

Vibration and Stability of 3000 HP Titanium Construction Chemical Process Blower

By

Les Gutzwiller

President

*Robinson Industries, Inc.
Zelienople, Pennsylvania*

Mark A. Corbo, P.E.

President & Chief Engineer

*No Bull Engineering
Guilderland, New York*

Title: Vibration Instability of a 3000 HP,
Titanium Construction, Chemical Process Blower

Name: Les Gutzwiller, President

Affiliation: Robinson Industries, Inc.
400 Robinson Drive
Harmony, PA 16037
Telephone: 724/452-6121 ;
Fax : 724/452-0388
E-mail: lgutzwil@robinsonfans.com

ABSTRACT:

These 74-inch diameter blowers have an overhung rotor design of titanium construction, operating at 50 psig in a critical chemical plant process. The shaft is supported by oil-film bearings and is direct-driven by a 3000 HP electric motor through a metal disk type coupling. The operating speed is 1780 RPM. The blower shaft and motor shaft motion is monitored by Bently Nevada proximity probes and a Model 3100 Monitoring System.

Although the blowers showed very satisfactory vibration levels during test runs at the manufacturer's plant, the vibration levels in situ have always been higher than desirable. After several months of monitoring showed ever-increasing vibration levels, one of the blowers was shut down in order to diagnose and resolve the problem.

Several steps were taken to diagnose the problem:

1. Remove the rotor and check/correct the shop balance.
2. Measure the bearing support movement due to thermal expansion. Then misalign the shafts in the cold condition in order to achieve near-perfect shaft alignment during normal operation.
3. Determine expected shaft vibration at the bearings using a lateral rotor dynamics analysis including critical speed mapping.
4. Add a heavy sleeve to the blower shaft to increase the radial load on the drive-end bearing.
5. Replace the metal disk type coupling with a gear coupling.
6. Finite element and impact testing of the bearing support pedestal to determine the bearing support stiffness.
7. Measure shaft movement during a coast down.
8. Evaluation of tilting pad bearings as a possible replacement for the original standard sleeve type hydrodynamic oil-film bearings.

The final solution shows the importance of coupling angular stiffness, (often rarely considered in machine design), rotor dynamic analysis, and the importance of field alignment.

Keywords : blower, vibration, fluid-film bearing, titanium, chemical process