NASA TECH BRIEF

Welded Repairs of Punctured Thin-Walled Aluminum Pressure Vessels

A tentative, experimental method has been developed for repairing punctures in thin-walled pressure vessels constructed of 2219-T87 aluminum alloy. The repaired vessels withstood test pressures in excess of vessel ultimate design values for 2-, 4-, and 6- inch holes in 0.202-inch-thick aluminum alloy parent material. The method consists of plugging the hole with an interference-fit disc and subsequent welding of the unit. Details of the experimental procedure followed are summarized below.

The disc was cleaned with MEK (methyl ethyl ketone) solvent and buffed with a clean, stainless steel brush.

An aluminum strip (0.25-inch thick) was bonded to the top side of the disc. These strips were used later to handle the cleaned, chilled disc while positioning it in the specimen hole.

The areas, within 3 feet of the hole, on the outside, and as far as could be reached on the inside, were cleaned with MEK. The area adjacent to the hole edge was then buffed with a stainless steel wire brush. During this operation, the oversized disc was being chilled with dry ice to reduce its diameter enough to allow its entry into the specimen hole. The chilled disc was then positioned within the specimen hole, taking care to handle it only by the bonded aluminum strip, and allowed to warm for approximately 5 minutes, thus swelling and wedging itself within the specimen hole. The disc was then tack-welded in place, using light tacks at several points. The aluminum strip bond was then broken and the strip removed. Excess bond material was removed from the disc and the weld tacks buffed with a stainless steel brush. A dc weld pass was then made, in two 180° arcs, each starting from the lowest point. After the weld cooled, it was buffed with a stainless steel wire brush. A second dc weld pass was then completed, again in two 180° upward arcs. This completed normal welding operations and left a weld bead protrusion, on the inside and outside, of approximately 0.05 inch above the specimen (skin) surface. The outside weld bead was then shaved, using a cutter designed for this purpose, to within 0.01 inch of the skin surface. The completed weld was then inspected by both X-ray and dye penetrant techniques. Repairs of cracks, porosity, etc., were made, when necessary, by grinding out the defective area and re-welding with ac. Repairs were shaved and inspected. This step was repeated until an acceptable hole repair was accomplished.

The 2-inch-diameter repair proved to be the most difficult. After initial welding, 5 repairs had to be performed in order to achieve an acceptable weld. Limited access, through the hole, to the underside of the specimen hindered proper underside cleaning operations. Each repair, of the initial weld, tended to enlarge the underside weld bead. This oversize bead was subsequently shaved, by access through an emergency drain fitting, to limit "hard spot" effects. The 4-inch-diameter hole repair was successful, on initial welding, and required no additional repairs. After initial welding on the 6-inch-diameter hole, 3 additional repairs had to be performed to achieve an acceptable weld.

Notes:

1. This repair method might also be feasible on punctures of thin-walled pressure vessels constructed of materials other than 2219-T87 aluminum alloy.
2. Documentation is available from:
   Clearinghouse for Federal Scientific
   and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10051

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

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