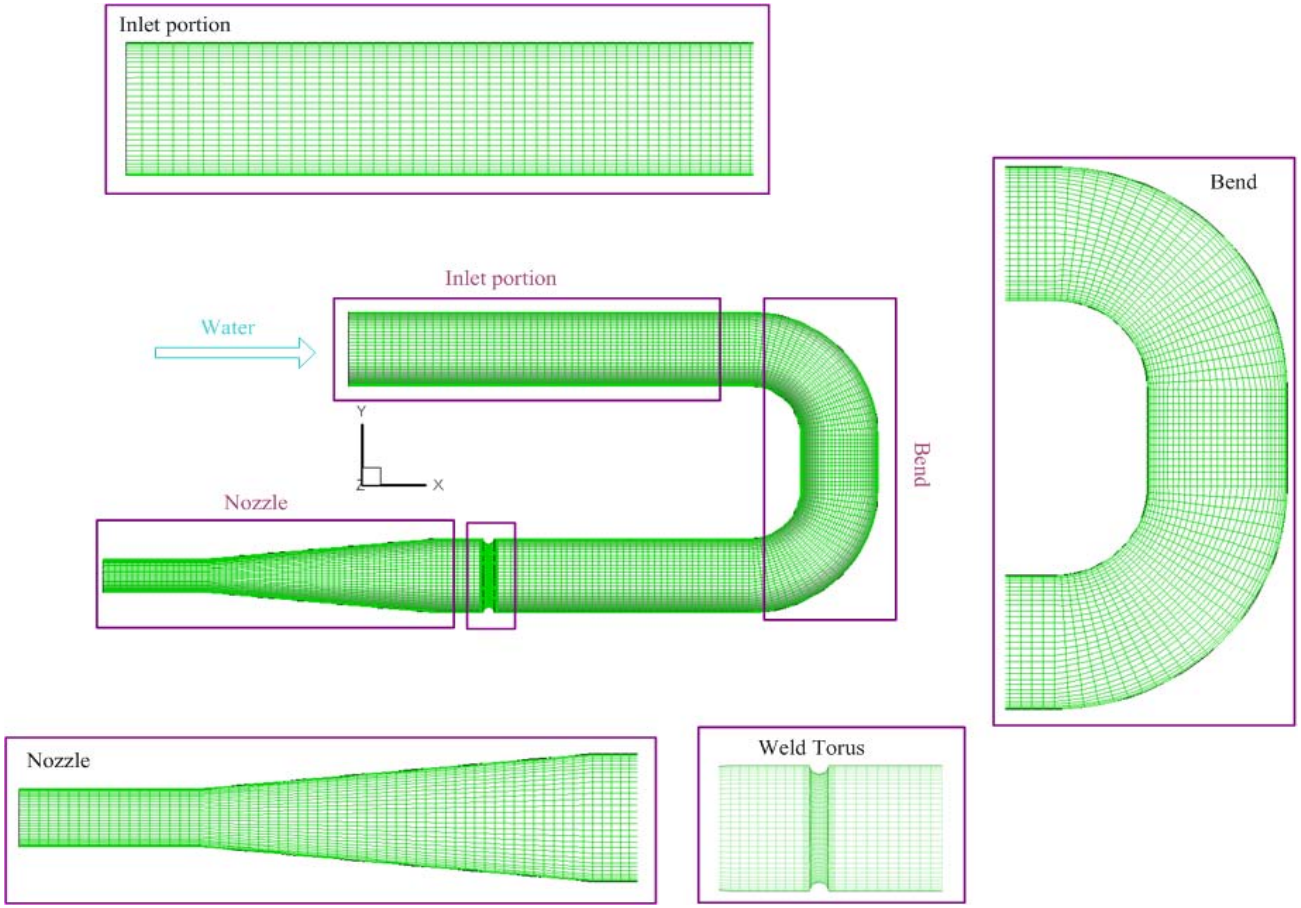


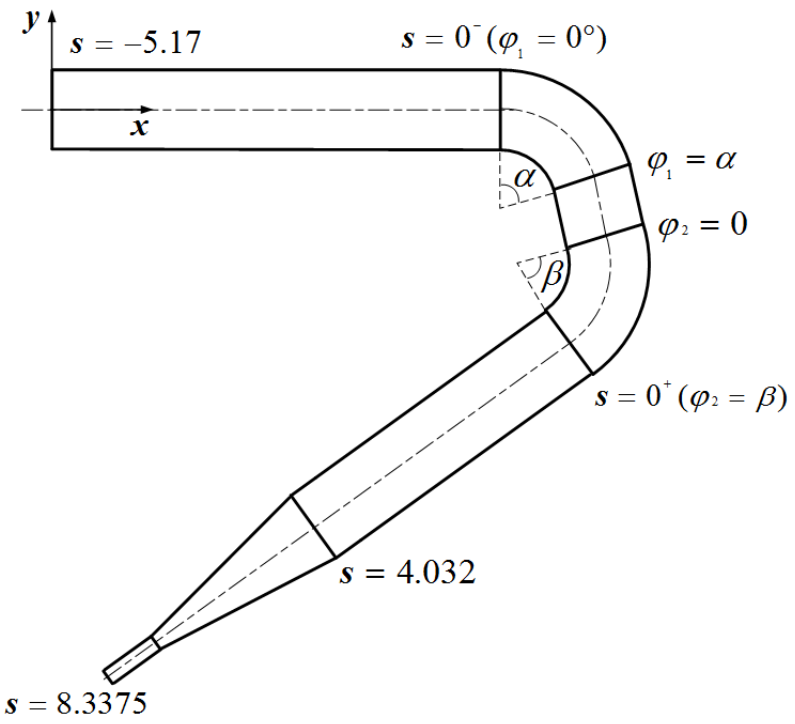
Fig. 3 The semi-circle topology of the Weld

Mesh for the Pipe with Whole Weld

Pipes	Mesh No. (EWT)
Pipe with whole weld	mesh0: n_θ=32, n_r=65, n_z=260, n_{tot}=5.3248e5
	mesh1: n_θ=40, n_r=77, n_z=274, n_{tot}=8.3296e5
	mesh2: n_θ=48, n_r=90, n_z=294, n_{tot}=1.255968e6



Velocity Line Plots for Pipe With Whole Weld



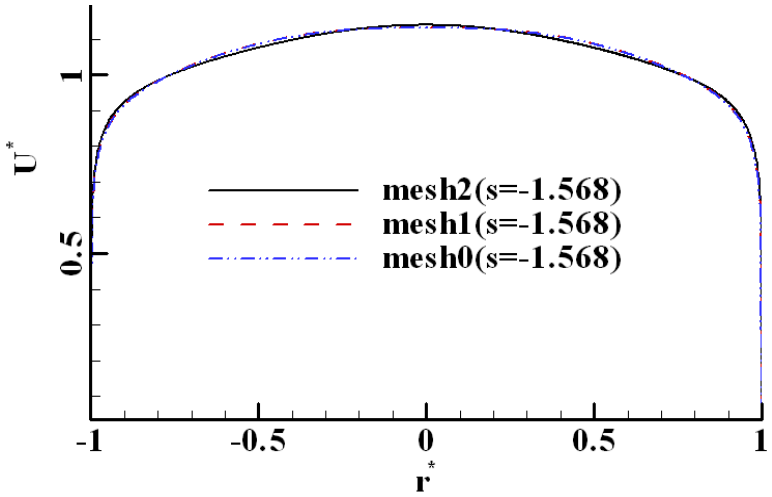
Portions along the positive flow direction

