

Sample Description

The samples were water jet cut from a 3/4" plate of 625 Inconel. Figure 1 shows the dimensioned sketch of the joint pieces. The samples were cut in an arc of 34.5" radius approximately 11" in length (Fig 2&3).

After machining the parts were run to 990 C for 20 minutes in vacuum atmosphere and allowed to cool with no quench. A sheetmetal dam (304ss) was tacked to the backside of the joint to create a cavity for Argon gas purge during the weld (figure 6). The parts were placed on a cradle made from 304SS to aid in alignment and were tacked there for support (figure 5). The microtherm insulation was placed beneath the joint to observe the effects of the welding heat (figure 7).

Sample Prep

Weld Procedure

The weld was performed in the horizontal position on a bench. The root pass was performed without wire added to the joint. The sample was welded from Right to Left, 160-180 amps, using a 3/32" tungsten electrode.

The joint gap was measured initially and then after each pass to quantify the distortion. Half way through the weld the measurements had to be taken from the outside since the gap was no longer even due to the filling of the joint with weld metal. Subsequent tests will be taken using center punch marks to avoid this problem in the future.

Observations

Weld quality

The welder was unable to get the land at the root of the weld joint to completely fuse as shown in figure 8. It was felt that a reduction of the land from 0.06" to 0.04" may improve the fusion in this area. After the initial pass the backside of the weld looked acceptable except for about 3/4" near the beginning of the pass, however inspection after the completion of the weld revealed that the joint opened up as the weld metal was added.

Distortion Measurements

As was expected the distortion per pass decreased as the joint was filled. Table 1 shows the data taken during the weld. The total distortion for the joint after 8 passes was approximately 1/8".

Magnetic permeability

The magnetic permeability of the parent material was <1.02
The magnetic permeability of the weld fillet was <1.02

Insulation

The microtherm insulation discolored in the area of the weld but did not show any other signs of distress. The stain was “coffee” colored and appeared as if something on the fibers had changed color. Microtherm Inc. has seen the photos and recognizes it as “carmelizing” of the sizing used on the fiberglass. The sizing turns brown 400-500C range and then disappears completely at slightly higher temperatures. Judging by the appearance of the Microtherm they feel it reached about 430C. This in no way harms the insulation.

Summary

This initial test is promising the distortion is about what would be expected for a test of this type. Total weld distortion was approximately 1/8-5/32”. The full spoolpiece weld should distort even less. The welder and weld engineer feel that with a smaller land the fusion during the root pass will improve.

Next Step

Sample #1 will be dissected into several pieces and inspected to verify a lack of voids and good fusion throughout the weld.

I would propose changing the weld cross section as shown in Figure 11. The changes are to reduce the land by 0.020” and to center the weld groove over the joint.

