

ENDURANCE OF ALUMINIUM ALLOYS (UNCLAD) (IN BENDING)

1. NOTATION

K_t'	geometric stress concentration factor based on net section		
N	endurance		
S_a	maximum alternating stress computed by elastic theory	N/m ²	lbf/in ²

2. NOTES

The results of approximately 3500 fatigue tests on plain and notched specimens of unclad aluminium alloy materials have been analysed to give curves of S_a against N .

The results were obtained from specimens with $1.0 \leq K_t' \leq 3.0$ tested in one of three ways, namely, under reversed bending, as a rotating cantilever or as a rotating beam. Most results were obtained from circular section specimens less than about 10 mm (0.4 in) in diameter at the critical section. Relatively few results were obtained from specimens between 25 mm (1.0 in) and 45 mm (1.75 in) in diameter, which was the largest size tested.

The data have been grouped according to the type of alloy, as indicated in Table 2.1. In each figure the same curve has been drawn through the results from plain specimens, since the differences in average fatigue performance between the various types of alloy in plain specimen form are not considered significant.

To facilitate comparison of notched and plain specimen results, S_a has been taken as the maximum alternating stress multiplied by K_t' (plain specimen $K_t' = 1.0$). This procedure results in an overestimate of the alternating stress at the notch, partly owing to the neglect of plastic effects, particularly at low endurance. A conservative estimate of the permissible alternating stress on a notched specimen may be obtained as the plain specimen value divided by K_t' . The extent to which this alternating stress is conservative may be gauged by the difference between the plain specimen curve and the notched specimen results at the given endurance. However, the larger the specimen, the smaller is this difference.

The curves apply to specimens in bending at zero mean stress. Under axial load at zero mean stress, the alternating stress may be up to 20 per cent lower than in bending for the same endurance. The effect of mean stress may be estimated from Items Nos Fat A.00.01 and Fat A.00.02.

None of the specimens tested had any protective surface treatment. Hard anodising or cladding may halve the fatigue strength of plain specimens. The reduction of strength of notched specimens is smaller, and in joints, where fretting occurs, there may be no reduction due to surface treatment.

It should be emphasised, however, that this Item refers to stress concentrations due simply to change of form; in particular it does not relate to stress concentrations forming part of the loading system, (for example, loaded holes) nor to the fretting that may occur in such cases. (See Items Nos Fat E.05.01, Fat A.05.02 and 80007.)

Issued April 1962
With Amendments A and B, March 1993

TABLE 2.1 DATA GROUPS AND FIGURE REFERENCE

<i>Type of alloy</i>	<i>Figure Number</i>
Naturally aged Al-Cu-Mg ; L 64 type	1
Naturally aged Al-Cu-Mg ; 2024 type	2
Artificially aged Al-Cu-Mg ; L 65 type	3
Artificially aged Al-Zn-Mg ; DTD 683 type	4
Artificially aged Al-Zn-Mg ; 7075 type	5

3. DERIVATION

1. SANDIFER, R.H. Fatigue strength of aluminium alloys. Handley Page Co. Ltd, Stress Note
METTAM, G.M. 68, Issue 2 and Addenda, December 1958 (Unpublished).

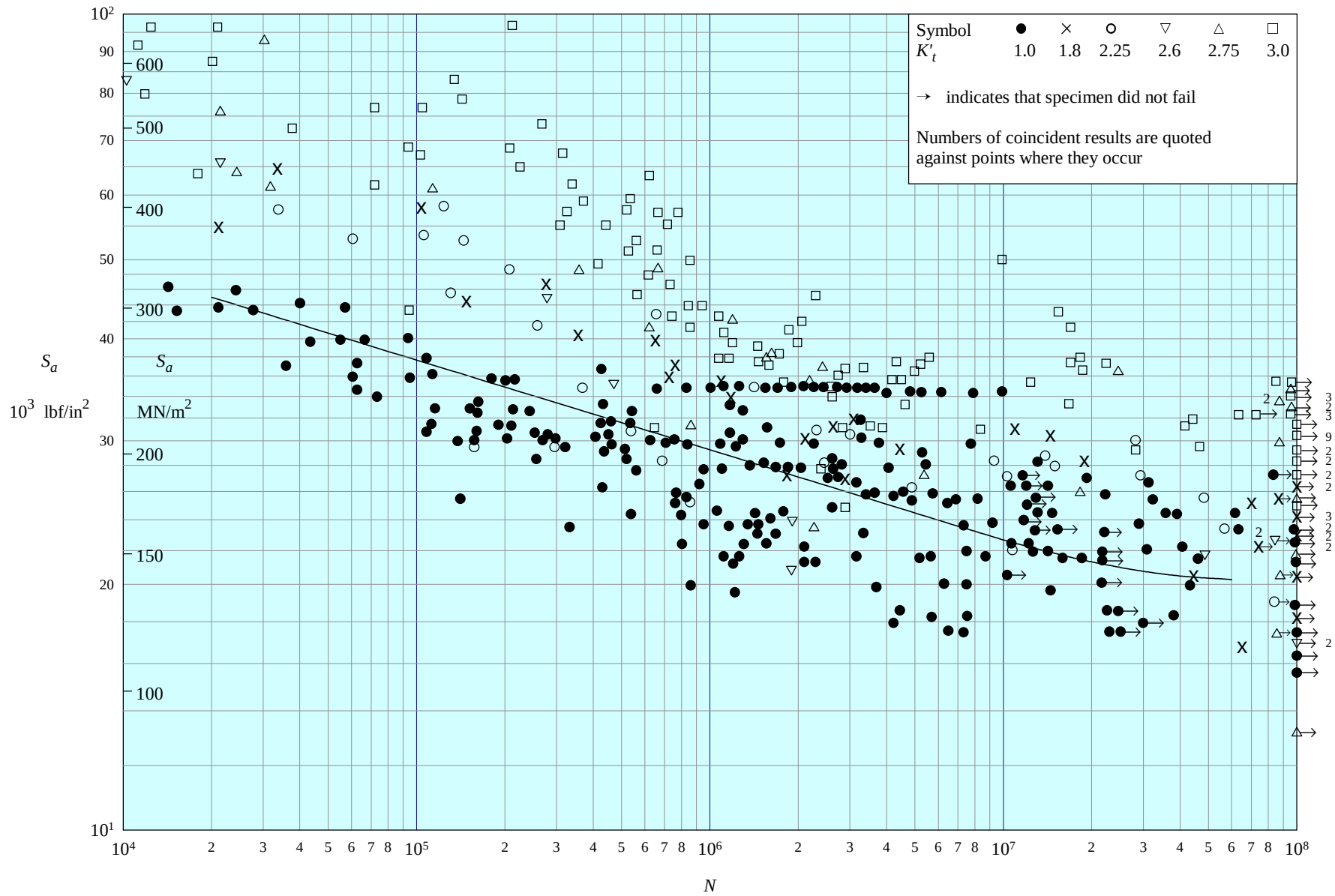


FIGURE 1 NATURALLY AGED ALUMINIUM-COPPER-MAGNESIUM ALLOYS OF L 64 TYPE