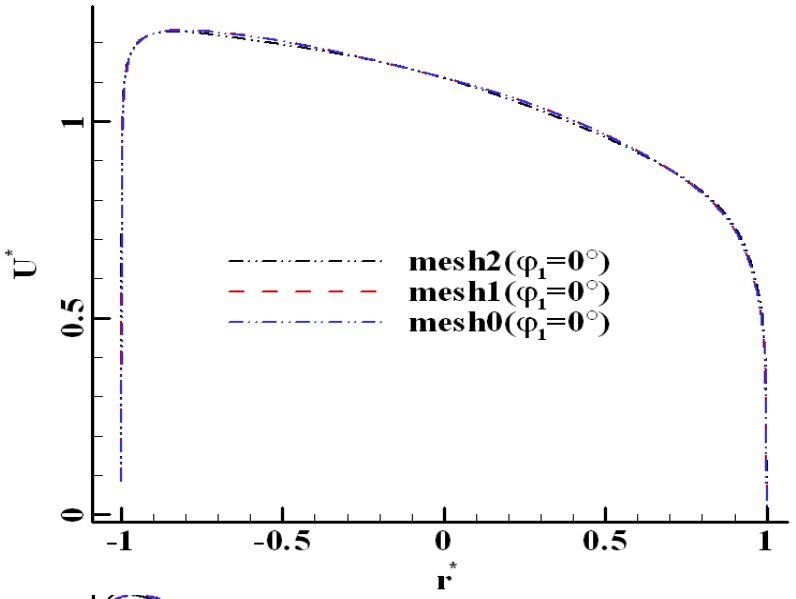
$$U^* = \frac{u}{U_b}$$

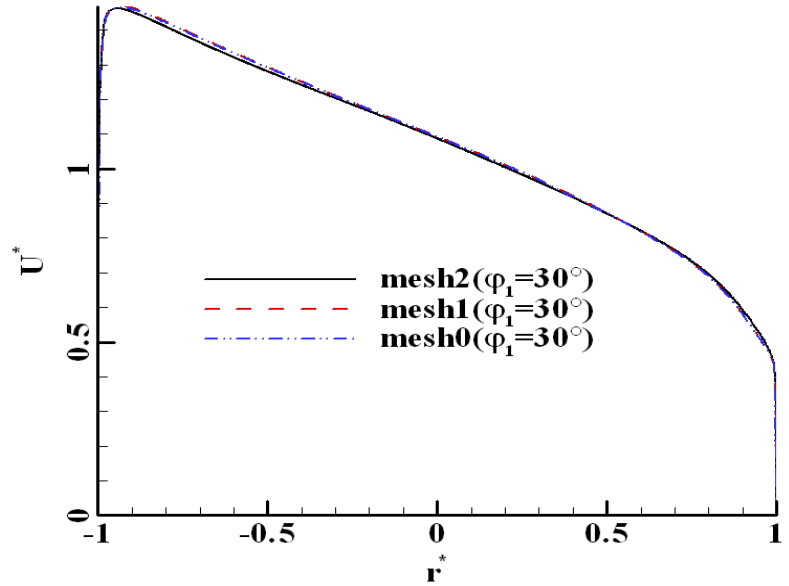
$$\text{where } U_b \equiv \frac{\int u(r,\theta) r dr d\theta}{\int r dr d\theta}$$

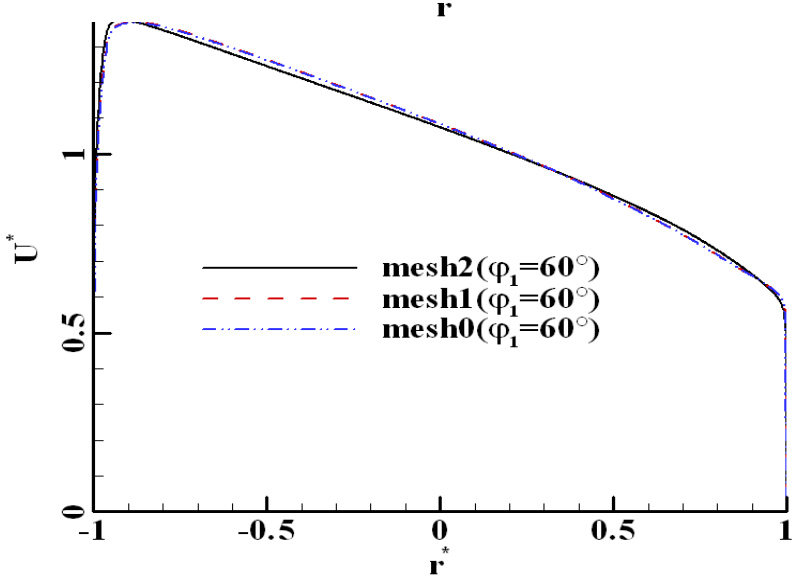
Plots of U* along the axial direction are chosen at s=-1.568, s=3.36, s=4.032, $\varphi_{1,2} = 0°, \varphi_{1,2} = 30°, \varphi_{1,2} = 60°, \varphi_{1,2} = 90°,$ s=6.89, and s=8.3375.

