

Technical Brief No. 31

All Technical Briefs are based on past projects at RH Lyon Division

Turbo-rotor Grinding Wheel Centrifuge

Spin/Burst Testing Machines

Resilient Support Ensures Both Greater Speed
and Off-Loading of Bearings

The Problem

Products like grinding wheels and centrifuge components are hazardous if they fly apart in use because of centrifugal forces. To guard against that happening, the designs for such products are routinely tested by spinning them at high speeds until they burst. A well-known manufacturer of spin-testing equipment came to us with a design problem. When the tested article would burst at a high speed, the fragmentation was not complete; and portions of the article were still retained by the arbor.

Consequently, the extremely high imbalance load from the large imbalance that resulted could put such high forces on the spindle that the bearings could be damaged or destroyed. The resulting downtime and costs for repair was unacceptable to our client's customers. The question put to us was, "How do you design a rotor-bearings system that will survive such excessive conditions?".

The same problem exists in general in many high speed components of gas turbines, compressors, centrifuges, separators, superchargers, turbo-generators, hob and grinding heads. Here the service life of the whole machine is often determined by its rotor-bearings system. Greater rotational speeds are needed to increase efficiency, productivity, and to meet various technological requirements. As design speeds grow steadily, the service life tends to decrease, due to increasing forces in the bearings.

The Solution

Most of the known techniques, from the Laval spindle to magnetic bearings, have either relatively high cost or certain technological limitations. A more advantageous suspension system, both in performance and cost, involves resilient supports mounted between either the bearings and the housing of a rotor machine, or between a bushing (in which the rotor itself is mounted) and the housing. These supports ensure *off-loading* of the bearings,

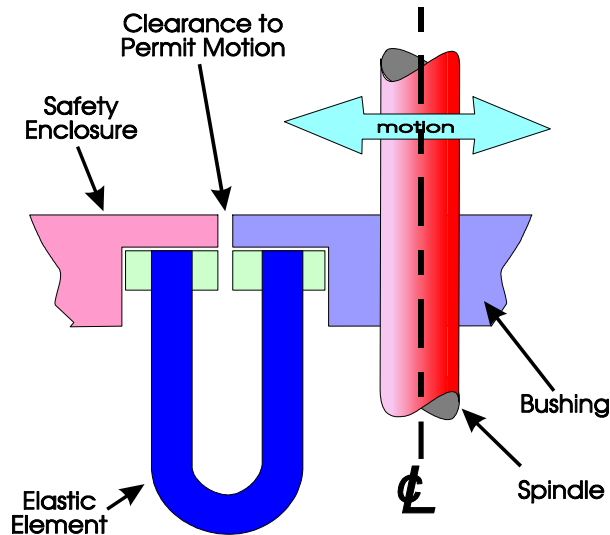
taking on the larger part of dynamic loads incurred by the bearing unit. Besides that, by lowering the critical speeds of the system, elastic supports can provide effective *self-centering* of the rotor.

The stresses in the supports themselves can be set at an acceptable level, if they are adequately designed and manufactured. The practical advantages of this approach are that greater speed and service life are achieved for low cost, with ease of implementation and flexibility in design, allowing the incorporation of the supports

into a wide variety of machine configurations.

Design, analysis and implementation

The technique outlined above was incorporated into a new spin-test machine design schematically shown in the figure. Thorough dynamic testing demonstrated the new design's remarkable resilience to severe imbalance loads. The result of this project was a testing machine of improved safety, longevity and productivity. These concepts can be successfully applied to the design of many high-speed strongly unbalanced rotors.



Schematic of Resilient Support