NASA TECH BRIEF

Marshall Space Flight Center

Welding High-Strength Aluminum Alloys

A handbook has been published which integrates the results of 19 research programs, sponsored by the Marshall Space Flight Center, involving the welding of high-strength aluminum alloys, especially the 2014 and 2219 types. The book introduces the metallurgy and properties of aluminum alloys by discussing commercial alloys and heat treatments. Several current welding processes are reviewed such as gas tungsten-arc welding and gas metal-arc welding. In this context, filler metals and optimum welding conditions are covered also.

The discussion then centers on the welding fabrication of aluminum structures. In this area, the characteristics of aluminum alloys used as structural materials are shown. Welding fabrication methods and welding problems encountered in the fabrication of aluminum structures for Saturn V are discussed, to illustrate some practical points encountered in actual applications.

This is followed by a study of weld defects and their role on the service performance of welded structures. The discussion includes stress concentrations caused by the defects and the role of defects on ductile, brittle, and fatigue fractures.

The subject of weld porosity, including its sources and control is covered. Surface and gas contaminants are reviewed along with the methods of their elimination. Weld thermal effects are discussed, with an emphasis on the time-temperature effect, welding with high-density power sources, and time-temperature control by cryogenic cooling.

This is followed by a study of residual stresses and distortion. The topics covered include: (a) thermal stresses produced during welding, (b) weld distortion, (c) the reduction of this distortion by controlling the thermal pattern, and (d) the development of nondestructive tests for determining residual stresses.

Manufacturing-process system control is covered next. This discussion is centered around the transferability of welding parameters, the development of welding-process control systems, and the computer simulation of welding processes to predict thermal effects.

Finally, a chapter is included which presents a summary of the entire material, with some practical recommendations for weld inspection and repair, and a listing of important future work.

Notes:

1. This handbook may be of interest to students of metallurgy and to engineers and scientists in related fields.
2. Inquiries concerning this handbook should be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B73-10481

Source: P. G. Parks, R. V. Hoppes,
and E. A. Hasemeyer
Marshall Space Flight Center
and K. Masubuchi of
Massachusetts Institute of Technology
under contract to
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