Velocity Line Plots for Pipe With Whole Weld -- Cont'd

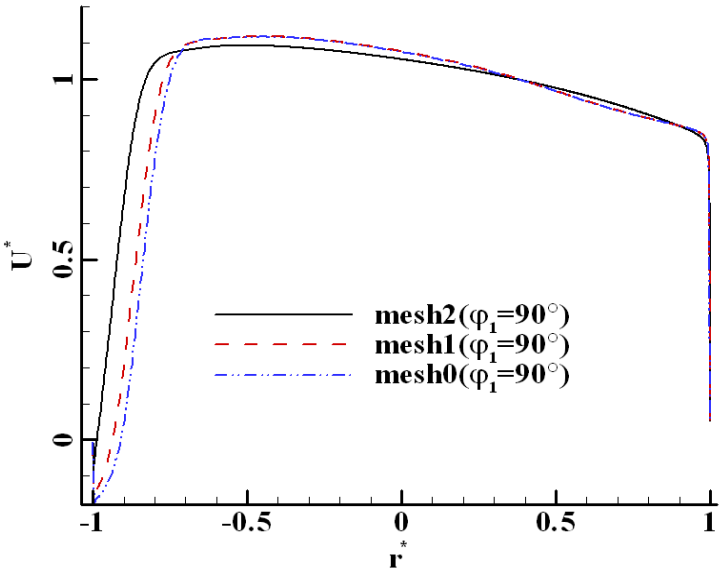


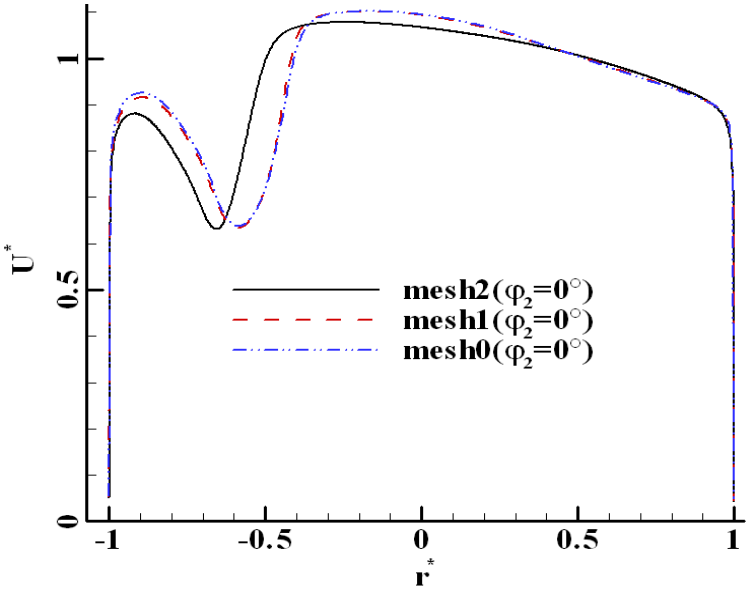


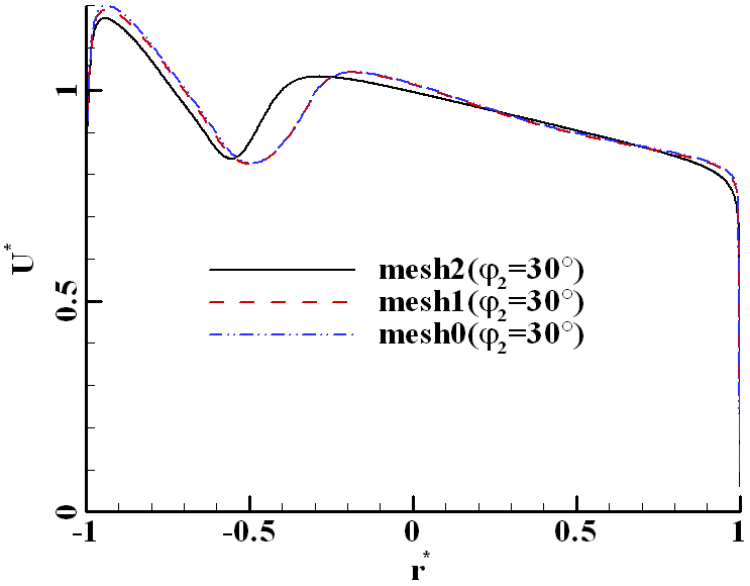


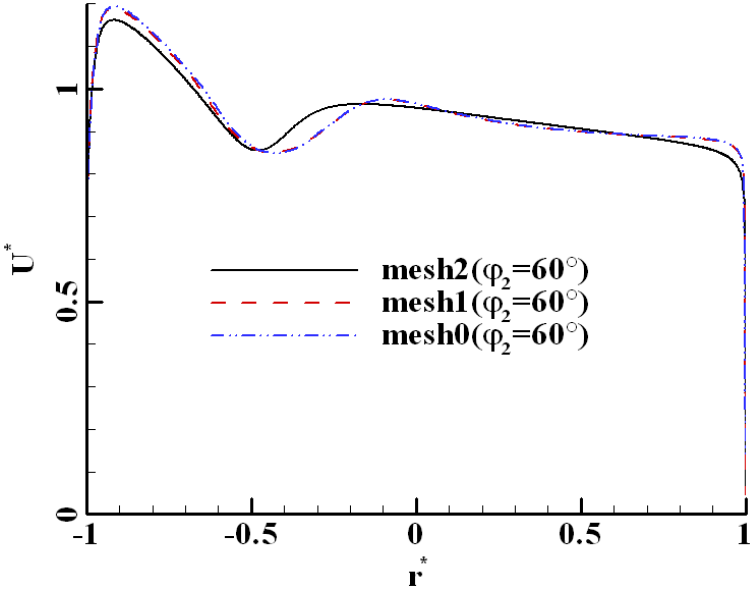


Velocity Line Plots for Pipe With Whole Weld -- Cont'd

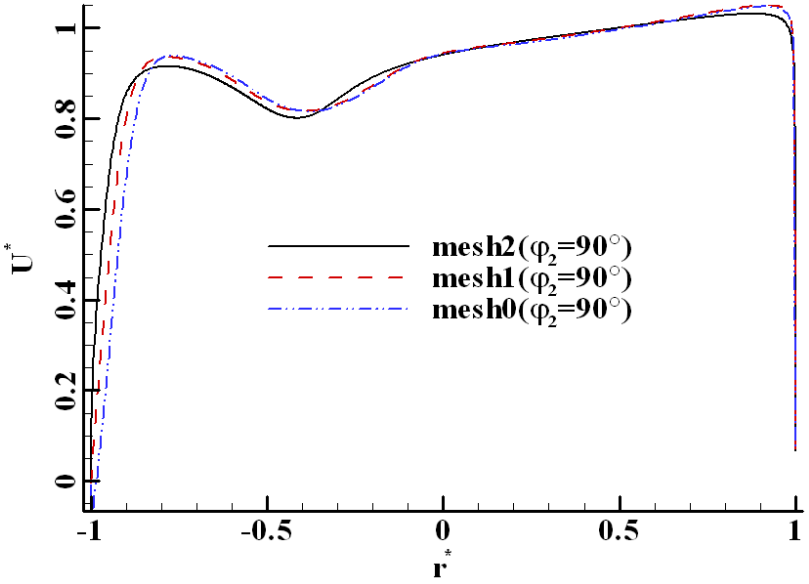