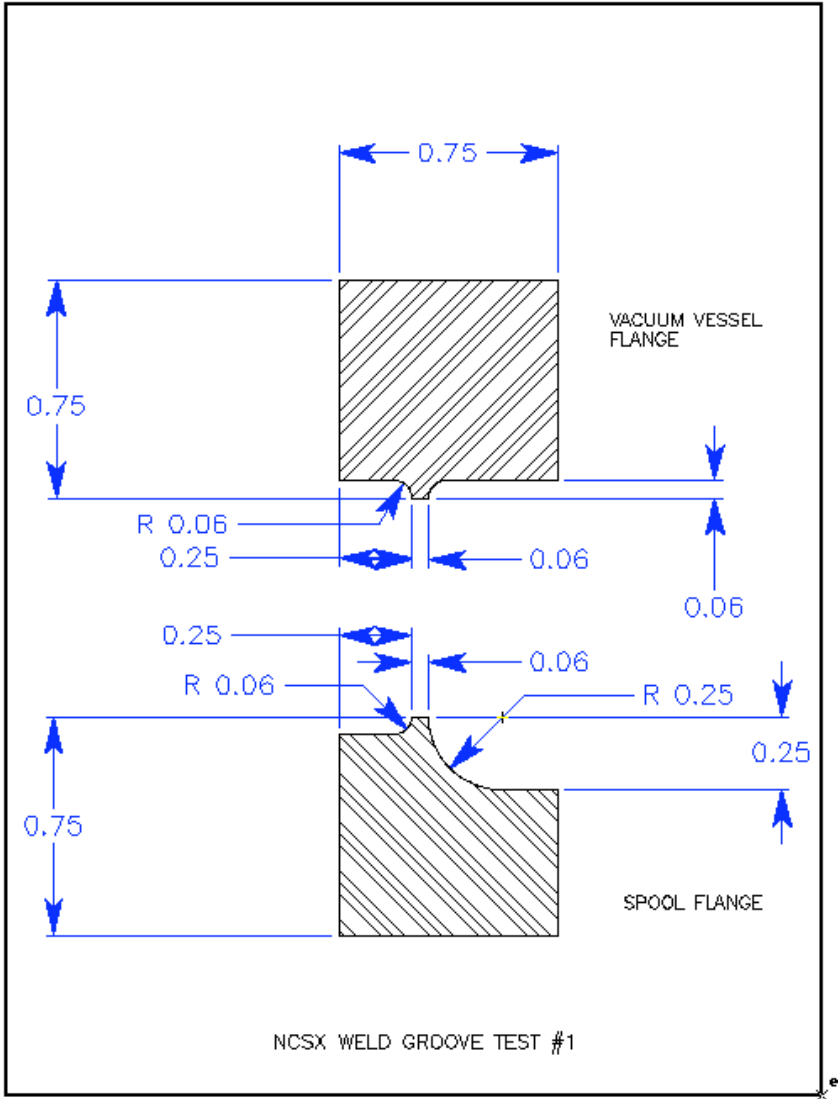


Figure 1: Sample Details

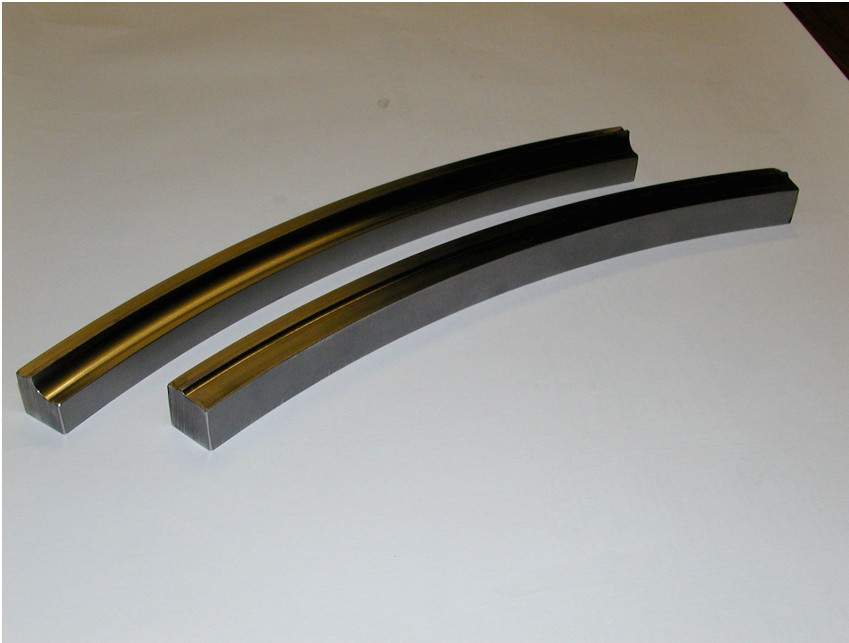


Figure 2: Weld Sample 1

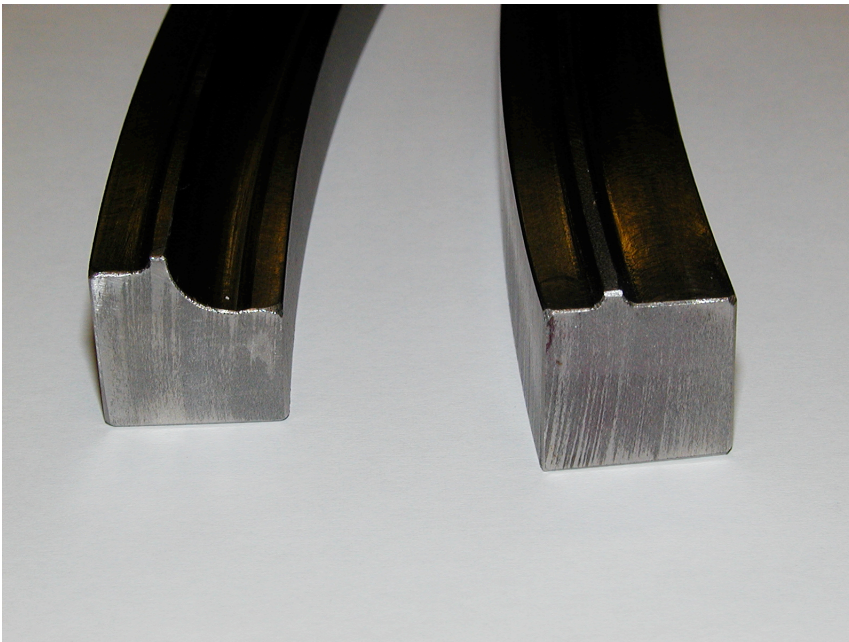


