A SUMMARY OF HUGONIOT ELASTIC LIMIT MEASUREMENTS

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ABSTRACT

A summary of Hugoniot elastic limit measurements published in the literature is presented. The summary, taken from about 60 references, includes about 120 entries describing metals, brittle single crystals, and polycrystalline ceramics. Geologic materials are not comprehensively surveyed. The tabulated data gives characteristic Hugoniot elastic limit values together with the experimental technique employed and critical comments concerning metallurgical condition, sample thickness and departures from simple time-independent behavior.

INTRODUCTION

The response of solids subjected to high-pressure shock-wave loading has been extensively investigated both theoretically and experimentally.[1-8] The presence of elastic precursor waves was first reported by Pack, et al.[9] in 1948, and the first quantitative measurements of precursor amplitude, i.e., the Hugoniot elastic limit (HEL), were reported by Minshall[10] in 1955. Although these early elastic wave measurements date from the same time as the more extensive studies of higher pressure shock-wave behavior,[11] comprehensive measurements and the study of the physical processes involved are of more recent origin. This is immediately apparent from the summary presented herein, which shows that one-half of the HEL values were reported within the last three years. The lower stress levels involved in HEL measurements and the time-dependent character of dynamic yield phenomena required the development of new measurement techniques with enhanced sensitivity and improved time-resolution.

The concept of a unique HEL value implies that rate effects are negligible and equilibrium is achieved. Under these conditions shock-wave propagation is steady and the value of the HEL will be time-independent, i.e., its value will not depend on propagation distance or driving stress amplitude. The experimental results given in the summary show that, in fact, many materials exhibit time-dependent unsteady behavior. Thus, the concept of a unique HEL value for a material is often an oversimplification; nevertheless, characteristic values can be assigned within limits, and these are the values given in the summary. Although the summary is a reasonably complete compendium of experimental results, individual references should be consulted for specific details.