

# **Identification of a Gearbox problem on an Overhead Crane**

## Introduction

In February 2001 MAARS installed online vibration monitoring equipment on seven overhead cranes used in a production environment. The cranes are automated and are controlled by PLCs. There are 3 primary components on each crane which are monitored:

1. Motor 50 HP AC motor with VFD speed controllers for the lift.
2. Gearbox Reducing gearbox (28.35:1) which connects the motor to the lift mechanism.
3. Bridge Drives AC motor and gearbox which are used to move the bridge.

There are 12 sensors installed on each of the cranes. The sensors are all accelerometers and are listed below:

1. Hoist Outboard Horizontal (MOH)
2. Hoist Motor Inboard Horizontal (MIH)
3. Hoist Motor Inboard Axial (MIA)
4. Hoist Gearbox Inboard Horizontal (GIH)
5. Hoist Gearbox Inboard Axial (GIA)
6. Hoist Gearbox Outboard Horizontal (GOH)
7. North Bridge Drive Motor Outboard Horizontal (MOH)
8. North Bridge Drive Motor Inboard Horizontal (MIH)
9. North Bridge Drive Gearbox Axial (GA)
10. South Bridge Drive Motor Outboard Horizontal (MOH)
11. South Bridge Drive Motor Inboard Horizontal (MIH)
12. South Bridge Drive Gearbox Axial (GA)

In addition there are two tachometers installed on each crane – one on the hoist motor and one for the bridge drives.

The tachometers are used to trigger data acquisition at times when the hoist mechanism is lifting or lowering and when the bridge drives are moving the crane bridge.

## Data Analysis

When the system was first installed, we were not able to obtain all of the details for the machinery so for the Hoist Motor and Gearbox we setup the following parameters:

1. Overall vibration
2. 1 X Motor speed
3. 2 X Motor Speed

At this point the gearbox gear details were not known so they were not included. Figure 1 shows the trend for the Overall vibration parameter for the GIA sensor.

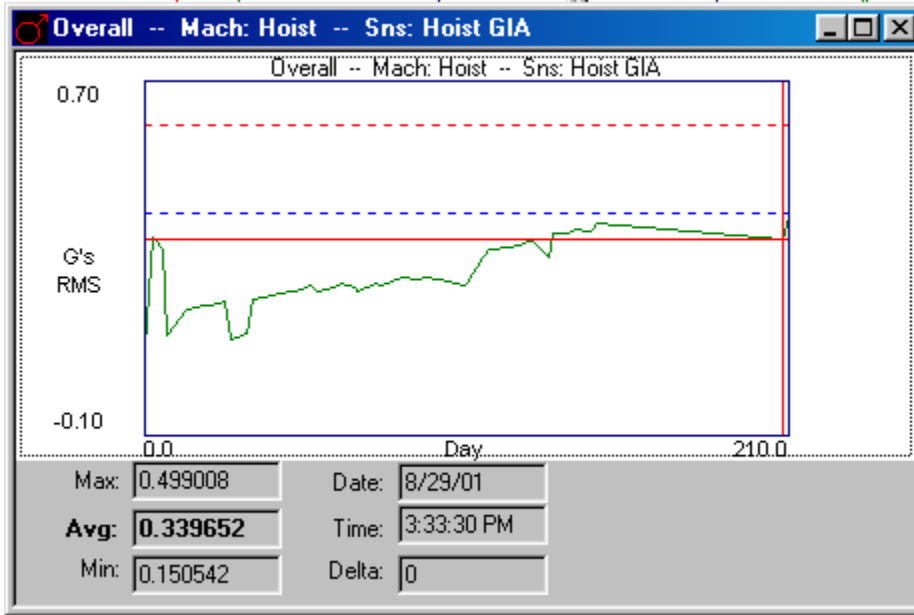


Figure 1 Trend of GIA from 2/20/01 to 8/30/01

Note that the overall value of the vibration for this point was trending up over the period of time from when the system was installed (2/20/01) to 8/30/01. Figure 2 shows a spectrum for the GIA measurement point on 2/28/01 and the same measurement point for 9/4/01 is shown in Figure 3.