Figure 3: Samples after machining

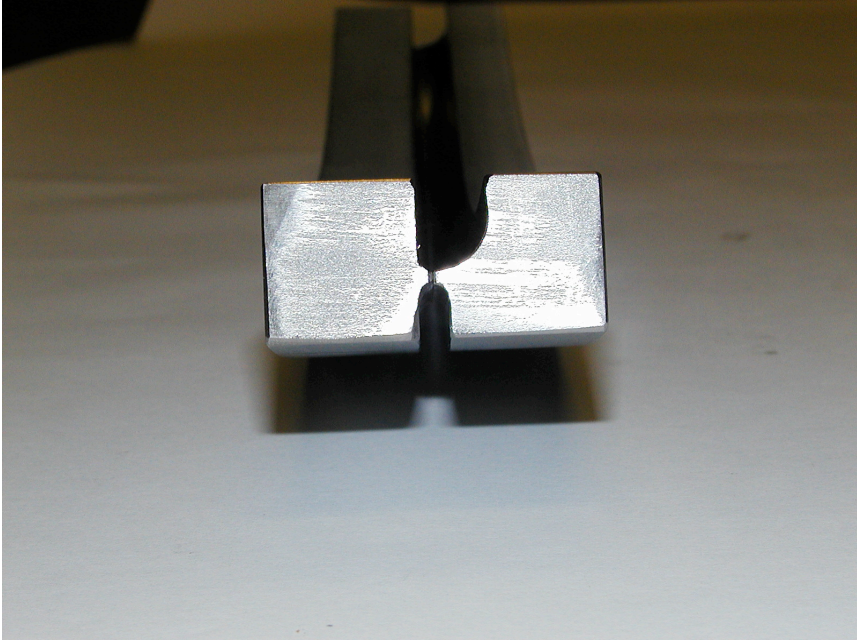


Figure 4: Samples as assembled

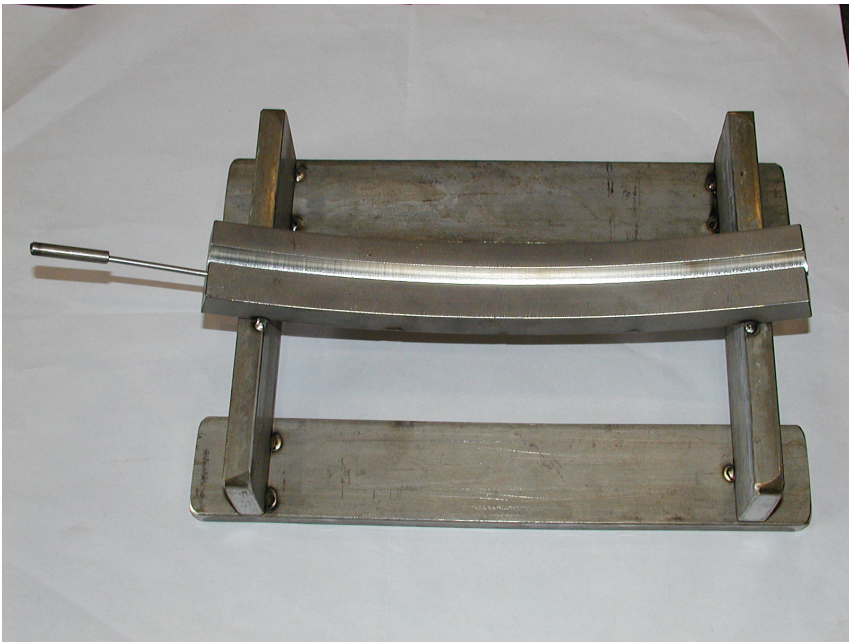


Figure 5: Sample in cradle with gas purge (on left)

