

DISCUSSION

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The work of Goel, Busch, and Zackay is very valuable. Their results help to develop and evaluate new improved materials. It is clear from their work that a number of parameters could influence the strength of materials. Some of the parameters are very important whereas some others hardly influence the properties of the metals at all. The authors of this paper have concentrated their efforts to investigate the effect of the prestrain temperature on the static strength of a given metal. As they wrote: "The discussion of the experimental results will be centered on the variable prestrain temperature in view of the over-riding influence. . . ." The prestrain values had been kept constant (2 percent) in most of the tests.

Though it is true that the prestrain temperature is extremely important it is not possible to state that it has an "over-riding" effect on the strength of materials. Similarly, it is not correct to say that a metal has improved properties if only the static strength is used as a comparison. Fatigue and other dynamic

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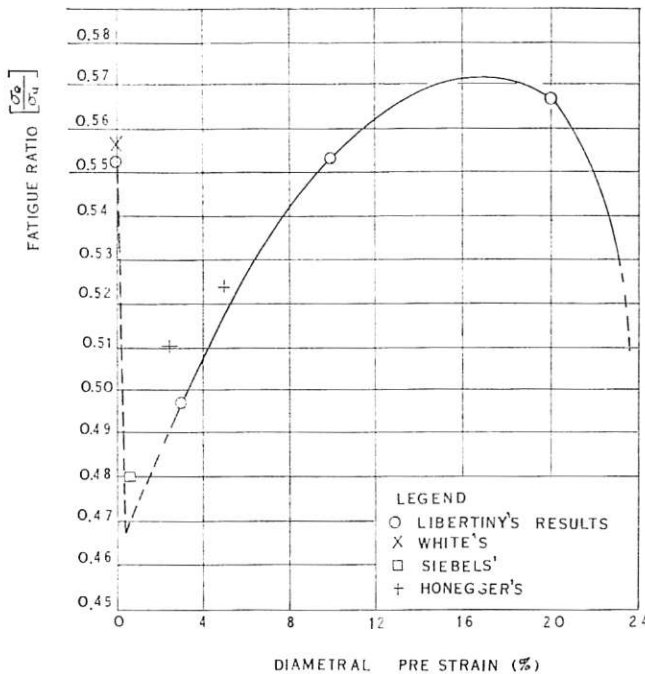


Fig. 13 The effect of prestrain on endurance limit

properties are as important in most of the modern engineering designs as the static properties of the metals. It is suggested therefore that the effect of prestrain temperature on the dynamic (fatigue) properties of this metal should be also investigated.

Furthermore, I should like to draw the attention of the authors to the fact that the value of the prestrain is an extremely important parameter, possibly as important as the prestrain temperature. Although I have not investigated the effect of prestrain on the static properties of metals, I carried out some tests to find the effect of prestrain on the endurance limit of some metals. In order to illustrate the importance of this parameter I show some of my results and some results of other investigators found in publications in Fig. 13. Although the materials and test techniques used by these investigators are different, the qualitative tendency is clear. This diagram leaves no doubt about the decisive effect of the prestrain value on some of the properties of metals. If the possibility of accidental overstraining of a machine part is kept in mind then the importance of the prestrain parameter on the strength of materials is even more obvious. It would be interesting to see some test results indicating the effect of the prestrain value (besides the prestrain temperature) on the mentioned steels.

Additional References

- 1 E. Honegger, "Fatigue of Metals When Stressed Beyond the Yield Point," *The Brown Boveri Review*, vol. XIII, no. 7, 1926, p. 169.
- 2 M. Siebel and W. E. Smallman, "A Report on the Effect of Tensile Overstrain and of a Subsequent Low Temperature Heat Treatment on the Tensile, Compressive and Fatigue Properties of an Alloy Steel," thesis, University of Bristol, Mechanical Engineering Department, Bristol, England, 1949.
- 3 D. J. White, B. Crossland, and J. L. M. Morrison, "Effect of Hydrostatic Pressure on the Direct Stress Fatigue Strength of an Alloy Steel," *Journal Mechanical Engineering Science*, vol. 1, no. 1, 1959.
- 4 G. Z. Liberty, "The Effect of Large Mean Strain on Fatigue Strength Under Various Hydrostatic Pressures," PhD thesis, University of Bristol, Bristol, England, 1963.

Authors' Closure

It is true that in addition to the prestrain temperature other parameters may have a strong influence on the properties of the material. It was not possible in the course of this investigation to study all of the possible variables. However, based upon preliminary screening tests, those variables which appeared to be important were investigated.

It is recognized that the usefulness of any material depends upon a combination of many factors such as its static strength, fatigue properties, corrosion resistance, and fracture toughness. It would definitely be interesting to see some work done which would bring out the effect of different processing parameters on other mechanical and physical properties.