# NASA TECH BRIEF

## Design Reliability Goal Developed from Small Sample

**The problem:**

In space vehicle development programs as in other sophisticated and complex hardware design, where delivery deadlines must be rigidly adhered to, high reliability requirements are frequently coupled with a limited number of test articles. It is necessary to determine if a specified minimum reliability is demonstrated at some fairly high confidence level.

**The solution:**

Sampling distributions, constructed by Monte Carlo simulation are used to aid in establishing a design reliability goal, place a confidence coefficient on reliability estimates, and determine whether sample stress/strength data demonstrate a specified reliability at a specified confidence level.

**How it's done:**

In reaching reliability goals, the designer has several possible approaches: safety margin, stress/strength relationships, and others of a statistical nature. The approach used here concerns the use of stress/strength statistics in design reliability, demonstration, and confidence limits. It is primarily concerned with the solution of statistical sampling problems for which no theoretical solution is readily available, and with the application of the data provided by these solutions. Application of Monte Carlo simulation to constructing empirical sampling distribution of reliability estimates are obtained by sampling from the classical stress/strength (load and failure) distributions, that are assumed gaussian. Typical stress/strength distributions, representing specific values of reliability, are stored in a computer. From these distributions various sample sizes are taken and the resulting estimate of reliability computed. Iteration of this procedure results in the construction of empirical sampling distributions for specific levels of reliability and specific sample sizes. Emphasis is placed on very high values of reliability (0.99 to 0.99999999) and on very small sample sizes (2 to 8).

**Notes:**

1. This approach will be useful to designers who have only a small sample of tested items to determine if a specified minimum reliability is demonstrated at an acceptable confidence level.
2. Inquiries concerning this innovation may be directed to:

    Technology Utilization Officer
    Marshall Space Flight Center
    Huntsville, Alabama 35812
    Reference: B66-10405

**Patent status:**

No patent action is contemplated by NASA.

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