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Limitations of the Hopkinson Pressure Bar for High-Frequency Measurements RICHARD AMES, Naval Surface Warfare Center, Dahlgren Division — The Hopkinson Pressure Bar is a measurement tool that has been used for a variety of applications, including measurement of high-strain-rate loads, characterization of blast fields, and impulse measurements for ballistic test specimens. The technique is generally used for integrated measurements (such as impulse) but has also been used to measure the time-history of a variety of dynamic loads. The limitations on this type of measurement are strict, however, and generally require bars of extremely small diameter for most measurements of practical interest. Dynamic loads with significant high-frequency energy can become severely distorted as they are propagated down the bar; this phenomenon is typically referred to as signal dispersion. This paper provides a review of the relevant theory behind the Hopkinson Pressure Bar technique and derives relationships that provide practical limitations on the use of the technique for high-frequency measurements. In particular, this paper uses Love's theory to derive the relationship

$$r < \frac{0.465 c_0}{2\pi \upsilon f}$$

where c_0 is the bar material sound speed, ν is the Poisson's ratio, f is the frequency of the disturbance, and r is the bar diameter. This equation defines the limitation on bar diameter that will allow propagation with less than 5% dispersion.

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