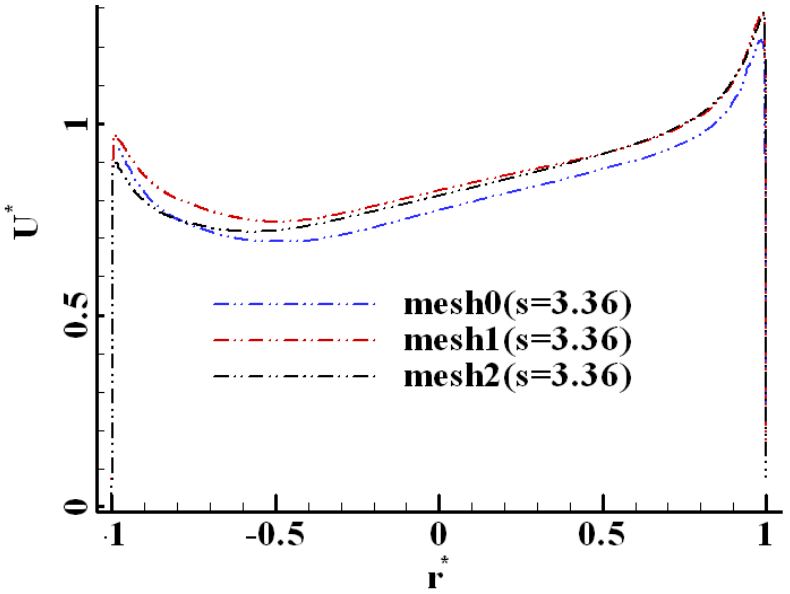


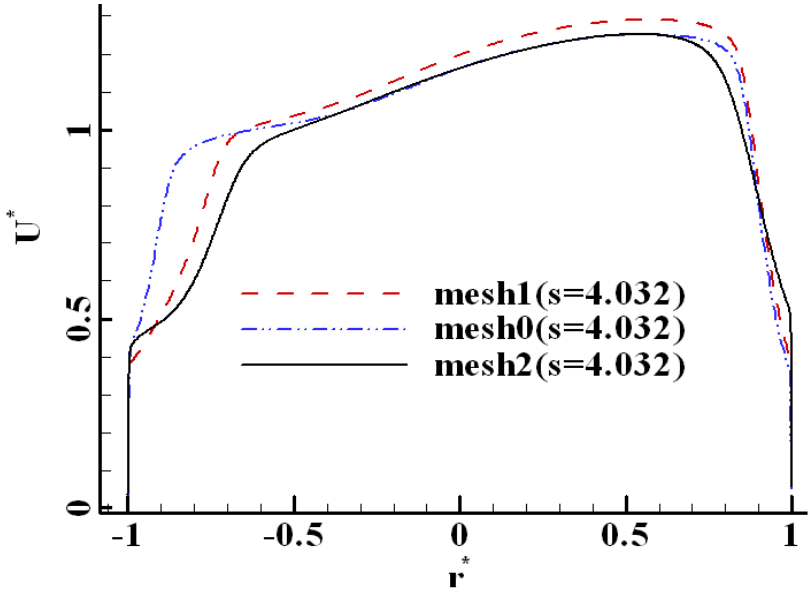


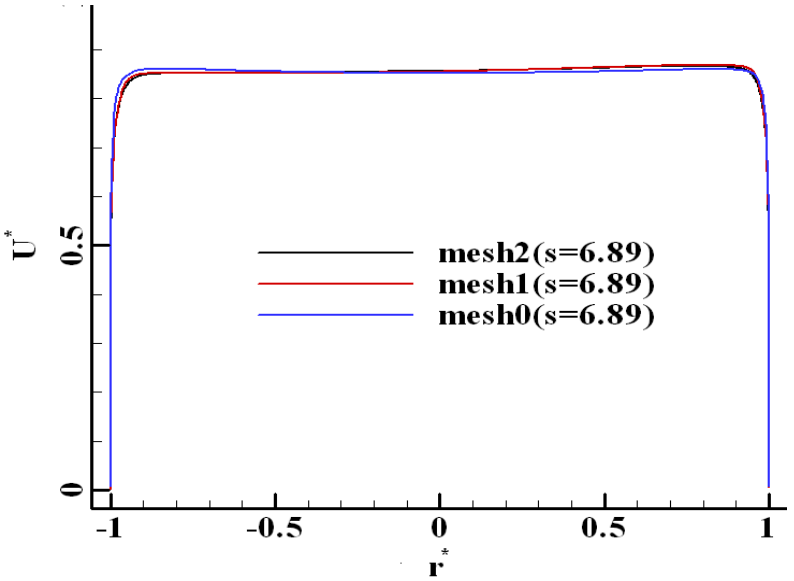


Velocity Line Plots for Pipe With Whole Weld -- Cont'd

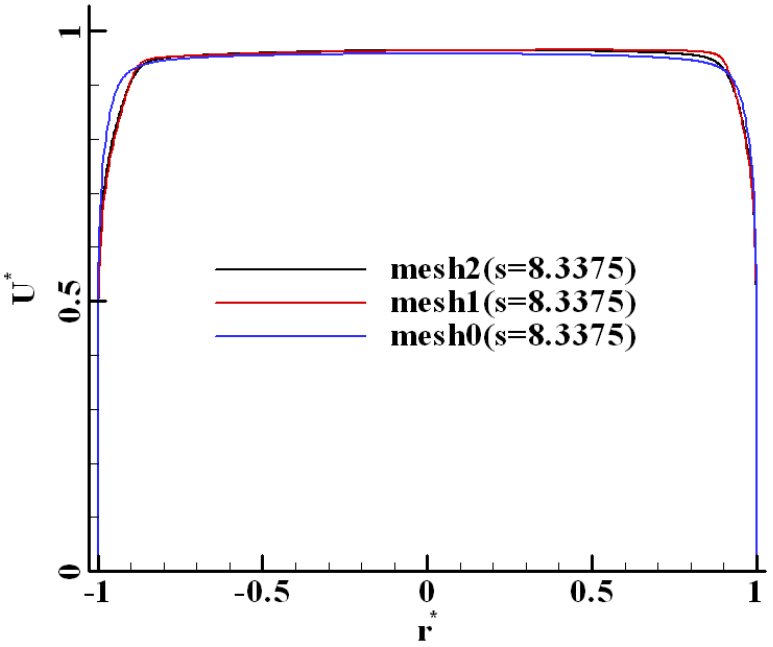


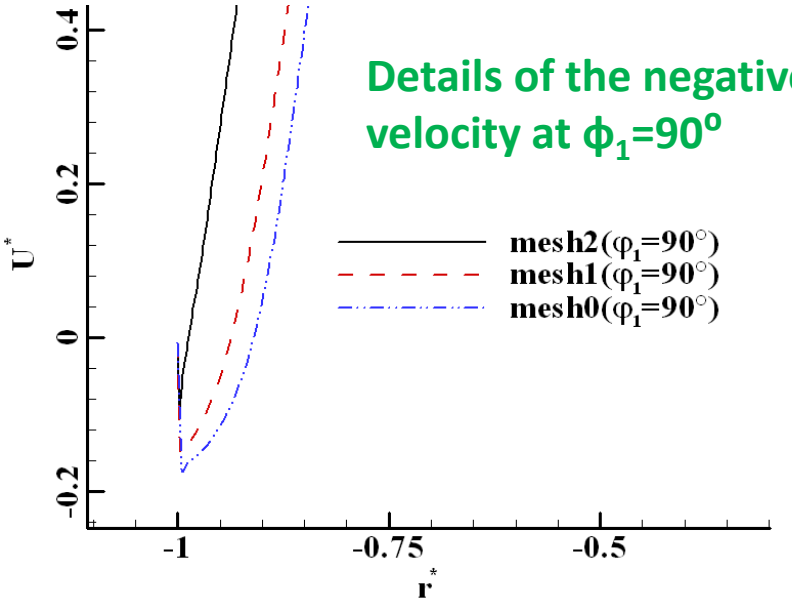




