NASA TECH BRIEF

Effects of High Frequency Current in Welding Aluminum Alloy 6061

Cracking has been found to occur frequently in the heat-affected zone of aluminum alloy 6061 weldments during TIG (tungsten inert gas) ac welding. The cracks appeared to be intergranular separations, normal to overheated aluminum alloy. An ensuing investigation showed the cracks to be superficial surface defects, located only on the torch side of the weld in areas of grain boundary melting and seldom more than 0.015 inch deep. The cracking continued to occur even when the best known TIG welding procedures were employed and strict control was maintained.

Continuous observation during welding revealed that the cracks developed when improperly adjusted, or erratic, superimposed high frequency current was agitating the semimolten metal in the areas of grain boundary. Lack of, or depletion of, boundary constituents combined with rapid freezing and normal shrinkage stresses (hot shortness) resulted in boundary voids or cracks.

A series of original tests was performed, which involved the heating of test plates to temperatures normal to the heat-affected zone and applying only high frequency current. The high frequency arc was varied by controlling arc length, electrode diameter, and the welding power supply for phase shift and intensity. Each plate was examined for surface defects immediately after testing and after 30 days.

An increase in the magnitude of any variable resulted in an increase in arc length or plate temperature and caused the most noticeable effect. After natural aging, severe crack propagation was found in areas exhibiting moderate boundary melting or a dendritic freezing pattern. The results were considered conclusive in demonstrating that uncontrolled high frequency current alone was extremely deleterious to the finished weld.

Samples sectioned from actual parts containing the defects were subjected to static tension, fatigue, and salt spray corrosion tests. In all samples, the defects, if not removed in accordance with recommended procedures, had deleterious effects.

Note:

Inquiries concerning the test procedures and results may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
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Patent status:

No patent action is contemplated by NASA.

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