

Coal Crusher Vibration & Dynamic Forces Caused By Misalignment

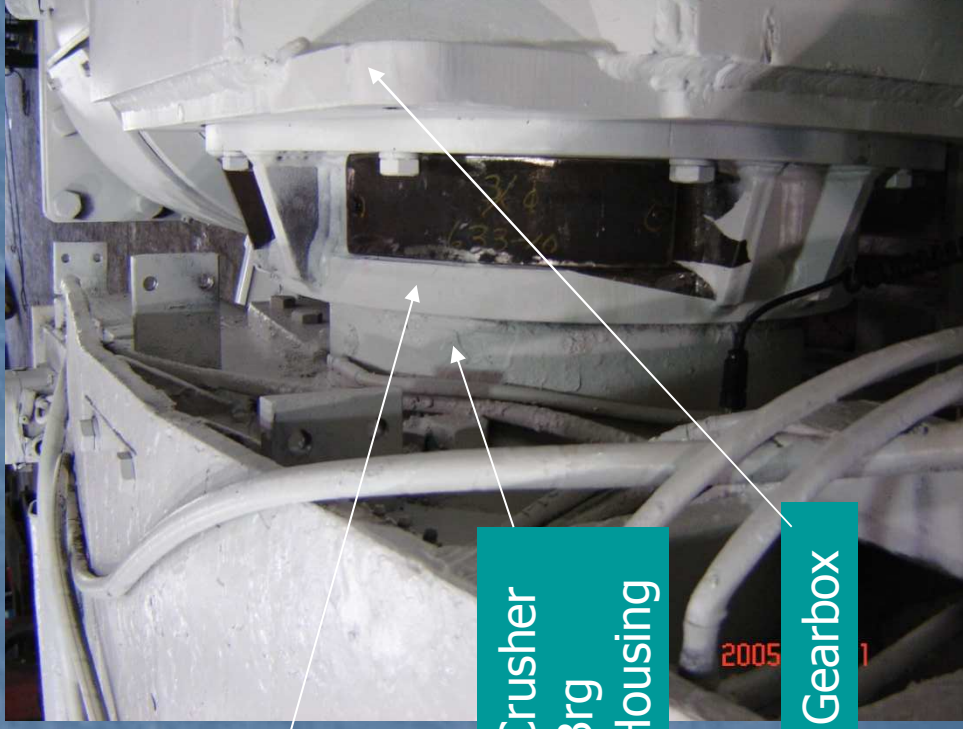
Vibration data and modal test data used to determine dynamic forces at motor outboard bearing housing before and after alignment of gearbox to crusher shaft.



Coal Crusher design supports a Gearbox & Motor from the Crusher Shaft IB Brg Housing. The gearbox output shaft is hollow with splines and slides over the crusher shaft.



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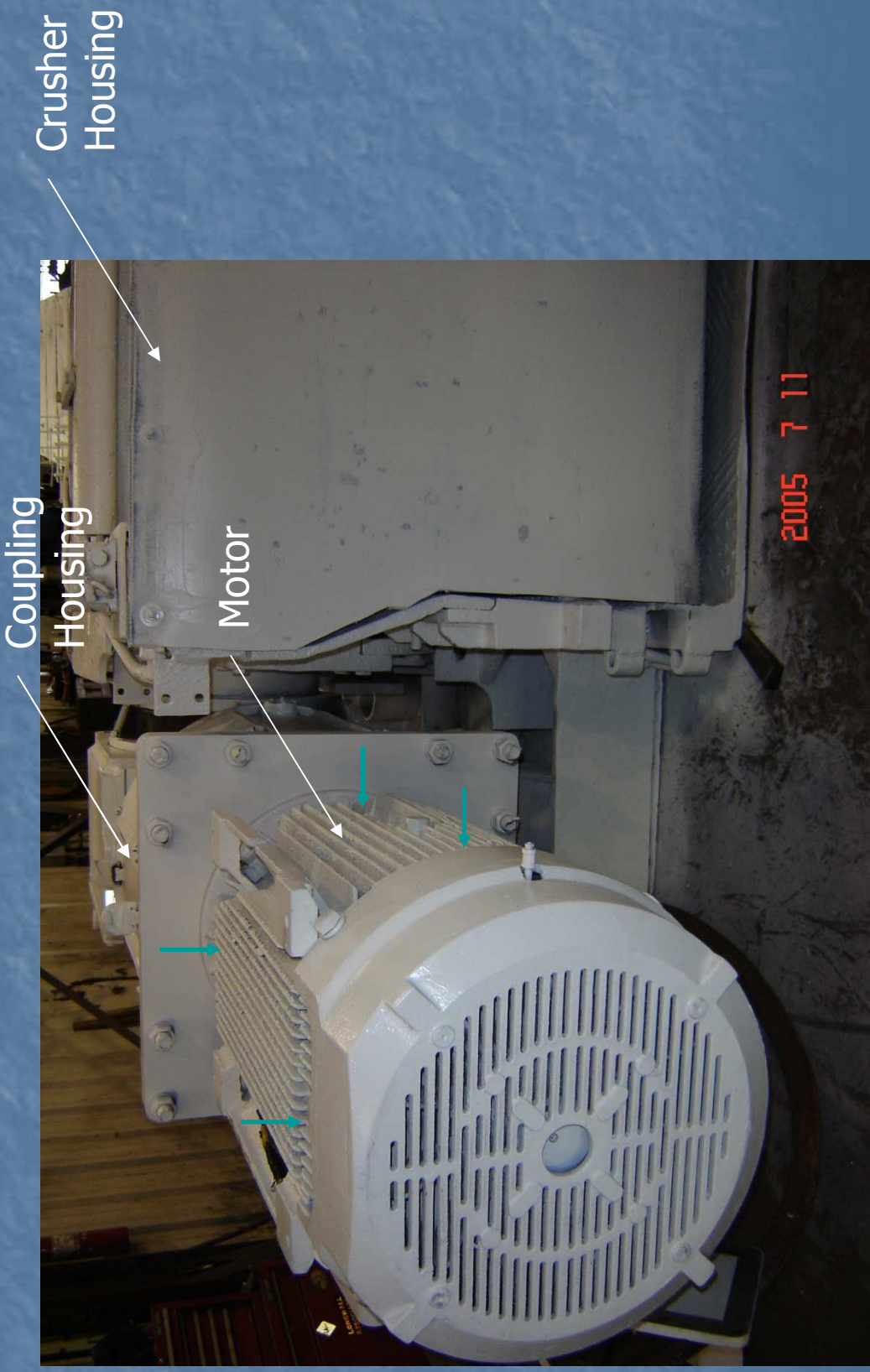


