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NASA TECH BRIEF

Heat Treatment Study of Aluminum Casting Alloy M45

A study was made to determine the heat treatment cycle of aluminum casting alloy M45 which will increase the strength levels of the alloy while maintaining optimum stress corrosion resistance. Aluminum casting alloy M45 is a high purity material that was developed primarily as a structural casting with high tensile, yield, and impact strengths at cryogenic temperatures. The material is a sand casting alloy, but possibly can be cast by other techniques. The alloy has a castability comparable to the commercial 195 alloy with good machinability characteristics. Presently the alloy is being used for flight and ground support equipment of intricate design and for castings which have large differences in section thickness.

As a result of the study, the following conclusions were reached:

(1) Aluminum casting alloy M45 can be solution heat-treated with satisfactory results using a wide range of temperatures and time exposures, 970°–1000°F (521°–538°C) and 16–48 hours, respectively, followed by quenching in cold water. However, material solution heat-treated at 990°F±10° (532°C±6°) for 24 hours and quenched in cold water yields the most uniform grain size as well as optimum response to subsequent artificial aging. Additional studies are being made to delineate the effects of the high solution heat treatment temperature on the various phases present in the matrix of the cast alloy.

(2) The alloy will not overage at 325°F (163°C) for periods up to 72 hours. This phenomenon clearly explains the stress corrosion problems associated with the early castings of the alloy which were aged at 325°F (163°C) for 16 hours. Apparently, the alloy must be overaged slightly to obtain acceptable stress corrosion characteristics. Material was obtained in a slightly overaged condition by aging cycles of (1) 350°F (177°C) for 48 and 72 hours, (2) 375°F (190°C) for 12, 16, or 18 hours, and (3) 400°F (204°C) for 6, 8, or 12 hours. Presently, production castings are being aged at 375°F (190°C) for 26 hours. The evidence in this investigation indicates that the present production castings are being overaged too severely to take full advantage of the strength of the alloy and still maintain acceptable stress corrosion characteristics.

Notes:

1. The original development of aluminum casting alloy M45 is described in Tech Brief 65-10092.
2. Additional details of the heat treatment study are contained in: "Heat Treatment Study of Aluminum Casting Alloy M45," by C. V. Lovoy, Internal Note P & VE-M-67-1, January 11, 1967, Marshall Space Flight Center. Copies are available from:

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Patent status:

No patent action is contemplated by NASA.

Source: C. V. Lovoy
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Category 03