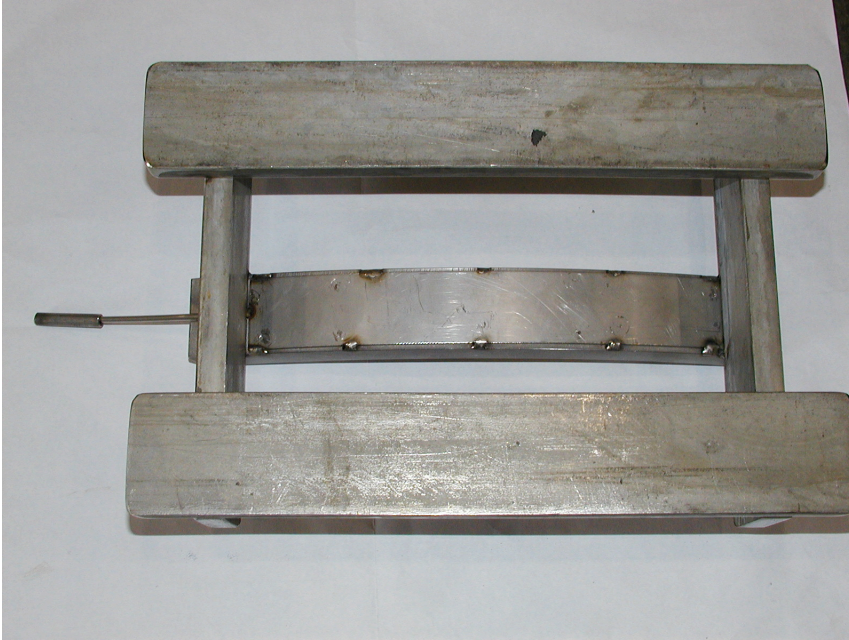


Figure 6: Backside of joint showing the sheetmetal gas purge dam

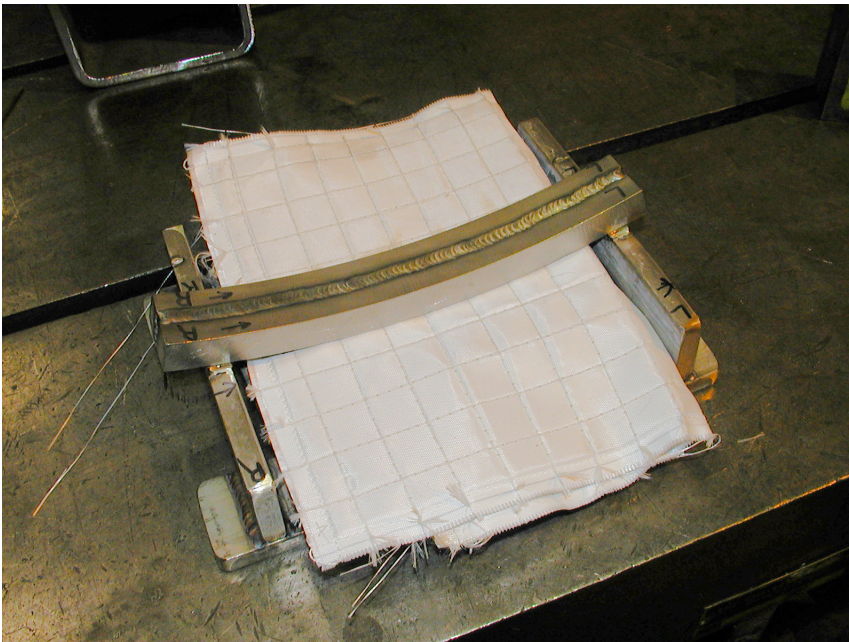


