

centrifugal compressors

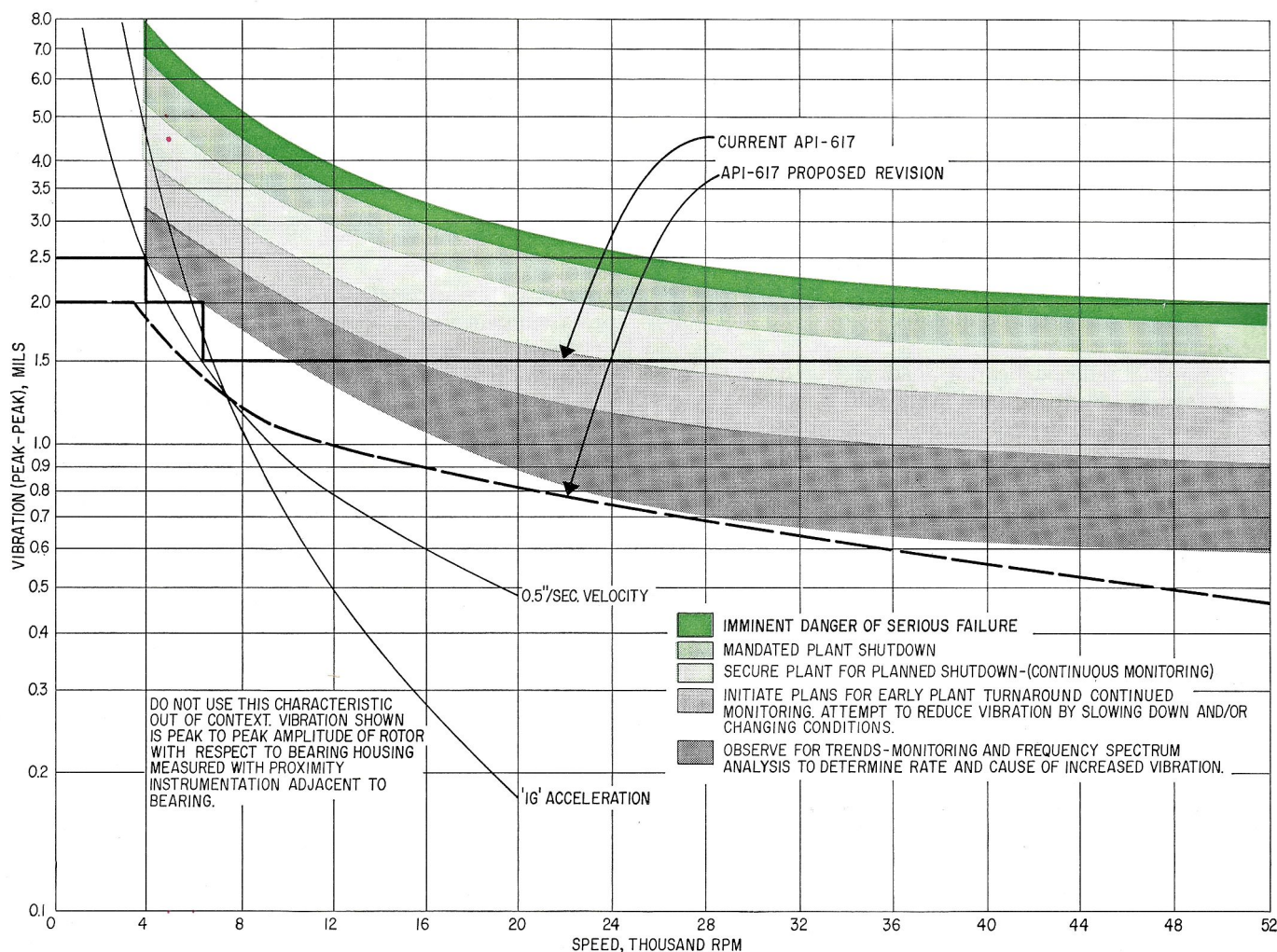


Fig. 6—Guide to centrifugal compressor vibration.

rotor-system stability have supplied analysis tools which can be used to more precisely design and evaluate rotor systems.

In the following circumstances operating 20 percent below the second critical speed or operation 10 percent away from a critical speed may not insure satisfactory operation.

1. The unit may be sensitive to relatively small amounts of unbalance,
2. The critical areas of operation can cover a speed range greater than 10 percent depending on the amount and location of unbalance and the particular compressor configuration.

These critical areas of operation can be defined as the speed range where unbalance which is unavoidable under normal operating conditions can result in large amplitudes of vibration or forces which could prevent continuous operation of the compressor. This amount of unbalance should be agreed to by the user and manufacturer.

A typical, critical-speed map with the average bearing and support stiffness superimposed is shown on Fig. 5. The intersections can be considered critical speeds; however, bearing geometry, clearance, and even oil tem-

perature and viscosity will change these values and therefore should not be considered as precise values.

Vibration. The one-mil vibration limitation which some users are imposing on manufacturers during the acceptance testing of compressors below the 12,000 rpm speed range is, in general, of little advantage. If journal-bearing clearances are reduced from the optimum value to satisfy a restrictive vibration specification, such a requirement can be a disadvantage because amplitudes at other shaft locations (such as the middle of span) and resulting bearing and pedestal forces can actually increase to dangerous values.

A general guide for vibration in our centrifugal compressors, measured at the bearings, is shown on Fig. 6. The lower, shaded line is typical of what we would consider satisfactory when the compressors are operated on the test stand. The present API Std. 617 and the proposed modification to API-617 are shown for comparison. It must be pointed out that each compressor's limitations must be evaluated individually and in general, shaft vibration adjacent to the bearings alone is insufficient to make this determination.

Indexing terms: Bearings-7, Clearances-6, Compressors-9, Control-6, Failures-7, Impellers-9, Loads-6, Operations-7, Seals-9, Specifying-8, Speed-6, Surging-6, Testing-9, Thrusts-6, Vibrations-7.