



NOTE NO. 147

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Relationship between the limits of fit determined
from B.S. 1916 and the functional requirements for interference fits

- by -

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Introduction

When a designer wishes to choose a shaft and hole deviation and tolerances, as, for example, an interference fit, he may be led to assume, when reading B.S.1916, that a particular fit combination will give the same functional characteristics over the entire size range covered by the standard.

It is the intention of this note to show that this assumption is not necessarily valid, and that the fit combination required to meet a particular functional requirement will vary with size. These comments are not intended as a criticism of the standard as such but, rather, that a supplement to the standard is required, to give the designer guidance on the choice of fit for particular functional requirements.

Example of an Interference Shrink Fit

Let us take, as an example, the interference required to produce particular stress levels in a circular bush when shrunk onto a solid shaft. A design criteria which the designers may choose, and for which the interference can be calculated, is the maximum and minimum shear stress levels in the bush.

The particular example illustrated in Fig. 1 is for a solid steel shaft and bush ($E = 30 \times 10^6$ lb/sq.in), where the ratio of internal to external diameters of the bush is 2. It has been assumed that the designer has chosen a maximum shear stress level of 20,000 lb/sq.in. and a minimum shear stress level of 10,000 lb/sq.in. With this information it is possible to calculate the interferences required to satisfy these stress conditions for various sizes of bush, as shown in Appendix 1.

Basically, these can be seen to vary linearly with size, whereas the interference obtained from a particular fit combination varies

with the cube root of size. Thus, as can be seen in Fig. 2, a single fit combination cannot, over a wide range of size, satisfy the design conditions chosen.

Conclusions

The interferences required to meet particular functional requirements are not difficult to calculate, and information on these could be made available fairly readily. The extension of this into clearance fits presents a rather more difficult problem and the Department of Production and Industrial Administration in the College of Aeronautics is proposing to initiate a research programme into this aspect of the problem.

Appendix 1

Calculation of interference for a particular shear stress level

ξ = Interference (inches)

b = 5 inches

c = 10 inches

E = 30×10^6 lb/sq.in.

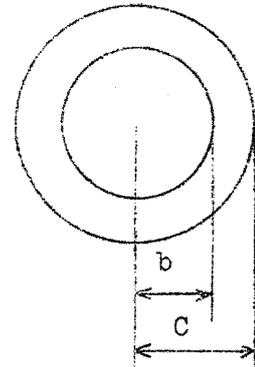
Shear Stress = 20,000 lb/sq.in.

$$\text{Shear Stress} = \frac{E\xi}{2b}$$

$$\therefore \xi = \frac{\text{Shear Stress} \times 2b}{E}$$

$$= \frac{20,000 \times 2 \times 5}{30 \times 10^6}$$

$$= \underline{\underline{.0067 \text{ inches}}}$$



Reference Strength of Materials. Timoshenko Part II

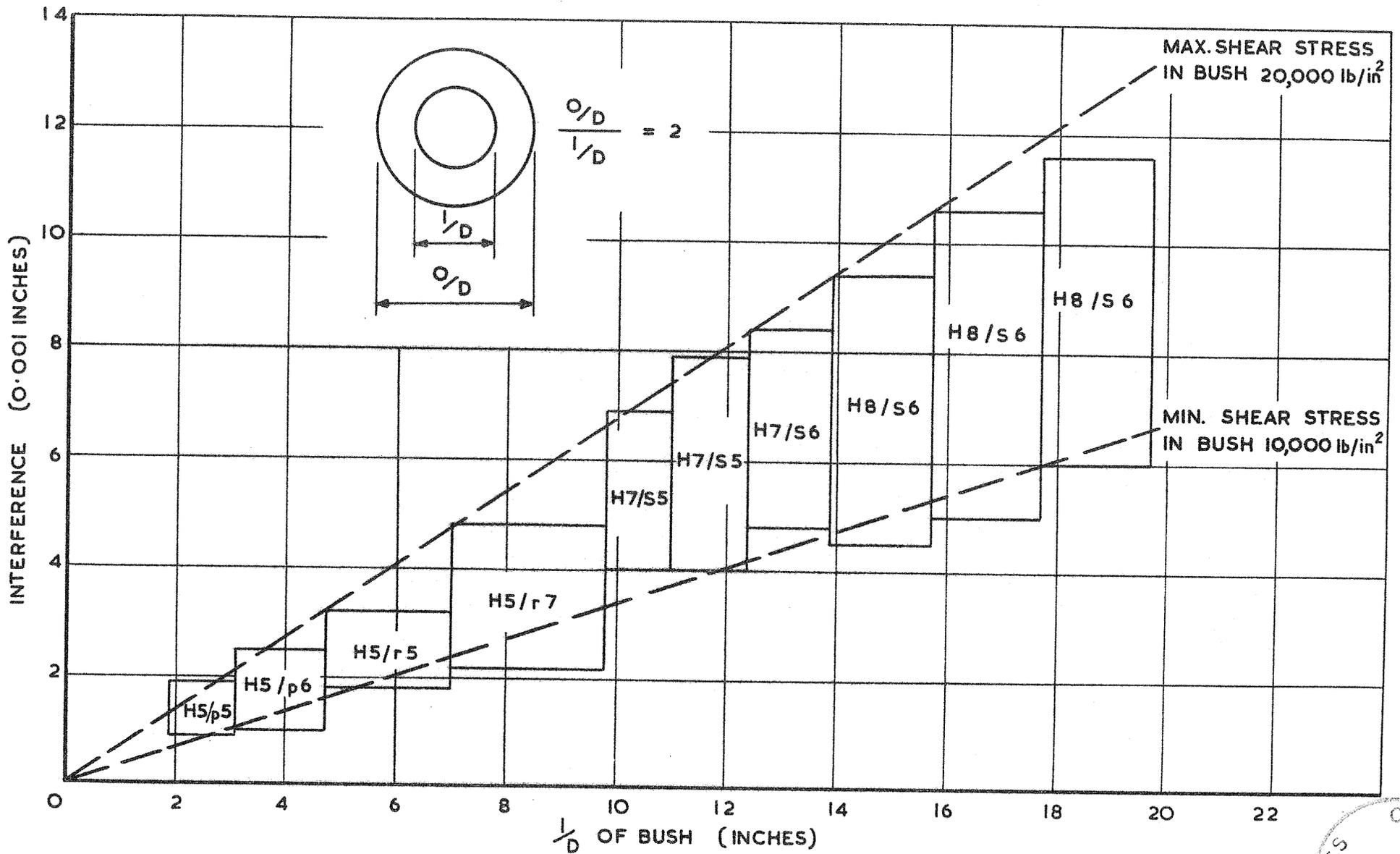
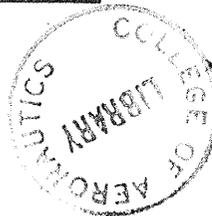