Figure 7: Sample after weld with Microtherm in position



Figure 8: Backside of the joint after welding

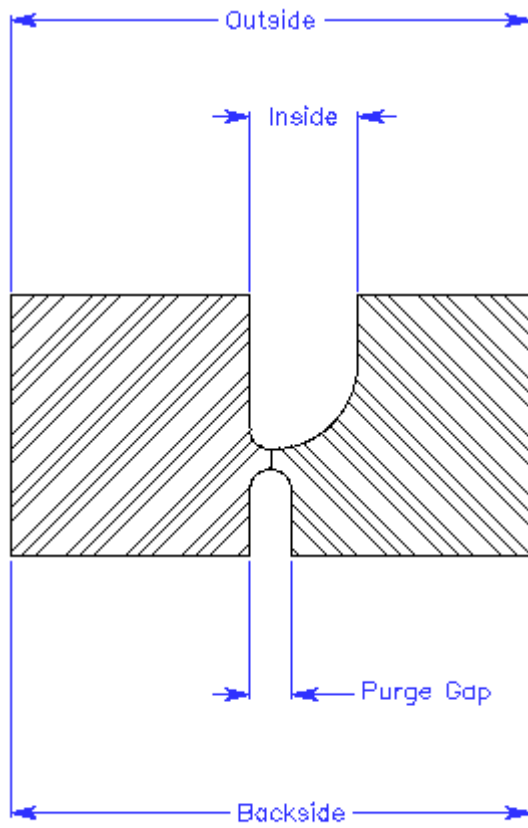


Figure 9: Location of measurements taken