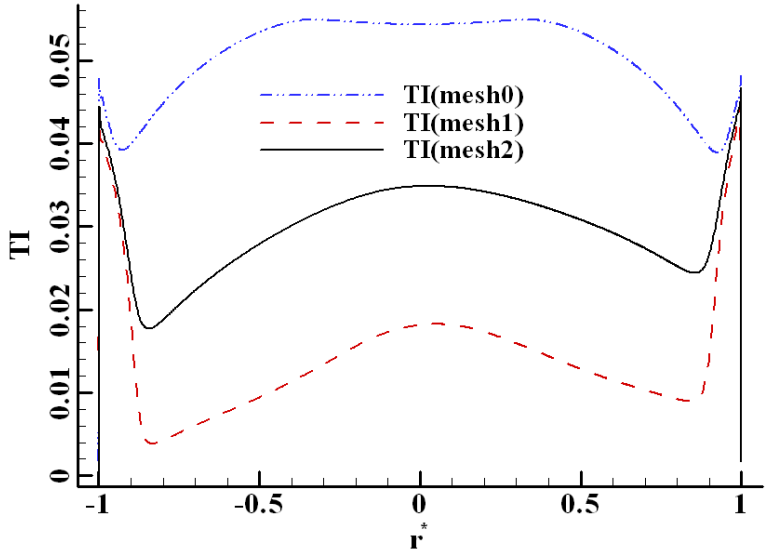


Velocity Line Plots for Pipe With Whole Weld -- Cont'd

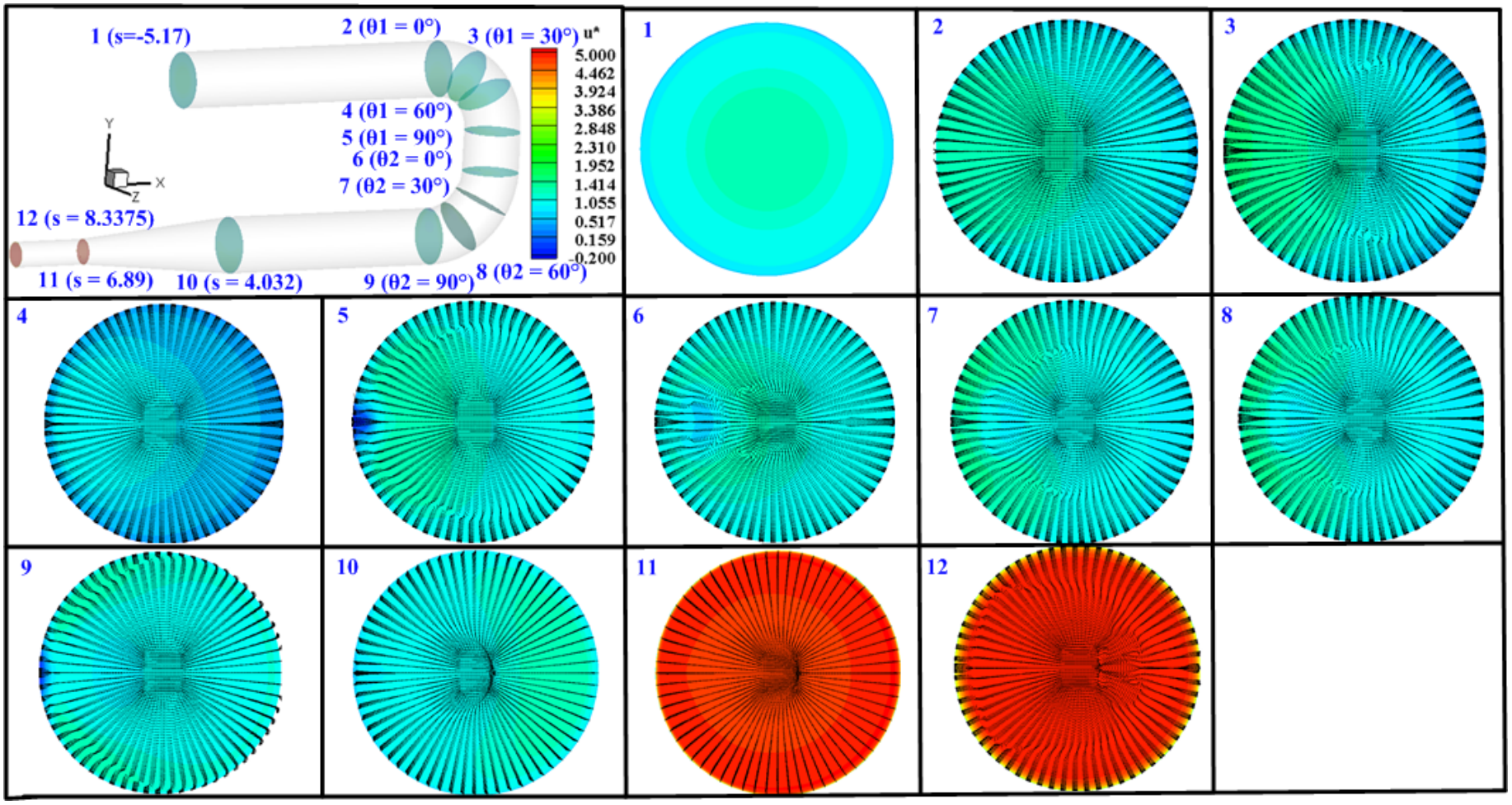




Details of the negative velocity at $\phi_1=90^o$

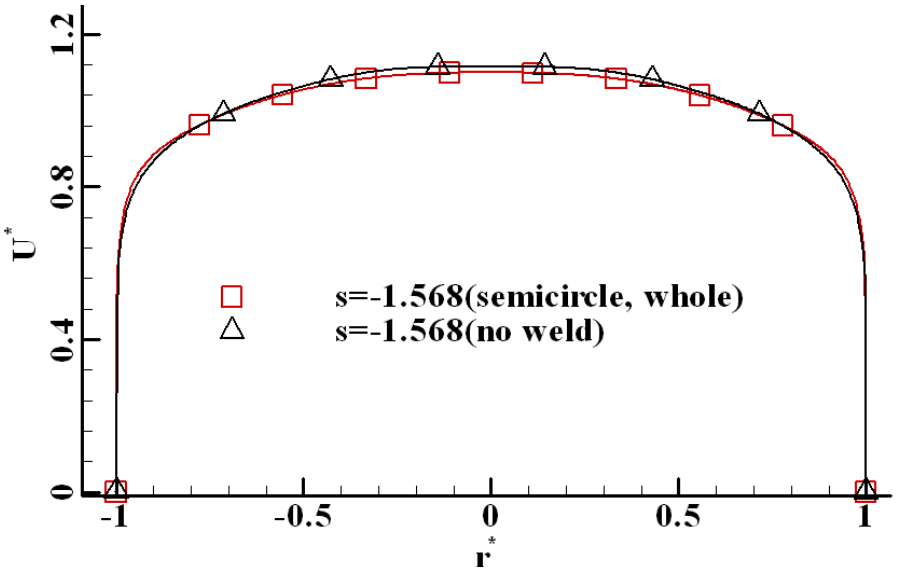


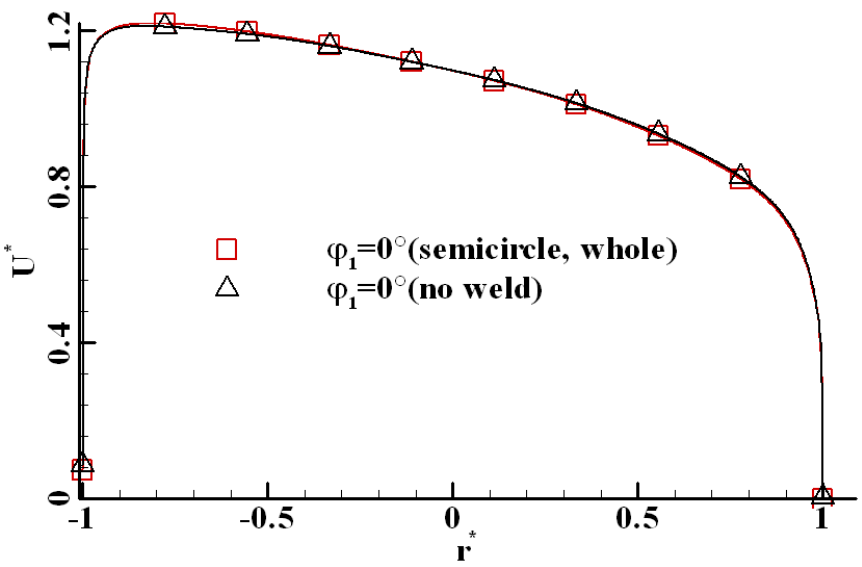
Velocity Contours for Pipe Without A Weld