Adapter Housing Bolts Gearbox to Bearing Housing.

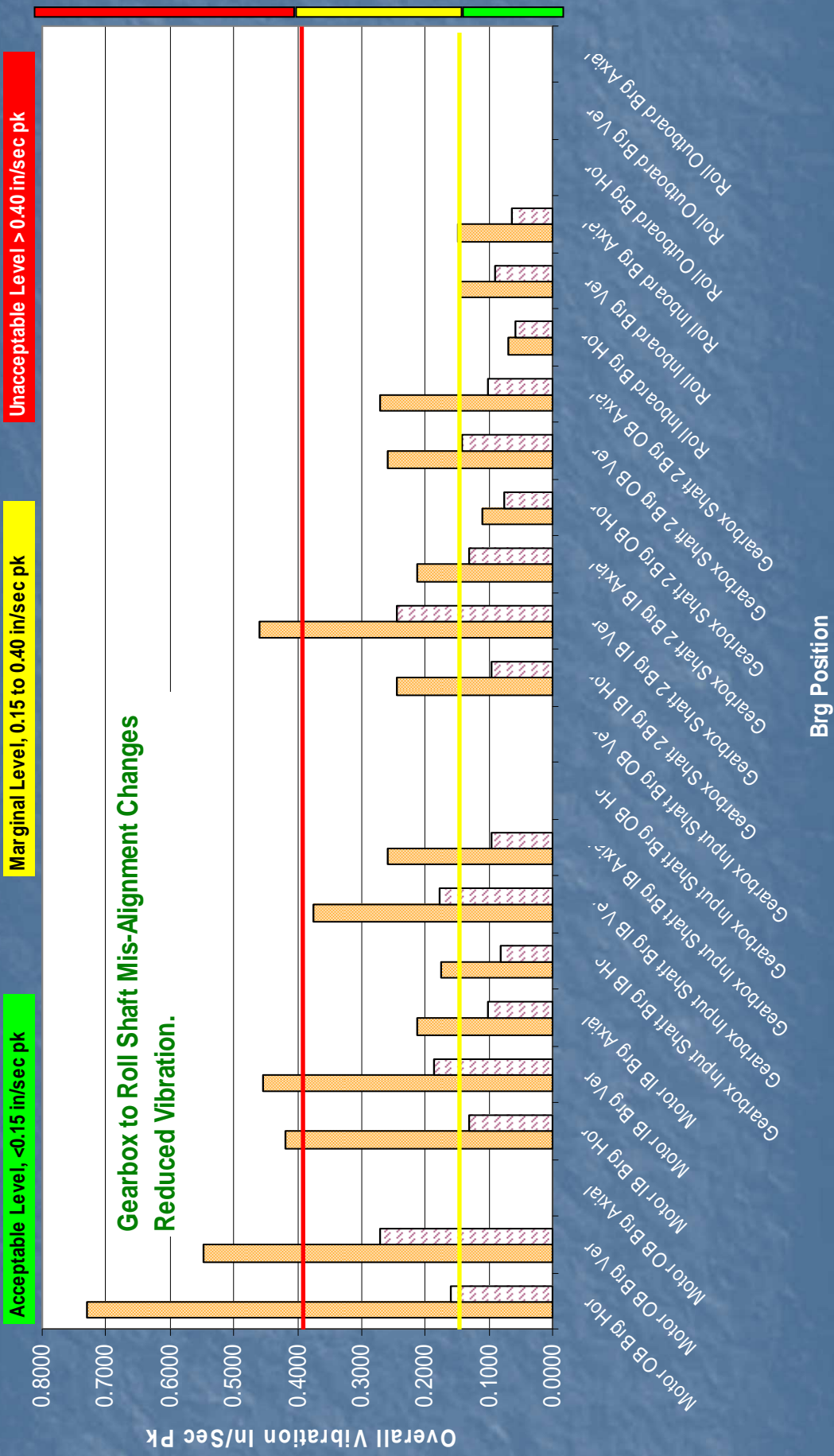
The power unit cantilevers the Motor, Fluid Coupling & Coupling Housing from the Gearbox. A Falk fluid coupling transfers power from the motor to the gearbox.



