ACTIVE FLUXES have been developed to improve the depth and consistency of weld penetration in austenitic stainless steels. However, it has been observed that the effectiveness of these fluxes is dependent on the arc length used. In this experiment the effect of arc length on weld penetration of orbital welds in 304 stainless steel when active flux is used was investigated. Results indicated that for all arc lengths, use of the flux increased weld penetration. Results also indicate that the effectiveness of the flux increased as arc length increased.

PROCEDURE
1. Six welds were made in a 1.25 inch diameter, 0.125 inch wall thickness 304 stainless steel tubing. All welds were made using the orbital tube welding (OTW) process.
2. Three welds were made using a commercially available active flux (EWI SS-7) and three welds were made using no flux.
3. All welds were made using identical welding parameters except that arc length was varied. Welds were made with and without flux using a 0.025 inch, 0.050 inch and 0.075 inch arc lengths.
4. All welds were then metallographically inspected at a location 180 degrees from the weld start location. The weld penetration was measured for each weld.

RESULTS
Photographs of the weld beads and measured penetration are shown in Figures 4, 5 and 6. As expected use of the flux increased weld penetration at all arc lengths. The percentage increase in weld penetration was greater with longer arc lengths. The measured weld penetrations are shown in Table 1.

<table>
<thead>
<tr>
<th>Arc Length (Inch)</th>
<th>Weld Penetration (Inch)</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>0.063</td>
<td>100</td>
</tr>
<tr>
<td>0.050</td>
<td>0.095</td>
<td>65</td>
</tr>
<tr>
<td>0.075</td>
<td>0.046</td>
<td>83</td>
</tr>
</tbody>
</table>

The weld on the right was made using flux and exhibited .82 inch of weld penetration. At .075 inch arc length the flux increased weld penetration 77%.

The increase in weld penetration was not as high as reported by previous investigators. This may have been due to a base metal chemistry rich in sulfur and/or high concentrations of oxygen in the shielding gas. Both of these conditions would increase weld penetration even when flux is not used thus reducing any increase in penetration caused by the flux.

5. Since relatively small changes in arc length can result in changes in effectiveness of the flux, arc length must be held constant during welding. This is best accomplished using a mechanized torch travel.

NOTES:
1. Thanks to The Edison Welding Institute (EWI) in Columbus Ohio for providing the active flux (EWI DeepTIG SS-7) and technical information for this project.
2. Note: EWI DeepTIG SS-7 is a patented and trademarked commercial product supplied by EWI.