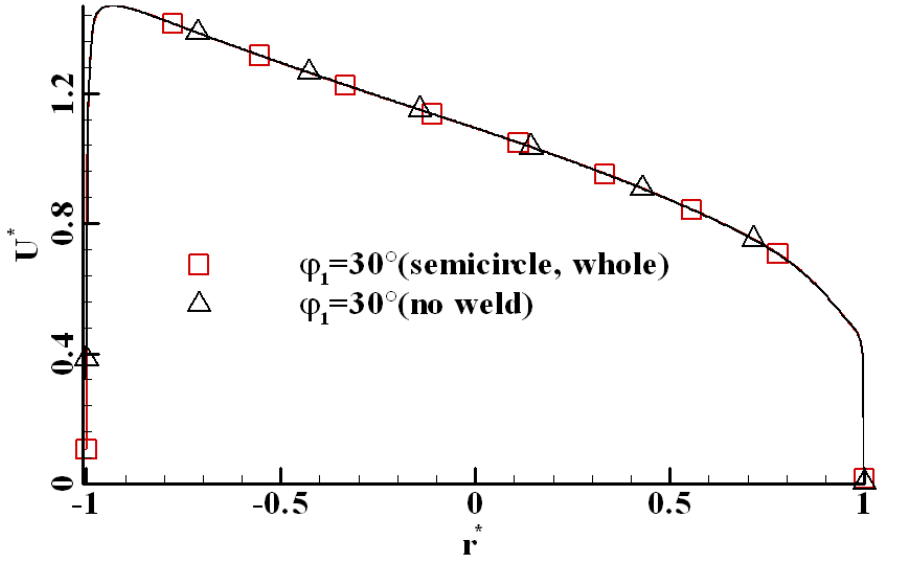


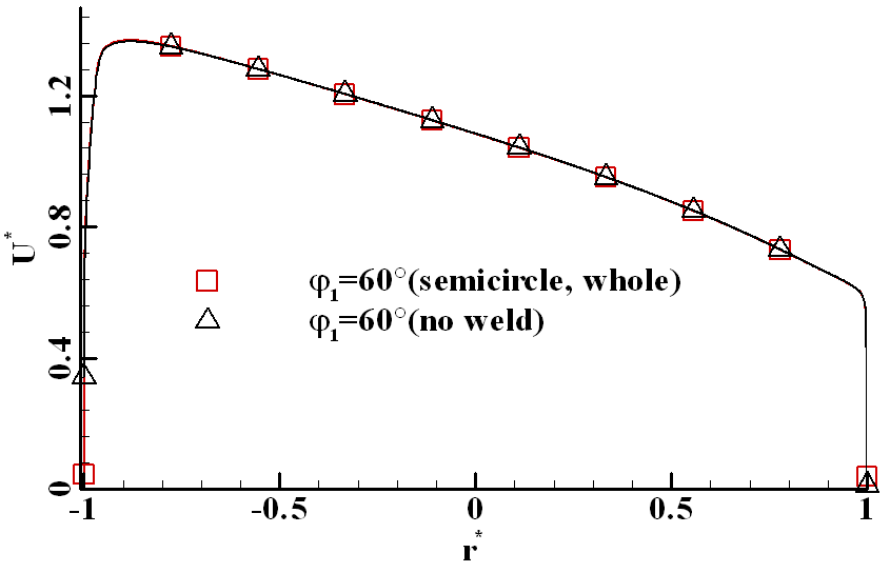
Mercury Flow (Mesh: n_θ=34, n_r=68, n_z=330, n_{tot}=7.5174e5)