FIG. I. SOLID STEEL SHAFT AND STEEL BUSH.



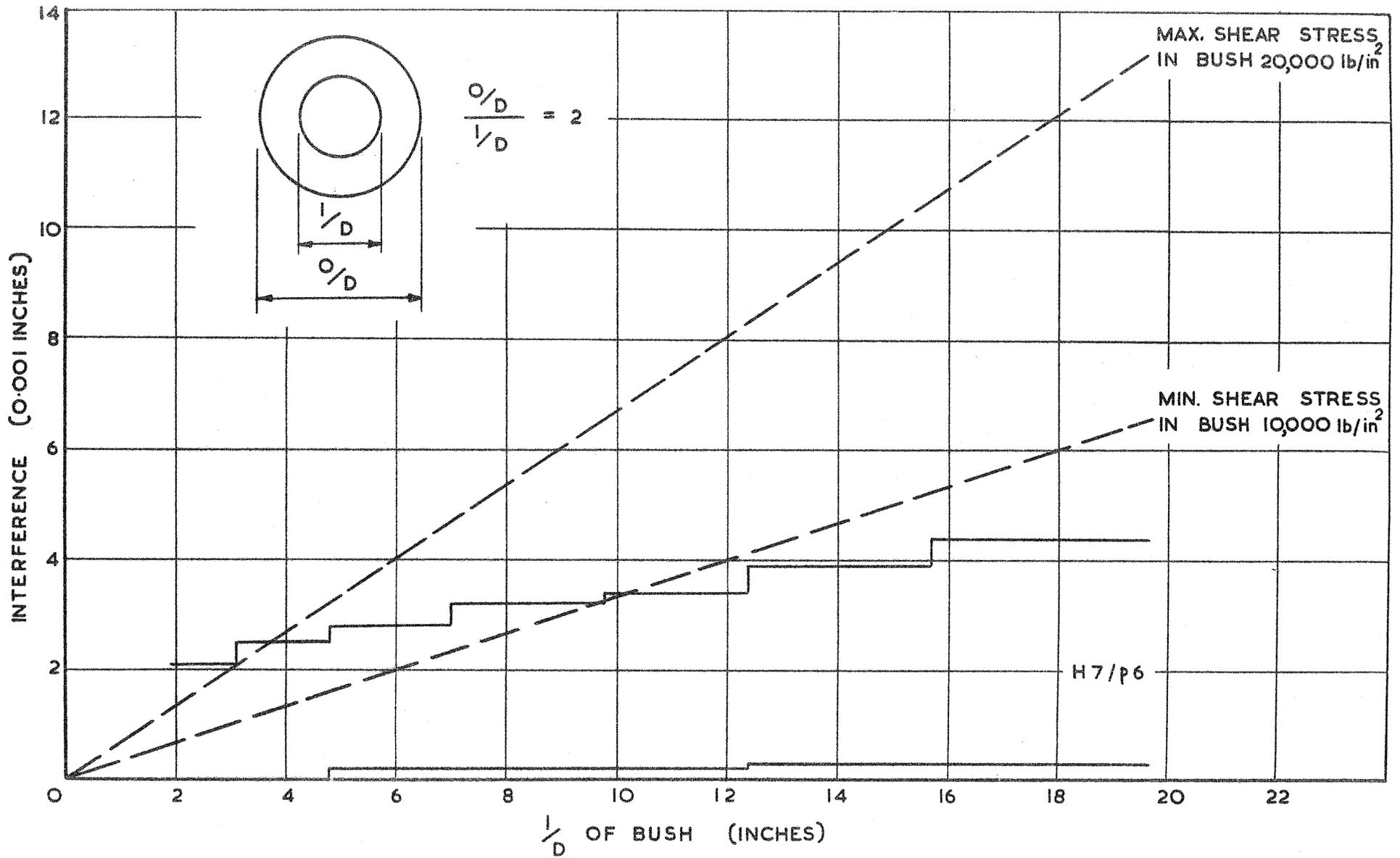


FIG. 2. SOLID STEEL SHAFT AND STEEL BUSH.