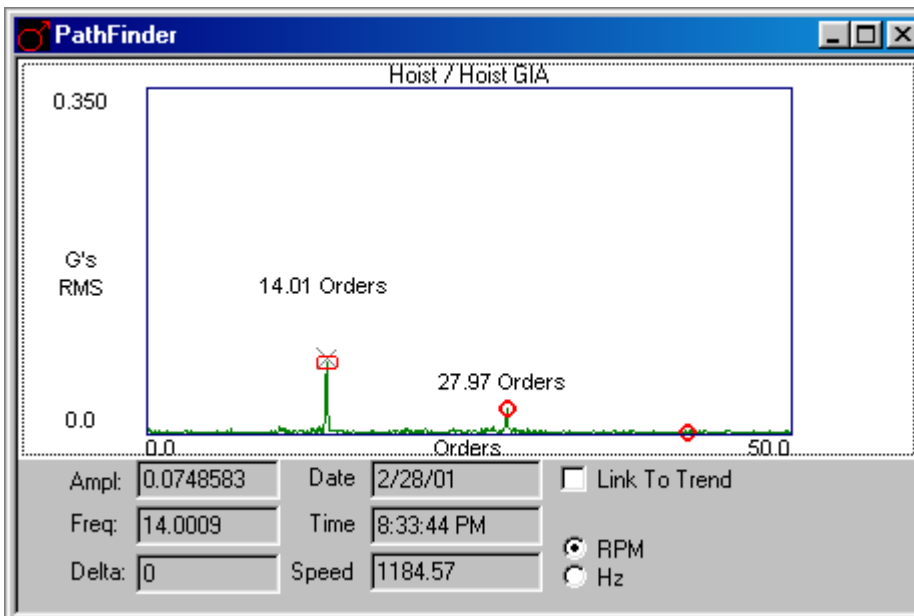
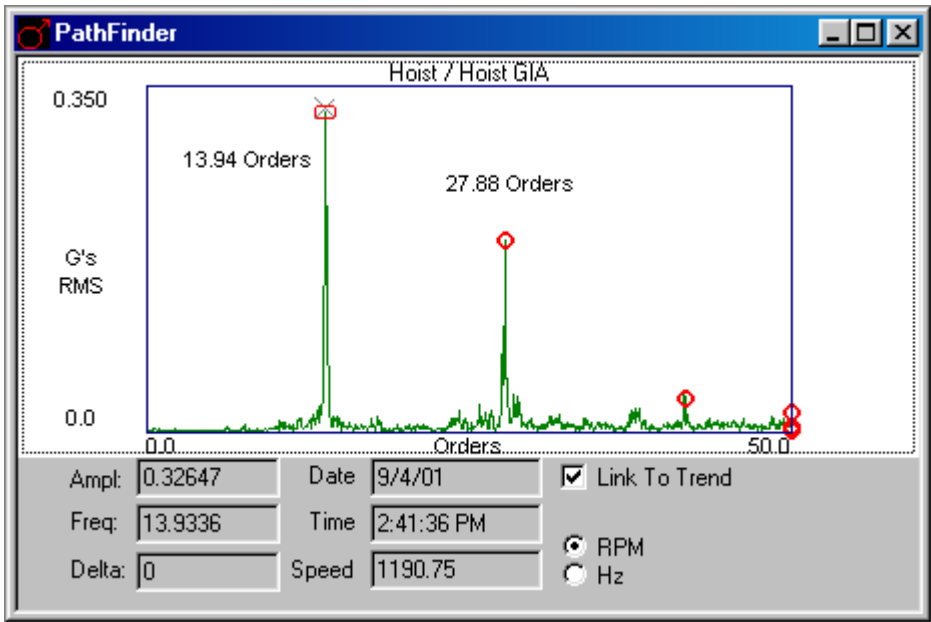
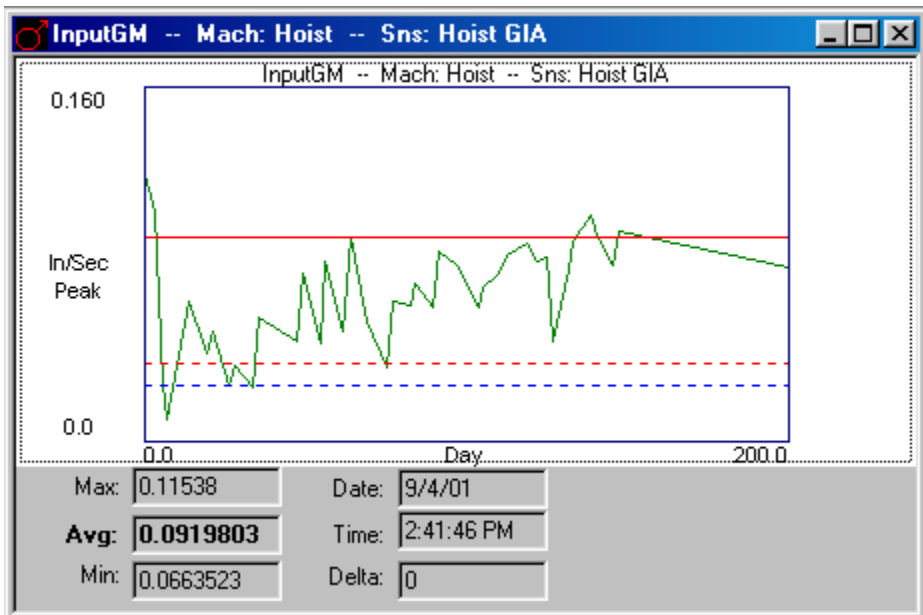