Comparisons Between Pipes W/O Weld

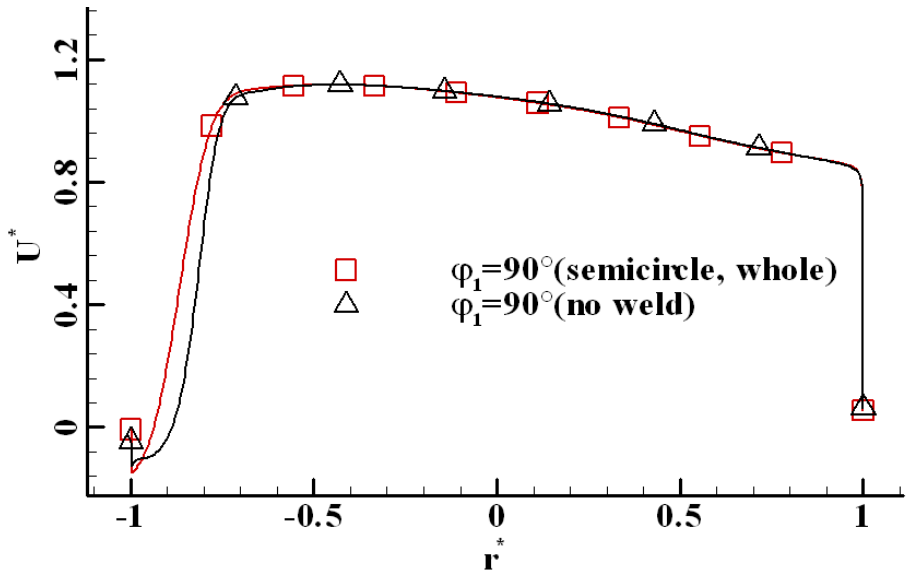


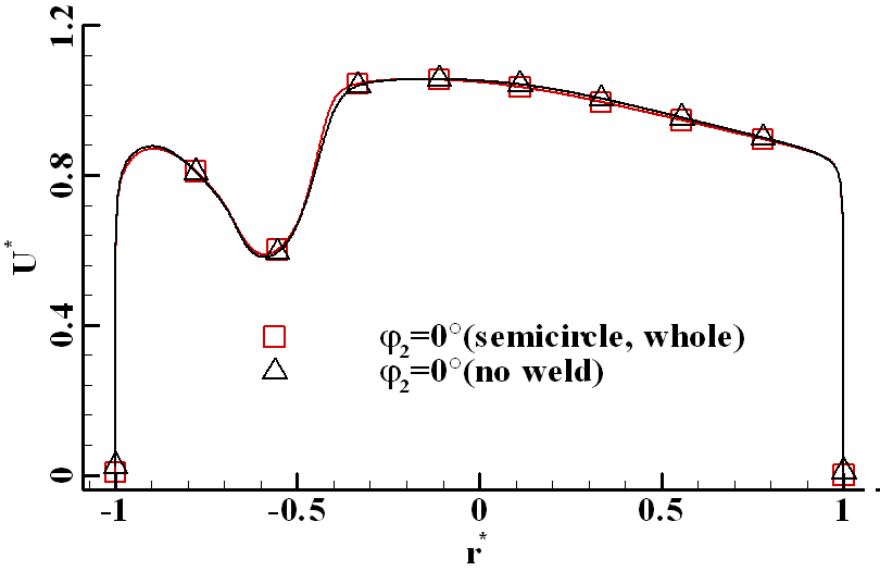


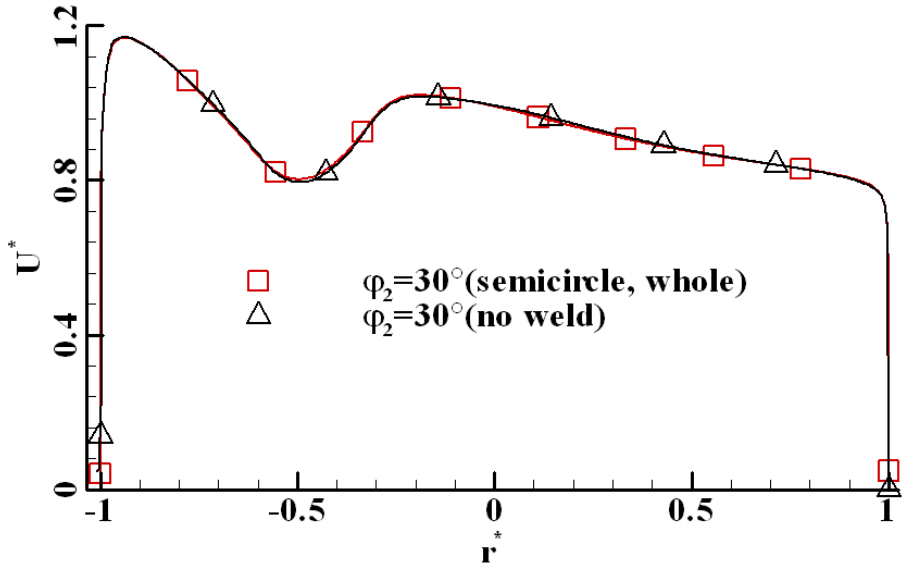


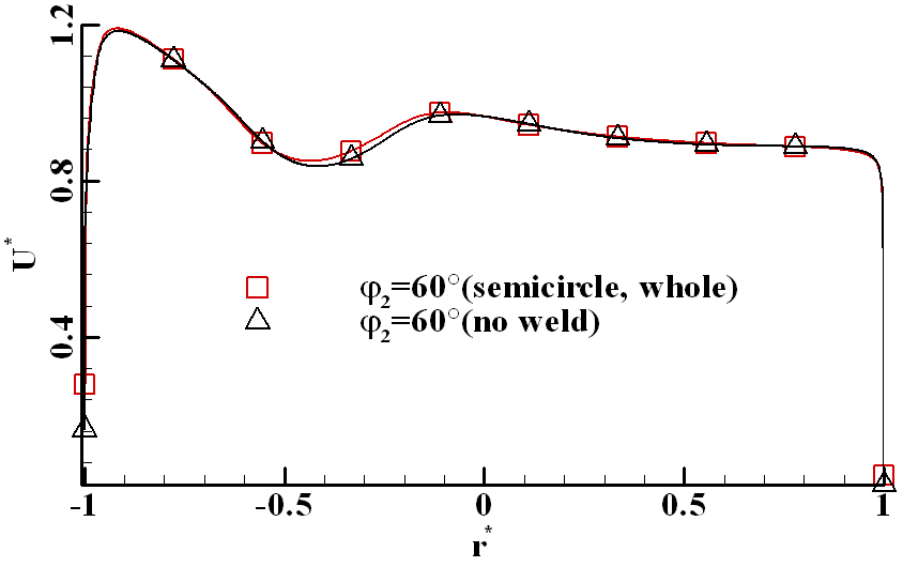


Comparisons Between Pipes W/O Weld -- Cont'd









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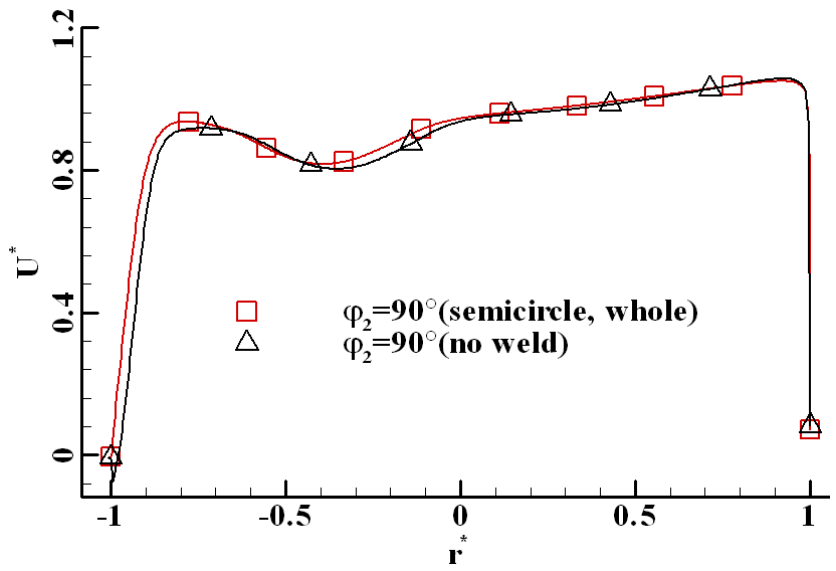