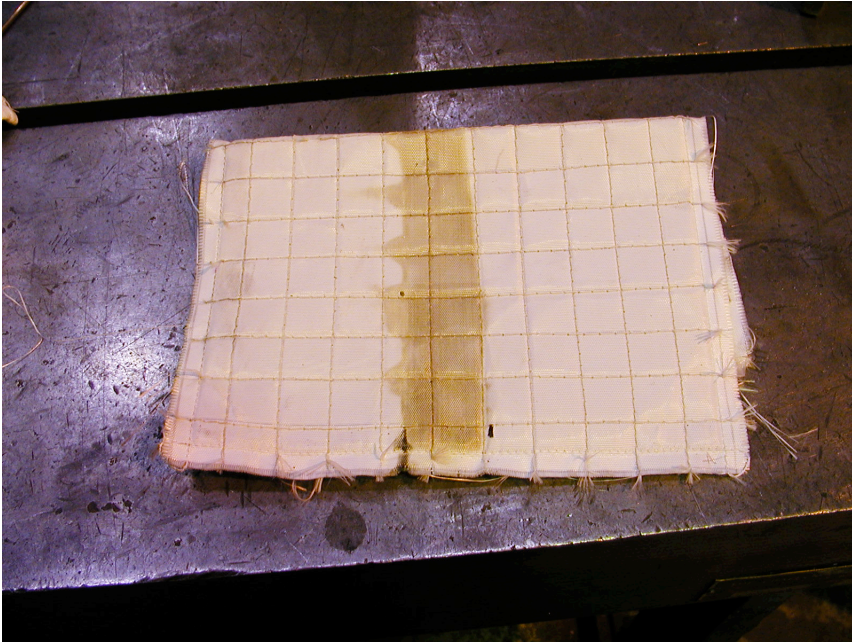


Figure 10: Microtherm insulation discoloration from weld heat

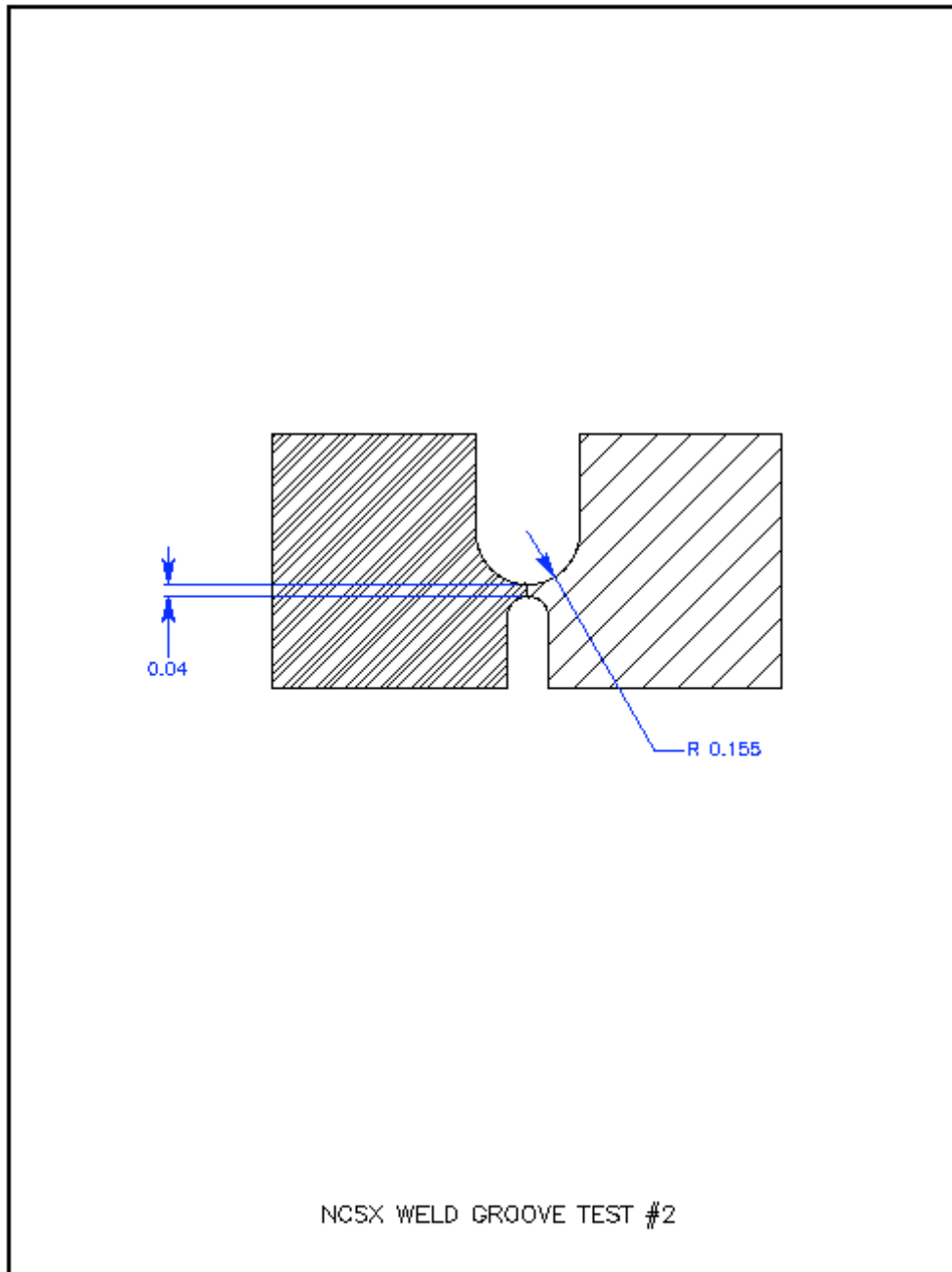


Figure 11: Proposed Sample #2 Cross Section