



Spindle
Technology

Detecting Torsional Defects in a Gear Driven Spindle.





INTRODUCTION

GTI was referred by Ingersoll Production Systems to investigate an ongoing problem on a face milling operation at Finkl Steel in Chicago IL. The application in the photo below was a process they have been doing for years on this machine. The face milling of a several ton steel block started to chatter violently for no apparent reason. This forced Finkl to slow the in-feed by 1/2 to produce the same results in the past. Even at 1/2 speed the finish on the part was less than desired and was easily obtained before the problem started.





LOOK FOR WHAT CHANGED AND WHEN

Before starting any testing, GTI first asked what had changed? Finkl Steel, explained that the machine spindle and gearbox were recently rebuilt and all obvious machine checks were made including tooling. The OEM (Ingersoll) and the tooling provider had been onsite on several occasions and could not identify the issue. There was only one change that happened before the problem started. Finkl Steel had put a harder material for a special job on the machine for a very short run. When they returned to the standard product the problem started. When all of the speeds and feeds were programed in to run the standard material, the operator noticed a loud noise coming from the machine. He also saw that after the cycle, the steel block had a horrible chattered finish. The only way to continue production was to slow the feed by 1/2. The Chatter was still visible, but acceptable. (See video)

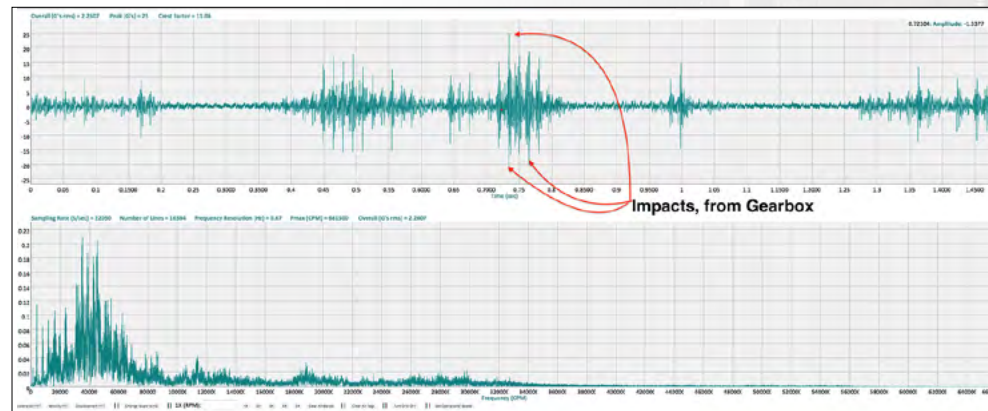
<https://youtu.be/EEgvB4dkGJQ>

After several visits and attempts to fix the issue, Ingersoll Production Systems referred GTI to conduct a full vibration analysis of the entire machine.

VIBRATION ANALYSIS TESTING

GTI took a very systematic approach based on how the problem started. We conducted vibration readings on the spindle, drive motor and gear box while running, but not cutting. All vibration levels were within ISO specification for this machine type. No bearing defects or gear defects were evident. We also compared the spindle vibration under load (while cutting) to the machine base to rule out any looseness from the spindle to the base of the machine. There was no transmissible vibration detected between the spindle and the machine base.

We then induced the noise and chatter by speeding the feed rate up and took a measurement. (while cutting) This is when we finally saw the defect in the vibration signature. (see below)



When running without load the amplitude was .3493 G's Overall RMS. As you can see above when the vibration is induced under load/cut it rises to 2.26 G's RMS and has peaks up to 25 G's.



CONCLUSION

Two things were conclusive from all the tests we at GTI conducted. #1 the vibration clearly had the most amplitude emanating from the gearbox. #2 The spectrum and wave form was clearly showing a torsional defect/impact in the gearbox.

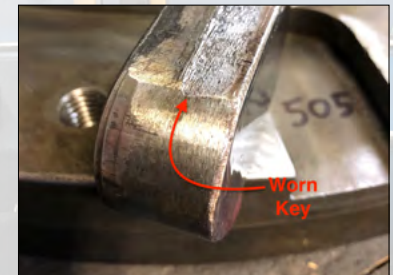
We did one more test from the drive motor, belt to the gearbox with a strobe light to rule out a slipping pulley/belt scenario. This test was clean and showed zero slippage.

At this point we knew we had a torsional looseness in the gear box. It was decided that the gear box must be dismantled to inspect the internal drive gears and components.

FINDINGS

We found 1 of the 8 final drive gear assembly bolts broken and several others loose. We also found the keys for the final gear assembly to be worn and the slots they sit in were worn oversized from the torsional chatter. (See Photo's to the right) Both the gear and the hub show this clear defect.

This is another clear example of how vibration analysis can be used to diagnose a problem in a complex machine with many moving parts.



888.473.9675 // 33 Zachary Road // Manchester, NH 03109

WWW.GTISPINDLE.COM