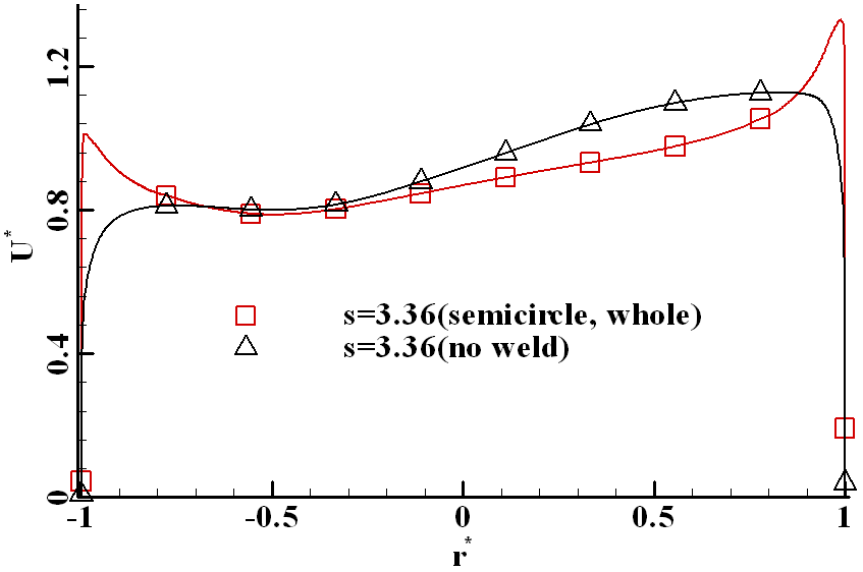

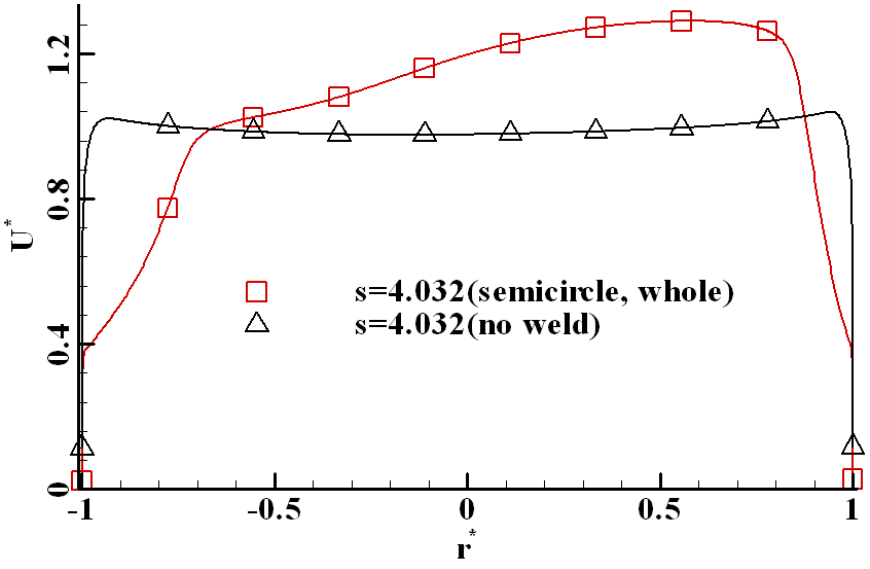

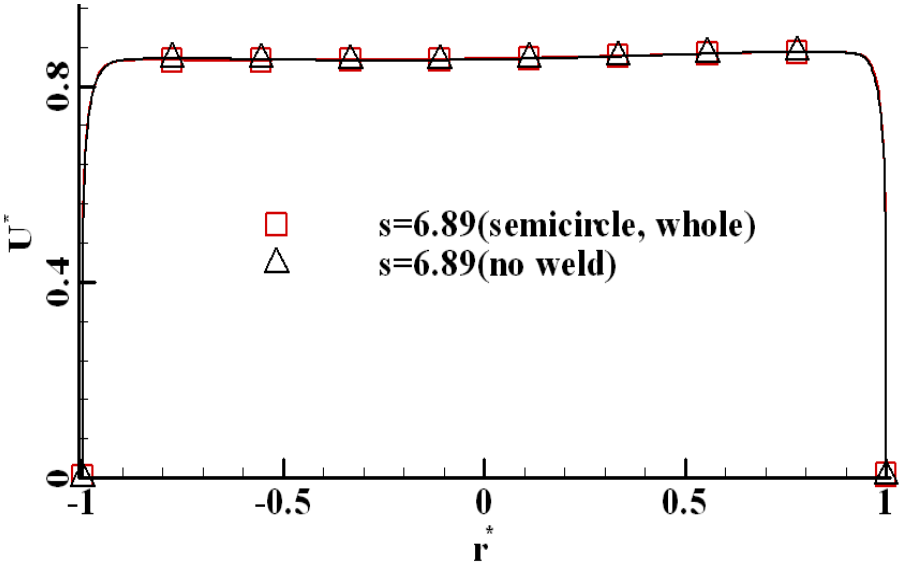

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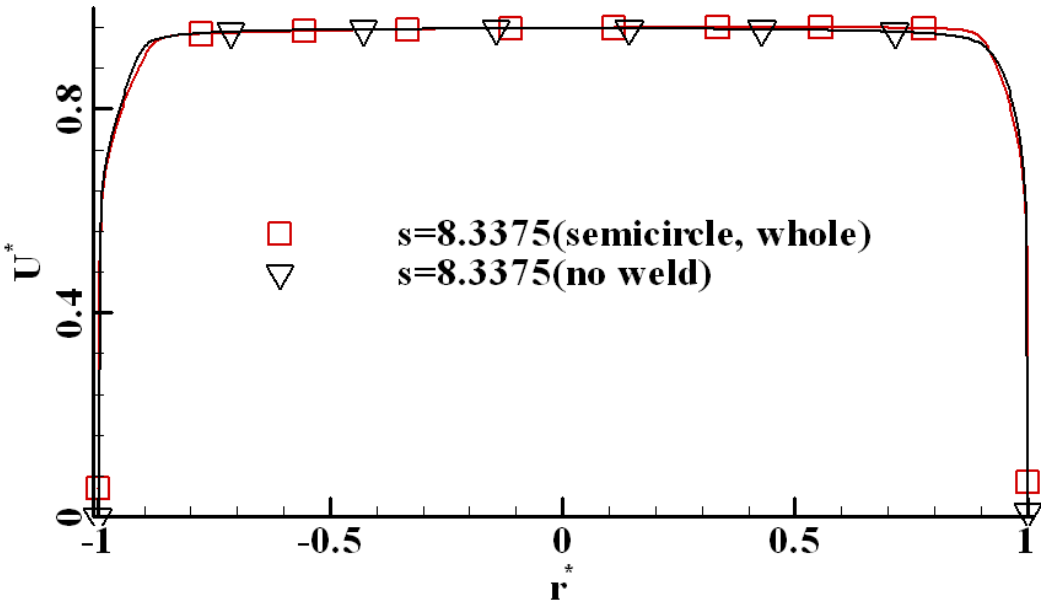

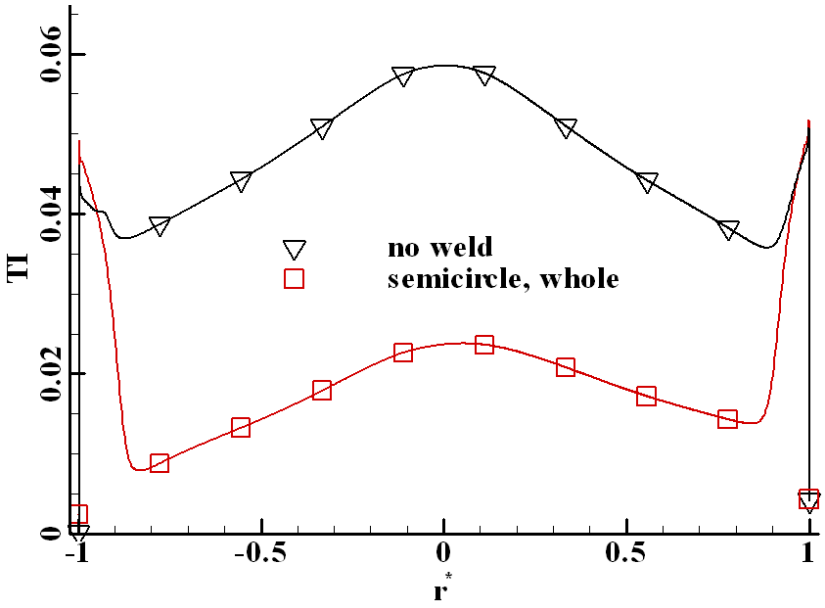

Summery

Mesh improvements:

(1)Denser mesh for the 1st half-bend;

(2) The mesh1 is good at the 2nd half-bend as well the weld;

(3) Denser mesh need near the wall region of the taper and the central region is according to the mesh1.

Future plans:

(1) Collect the size information on the partial azimuthal weld;

(2) Do the mesh and simulation for partial weld case based on the experience of whole weld case;