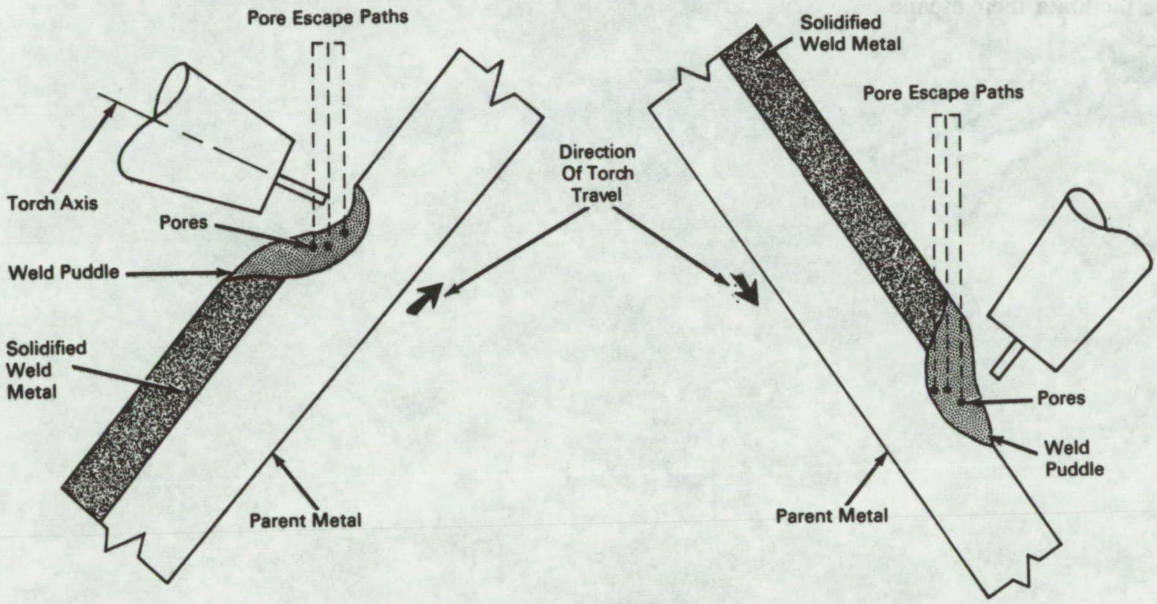
NASA TECH BRIEF

Effect of Welding Position on Porosity Formation in Aluminum Alloy Welds



A program has been initiated to investigate the effects of varied welding positions on such weld qualities as deposit soundness and uniformity, bead geometry, chemical composition, and mechanical properties. Automatic MIG welds have been prepared in positions ranging from flat (0 degrees) to 35 degrees both upslope and downslope, using standing welding procedures as weld speed in inches per minute, weld current and voltage, torch lead angle, and shielding gas delivery rates.

Progressive changes in bead geometry occur as the weld plane angle is varied from 35° upslope to 35° downslope. Generally, upslope welds are characterized by a narrow weld deposit with a high crown, while downslope welds are wide and flat. The fused cross section area is found to be greater and to contain somewhat greater amounts of copper (from welding 2014-T6 aluminum alloy) in downslope welding, indicating that more of the parent plate is melted when welding in this plane. Nondestructive inspection indicates that fewer surface and internal defects are produced by welding upslope as opposed to downslope. Upslope welds made at 25° and 35° angles are completely free of defects. As the weld plane angle is reduced through the flat position to a 35° downslope angle, both surface and internal porosity become

(continued overleaf)

progressively more severe. The porosity content observed in all downslope welds are such that these will not meet acceptance specifications.

As shown in the figure, the gravitational effect on the weld puddle varies greatly with welding position. Porosity, forming in the weld puddle, rises vertically toward the surface where it is liberated in the form of gas. In the case of upslope welds, the escape path is quite short and essentially all porosity is liberated before the puddle solidifies. Downslope welds, however, present a much longer escape path and the weld puddle has a tendency to solidify before the gas bubbles can rise to the surface and they are entrapped in the weld deposit as porosity.

Notes:

1. This method does not eliminate or minimize the formation of gas bubbles in the weld puddle but does facilitate their escape.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10177

Patent status:

No patent action is contemplated by NASA.

Source: Robert S. Wroth and John Haryung
of Douglas Aircraft Company
under contract to
Marshall Space Flight Center

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