

ENDURANCES OF STRUCTURAL JOINTS (ALUMINIUM ALLOY MATERIAL – TENSILE LOADING)

1. NOTATION AND UNITS

N endurance

S_a alternating stress on net area N/m^2 lbf/in^2

$$1 \text{ N/m}^2 = 1.450\,38 \times 10^{-4} \text{ lbf/in}^2$$

$$1 \text{ lbf/in}^2 = 6.894\,76 \times 10^3 \text{ N/m}^2$$

Both SI and British units are shown but any coherent system of units may be used.

2. NOTES

The results of 230 tensile fatigue tests on typical aircraft structural joints in aluminium alloy have been analysed to give the curves of S_a against N shown in Figure 1 for various standards of design. Curve A is the mean of all results, and may be taken as the mean fatigue performance that is to be expected in a joint of average design standard. Curve B represents an upper limit of fatigue performance where special care has been taken in the design and manufacture, for, although a few of the results analysed fell above Curve B, they were for experimental joints in which special measures were taken to increase fatigue strength. Similarly, Curve C may be interpreted as approaching the lower limit of fatigue performance where no special attention has been paid to fatigue, for, although a few of the results fell below Curve C, they were for joints having unusual features.

The materials represented include both medium and high strength aluminium alloys, but no correlation was found in these results between endurance and type of alloy. The range of mean stress covered in the tests was from 9000 lbf/in² to 15 000 lbf/in² calculated on net area. At mean stresses below this range, better fatigue performance could be expected.

The details of the design have a predominant influence on fatigue performance, but this cannot be indicated by any broad classification. Accordingly, the curves on this Data Item can give only an indication of the possible fatigue behaviour in a particular case and the suitability of the information is thus in relation to project design and preliminary fatigue analysis. According to the standard of design adopted, the curves give the alternating stress, S_a , that can be applied for any required number of cycles; thus a joint of average design standard might be expected to withstand an alternating stress of 3000 lbf/in² for 10⁶ cycles.

3. DERIVATION

The derivation lists selected sources that have assisted in the preparation of this Item.

1. HEYWOOD, R.B. Correlated fatigue data for aircraft structural joints. ARC Current Paper 227, 1956.

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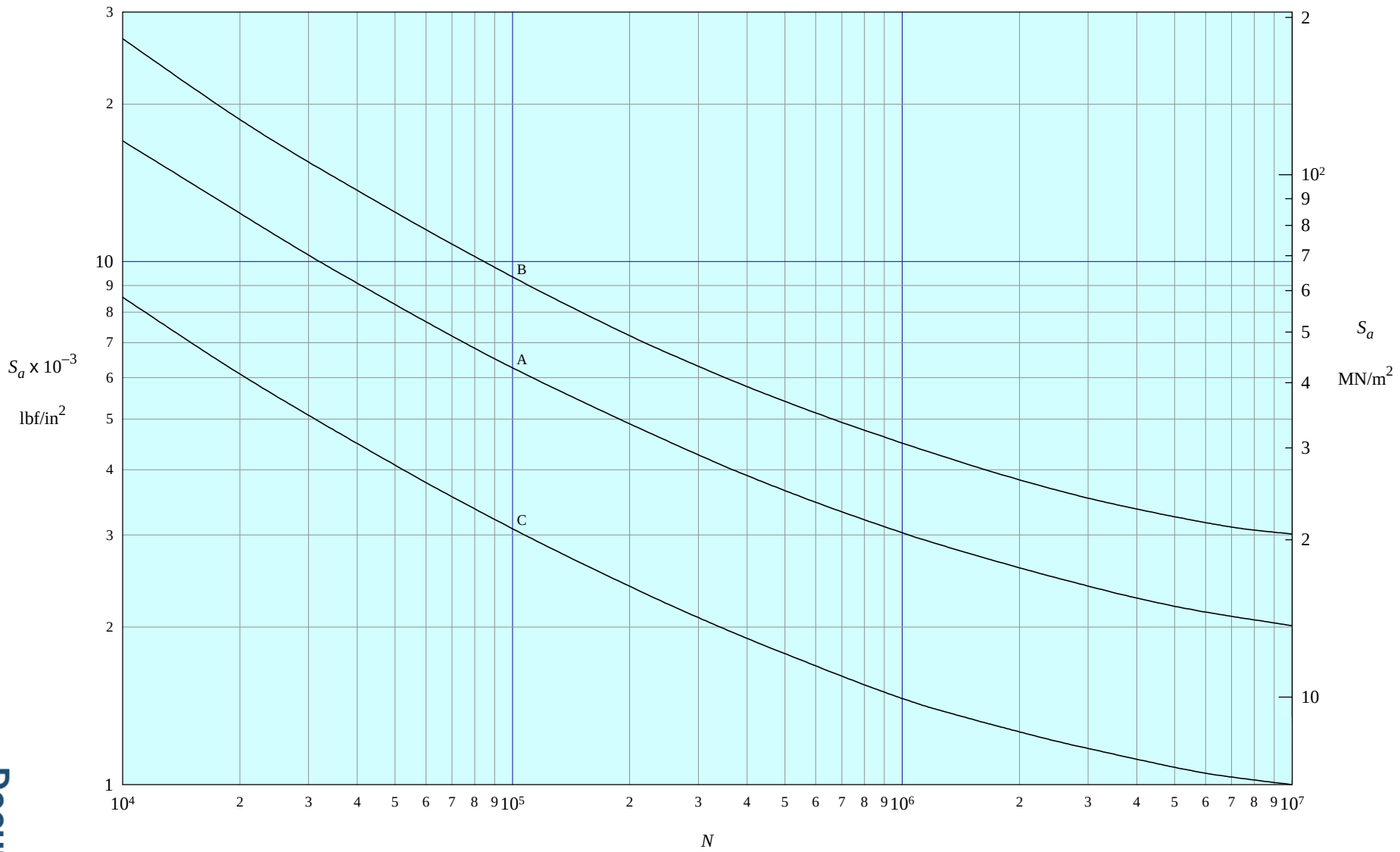


FIGURE 1