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Beryllium Fastener Technology

A program was conducted to investigate the use of beryllium mechanical fasteners. Beryllium has the advantages of high strength-to-weight ratio, a high Young's modulus, and long fatigue life. The disadvantages of the material are its low ductility and attendant notch sensitivity, poor crack propagation characteristics, and high initial cost. In certain structures (e.g., space vehicles) where total weight must be kept to a minimum, the use of beryllium fasteners would effect an appreciable saving in weight and off-set initial costs.

Objectives of the program were to develop, produce, and test optimum-configuration, beryllium prestressed (point-drive bolt and twist-off nut) and blind fasteners having the following minimal mechanical properties: ultimate tensile strength, 75,000 psi; ultimate shear strength, 65,000 psi; endurance limit at 10^6 cycles, 45,000 psi. The program was carried out in four phases: phase 1, feasibility study; phase 2, development; phase 3, evaluation of beryllium alloys; and phase 4, fabrication and testing.

Phase 1 covered the history of beryllium fasteners and materials, the state of the art in the production of beryllium fasteners, and probable problem areas. The investigation showed that semiblind and blind fasteners of beryllium were feasible and a planned approach was established for the development of these fasteners. Phase 2 established fastener configuration,

selection and procurement of materials, determination of process controls; tooling, and a test program for phase 4. In phase 3, five grades of beryllium alloys were evaluated and the optimum alloy was selected for fastener fabrication. Phase 4 consisted of the fabrication and testing of a production-size lot of prestressed fasteners and a study of the fabrication problems and test results.

Note:

Documentation covering this investigation is available from:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

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