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NASA TECH BRIEF

Lewis Research Center

Creep-Fatigue Analysis by Strainrange Partitioning

Strainrange Partitioning is a method for predicting the life of structural materials. It is used to analyze and predict the onset of low-cycle fatigue failure of metals and alloys in structures operating in extreme high-temperature environments. Using the approach, a designer can determine, in advance of service, just how many loading applications can be imposed on a part without having it fail. A designer can assess the severity of any complex or simple service loading cycle and thereby arrive at the most efficient design for resisting cyclic failures for the particular problem at hand. Strainrange Partitioning provides a unifying framework for characterizing high-temperature, low-cycle, creep-fatigue properties of metals and alloys.

Systems such as heat engines, combustors, power generators, and heat exchangers are susceptible to failures due to the interaction of creep and fatigue at high temperatures. Current methods of avoiding or anticipating these failures are expensive, time consuming and may even be unreliable. For these reasons, designers and manufacturers are seeking methods of life prediction that are less expensive, simpler, and more accurate. Strainrange Partitioning offers these very advantages. This approach has been demonstrated to be fundamental, versatile, and reliable. Yet the approach is simple in concept and is easy to apply. To date, this method has been applied to laboratory specimen test results on approximately 15 different alloys with a high degree of success. Strainrange Partitioning has been able to encompass the numerous anomolies in creep-fatigue behavior that have been reported in the literature. The method also offers the distinct advantage to designers of immediately providing reliable upper and lower bounds on cyclic life for any type of inelastic strain cycle that may be encountered in service. Consequently, the Strainrange Partitioning approach will be used in the design of high temperature, high performance systems, and will be incorporated into design handbooks and codes.

Notes:

1. Further information is available in the following reports:

   NASA TM-X-67838 (N71-27945), Creep-Fatigue Analysis by Strain-Range Partitioning

   NASA TM-X-68023 (N72-18916), Temperature Effects on the Strainrange Partitioning Approach for Creep-Fatigue Analysis

   NASA TM-X-68171 (N73-15923), The Challenge to Unify Treatment of High-Temperature Fatigue -- A Partisan Proposal Based on Strainrange Partitioning

   Copies may be obtained at cost from:

   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B73-10314

2. Specific technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B73-10314

Patent Status:

NASA has decided not to apply for a patent.

Source: S.S. Manson, G.R. Halford, and M.H. Hirschberg
Lewis Research Center
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Category 04