Figure 2 Spectrum for GIA on 2/28/01

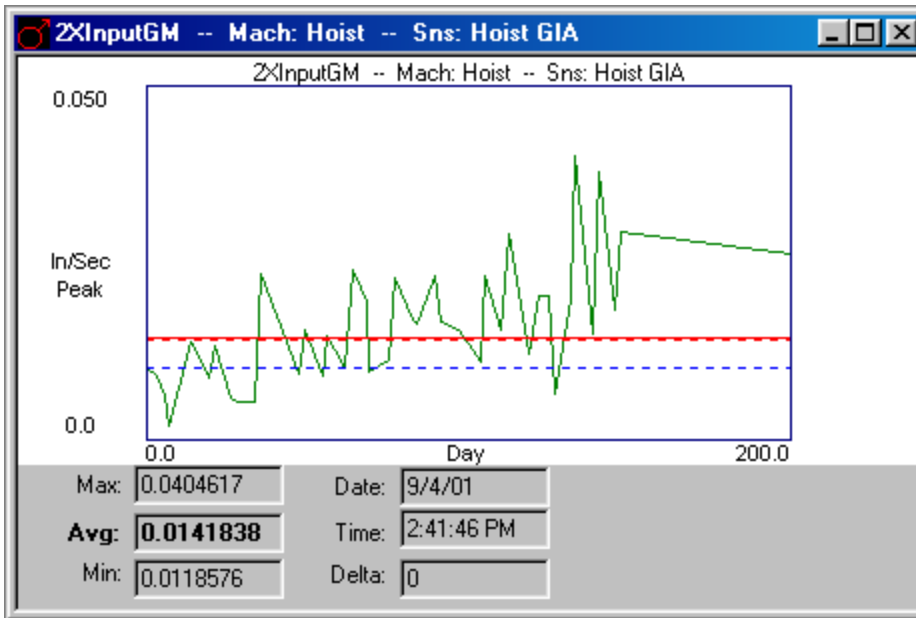


**Figure 3 Spectrum for GIA on 9/4/01**

Clearly there is a significant increase in vibration at 14 and 28 times the motor speed between these two dates. As it turns out, the number of teeth on the input shaft of the gearbox is 14. Using a feature built in to the MAARS software, we added 2 analysis parameters to the database to define the 1X and 2X input gearmesh frequency and then had the software go back and calculate trends for these parameters from the data stored in the database. Figures 4 and 5 show these trends.

