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NASA TECH BRIEF

Tests Show That Aluminum Welds Are Improved by Bead Removal

In welding 1/4- to 1/2-inch thick 2219-T87 aluminum alloy plate, top and bottom weld beads are necessary in order to assure full penetration of the metal. It was found, however, that the beads caused increased stresses at the toes of the welds.

To eliminate these stresses, tests were run to determine whether the removal of the top and/or bottom weld beads would have any effect on the mechanical properties of the welded plate. The beads were removed by mechanical milling followed by light belt sanding. The test results were as follows:

1. Removal of either top or bottom bead increased the ultimate strength (34,000 psi) by 5%.
2. Removal of both beads increased the ultimate strength by 10%.
3. Ductility (7% in 1 inch) increased by 14% when the top bead was removed; by 29% when the bottom bead was removed.
4. Ductility was increased by 50% when both beads were removed.
5. Yield strength followed a reverse trend by becoming approximately 3% lower when the top bead was removed, 8% lower when the bottom bead was removed, and 11% lower with both beads removed.

Burst tests of as-welded 14-inch diameter 1/4-inch tanks resulted in an average burst pressure of 1445 psi. Pressure increased by 8% with the bottom bead removed, 33% with both beads removed, and 56% with only the top bead removed. The biaxial type loading occurring during burst testing produces maximum tension stresses at the upper specimen surface. This accentuated the notch condition at the toe of the top weld bead, as indicated by the great magnitude of improvement when it was removed. The consistency of the test data was considerably improved by weld bead removal.

Fatigue properties were greatly improved by removing both weld beads. Samples with weld beads failed in an average of 545 cycles at a 36,000 psi stress level, while samples with both beads removed did not fail in 2,000 cycles at the same stress level.

These tests with 2218-T87 aluminum alloy plate indicate improvements in strength, ductility, fatigue properties, and burst pressure result when one or both of the weld beads are removed. However, the increased advantages must be balanced by the slight drop in yield strength.

Note:

Inquiries concerning this innovation may be directed to:

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Patent status:

No patent action is contemplated by NASA.

Source: D. W. Hood
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