thickness of 0.012 in. (≈0.3 mm) is small enough that the tape can fit in the clearance between the mating blade-root and hub surfaces in a typical turbomachine.

In an experiment, a blade was mounted in a test fixture designed to simulate the blade-end conditions that prevail in a turbocompressor. Vibrations were excited in the blade by use of an impact hammer, and damping of the vibrations was measured by use of a dynamic signal analyzer. Tests were performed without and with viscoelastic dampers installed in the dovetail root attachment. The results of the measurements, some of which are presented in Figure 2, show that the viscoelastic dampers greatly increased the rate of damping of vibrations. Accordingly, dynamic stresses on rotor blades were significantly reduced, as shown in Figure 2.

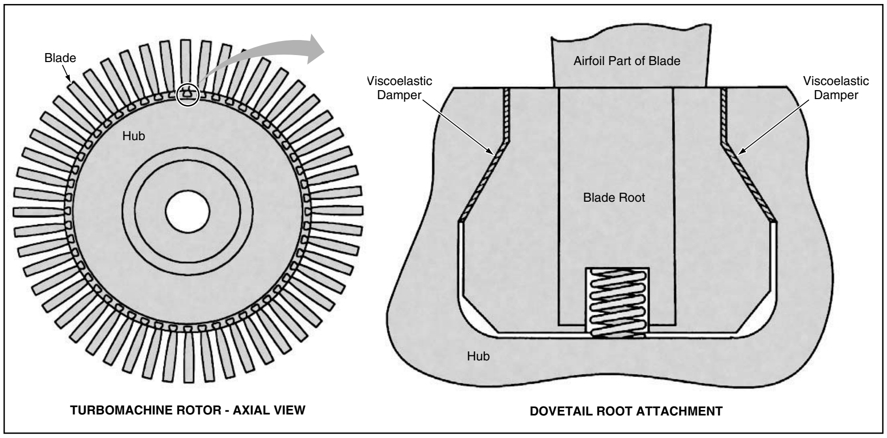

Figure 1. **Thin Layers of Viscoelastic Damping Material** between the blade and hub contact surfaces provide for dissipation of vibrational energy on load paths.

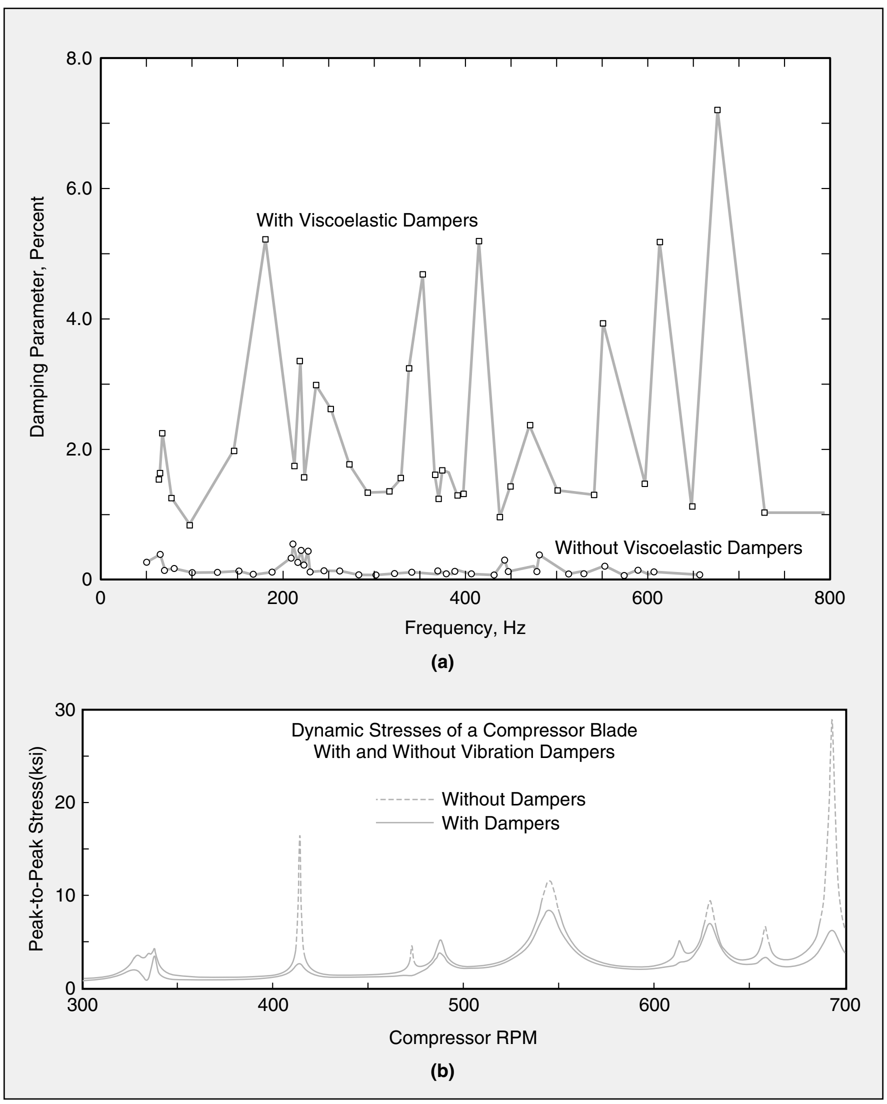

Figure 2. The **Results of the Measurements** have shown that the rate of damping at all frequencies was found to be increased significantly when viscoelastic dampers were installed, as observed in (a). This damping increase results in a significant reduction in operational vibratory stresses of rotor blades in a compressor, as seen in (b).

This work was done by Nhan Nguyen of **Ames Research Center**. *For further information, access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com***.

This invention has been patented by NASA (U.S. Patent No. 6,102,664). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Ames Research Center, (650) 604-5104. Refer to ARC-14061.

Books and Reports

Soft Landing of Spacecraft on Energy-Absorbing Self-Deployable Cushions

A report proposes the use of cold hibernated elastic memory (CHEM) foam structures to cushion impacts of small (1 to 50 kg) exploratory spacecraft on remote planets. Airbags, which are used on larger (800 to 1,000 kg) spacecraft have been found to (1) be too complex for smaller spacecraft; (2) provide insufficient thermal insulation between spacecraft and ground; (3) bounce on impact, thereby making it difficult to land spacecraft in precisely designated positions; and (4) be too unstable to serve as platforms for scientific observations. A CHEM foam pad according to the proposal would have a glass-transition temperature (T_g) well above ambient temperature. It would be compacted, at a temperature above T_g, to about a tenth or less of its original volume, then cooled below T_g, then installed on a spacecraft without compacting restraints. Upon entry of the spacecraft into a planetary atmosphere, the temperature would rise above T_g, causing the pad to expand to its original volume and shape. As the spacecraft decelerated and cooled, the temperature would fall below T_g, rigidifying the foam structure. The structure would absorb kinetic energy during ground impact by inelastic crushing, thus protecting the payload from damaging shocks. Thereafter, this pad would serve as a mechanically stable, thermally insulating platform for the landed spacecraft.

This work was done by Witold Sokolowski and Marc Adams of Caltech for **NASA's Jet Propulsion Laboratory**. *To obtain a copy of the report, "Novel Precision Soft Lander (PSL)," access the Technical Support Package (TSP)* ***free on-line at www.nasatech.com****.*
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