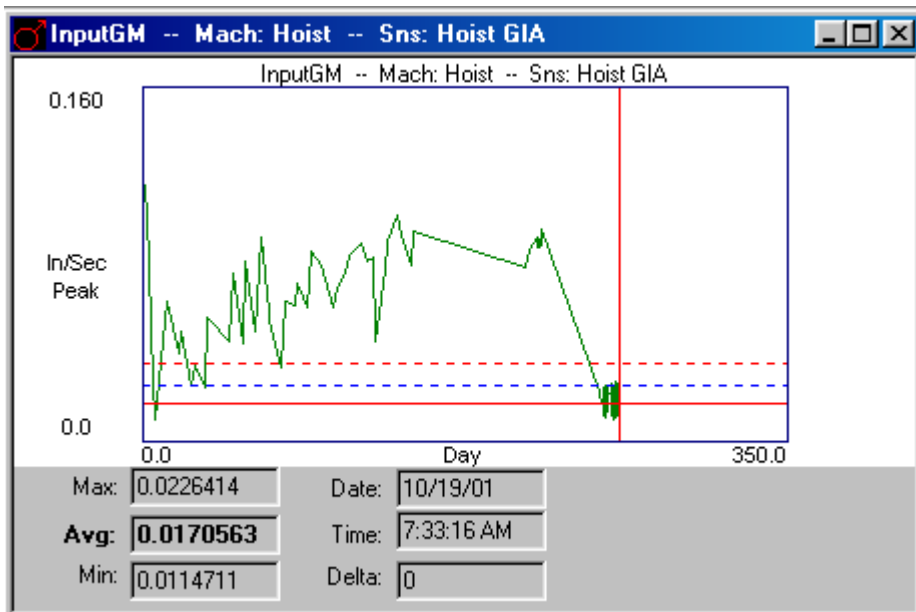


**Figure 4 Trend for Input Shaft Gearmesh**

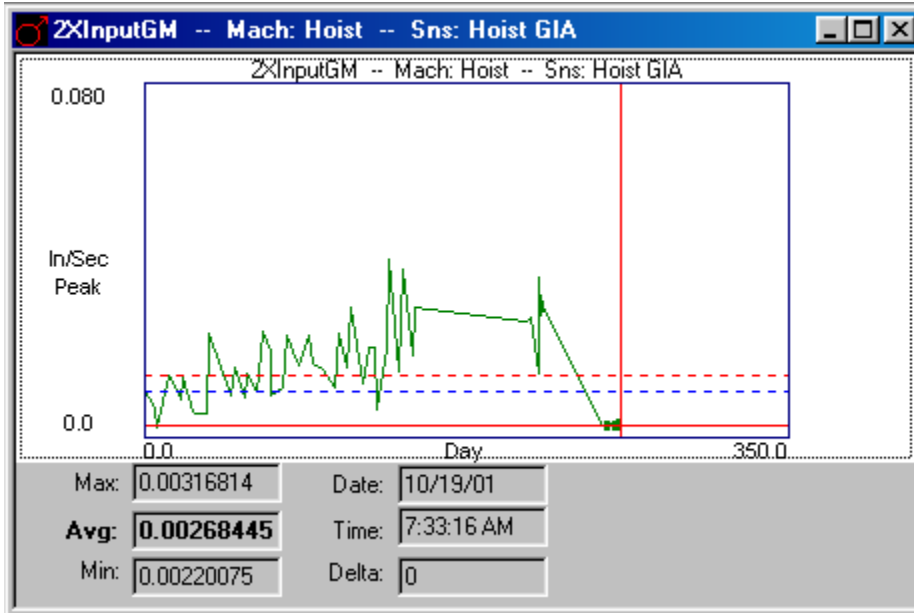


**Figure 5 Trend for 2X Input Shaft Gearmesh**

In early September 2001 we recommended to the plant to inspect/repair or replace the gearbox. The gearbox was replaced during a planned outage that took place between 9/7/01 and 10/8/01. Figures 6 and 7 show the trends for the same two analysis parameters with data through 10/19/01.



**Figure 6 Input Shaft Gearmesh**



**Figure 7 2X Input Gearmesh**

It is clear from these trends that the replacement of the gearbox reduced the vibration levels to the original levels. Subsequent inspection of the removed gearbox revealed a damaged bearing on the input shaft. The gearbox replacement took 4 days.