

The second of six installments on bevel gearing, this month's column focuses on the potential causes of catastrophic failure, and how to avoid it.

As described in last month's column, gear tooth problems are usually recognized at higher frequencies with exact multiples from your readings on your gearbox. Non-synchronous multiples usually reflect bearing problems.

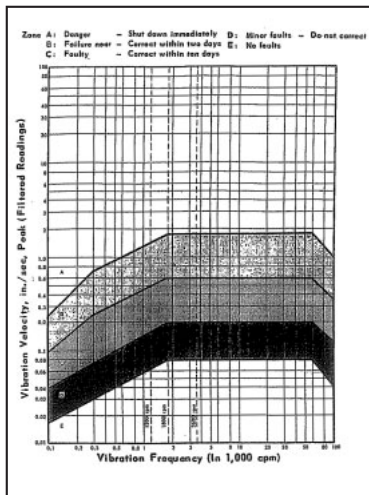


FIGURE 1

This chart is a reference showing acceptable, useable, and dangerously high levels of vibration caused by gear and/or bearing failures, providing all other variables have been eliminated. Some causes of gear and/or bearing failures are:

- Oil level
- Oil viscosity breakdown

“EXCEEDING THE OEM’S LOAD CAPACITY AND/OR SPECIFICATIONS WILL RESULT IN CATASTROPHIC FAILURE, AND GEAR REPLACEMENT IS INEVITABLE AT THAT POINT.”

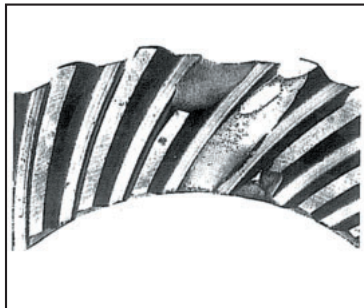



FIGURE 2

- Lack of proper lubrication
- Loss of bearing end-play/pre-load
- Foreign corrosive materials entering the gearbox through standard lip seals
- Standard fatigue caused by time, wear and tear
- Overloading (deviating) from the original OEM design, which is the most common failure seen

Alone or combined, all of these will eventually lead to catastrophic failure, as seen in Figure 2.

This image depicts the fractured surfaces of broken gear teeth. Sections were removed from these areas for microscopic examination. The failure shown is characteristic of an overload breakage rather than fatigue, as determined by an independent metallurgical laboratory. The gear is a spiral bevel ring gear from a 90-degree drive gearbox.

Most spiral bevel gears are manufactured using low carbon alloy materials. They are then carburized and hardened, or case hardened, with an effective case depth of 10-20 percent of the tooth thickness at the addendum line to create a surface hardness of 58-62 R^oC on the Rockwell “C” scale. This process keeps the tooth core hardness several points softer than the outer shell or the case hardness depth, allowing the gear to absorb the immediate shock loads that may be introduced. When you exceed the OEM’s load capacity and/or specifications, the preceding no longer applies, resulting in catastrophic failure. Gear replacement is inevitable at this point.

To prevent catastrophic failure, it is beneficial to predict your repair maintenance scheduling by referring to Figure 1. When levels reach the high end of the useable graph, it is a good time to schedule repairs through replacement bevel gearing and new bearings. 

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