Vibration data were measured before alignment changes and then after each alignment adjustment. Final vibration levels were significantly lower.

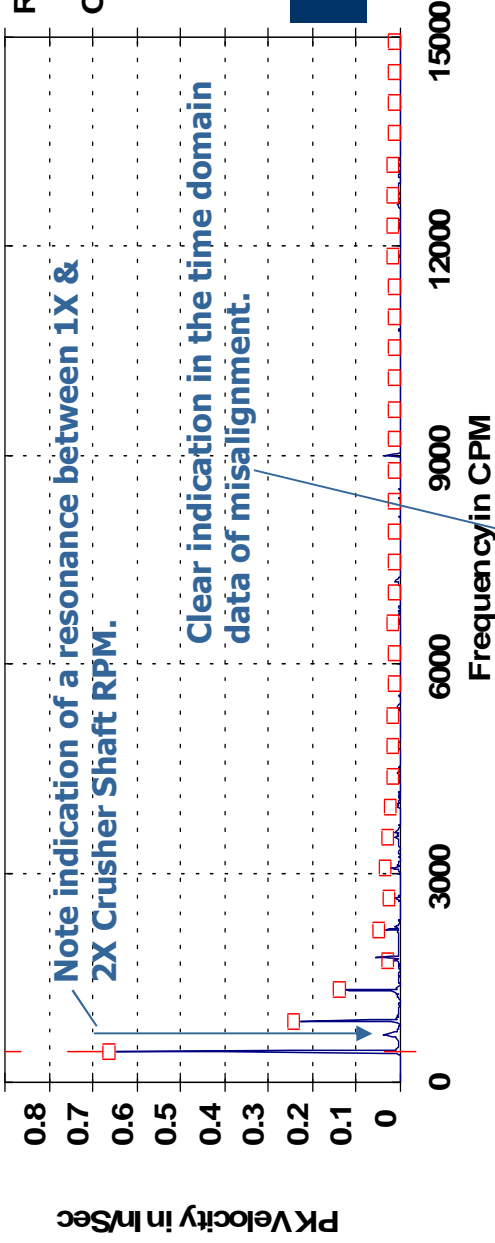


Coal Crusher



Jul 11 05 Initial Test
 Jul 11 05 Final Test

Mett - Louis Allis 300HP
3280547001-M1L Motor Outboard Horizontal Low



Before Alignment

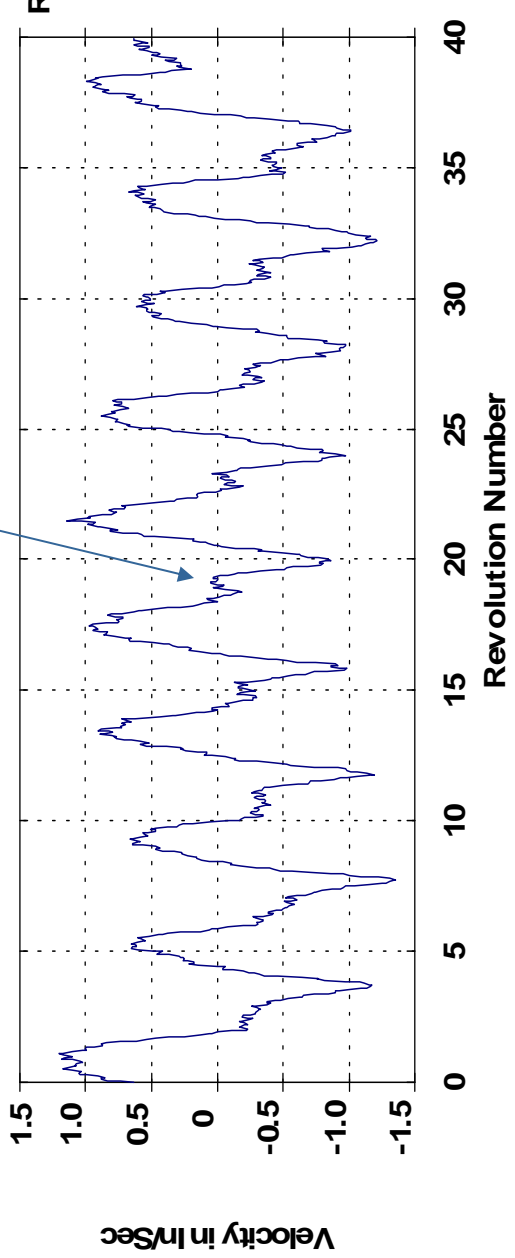
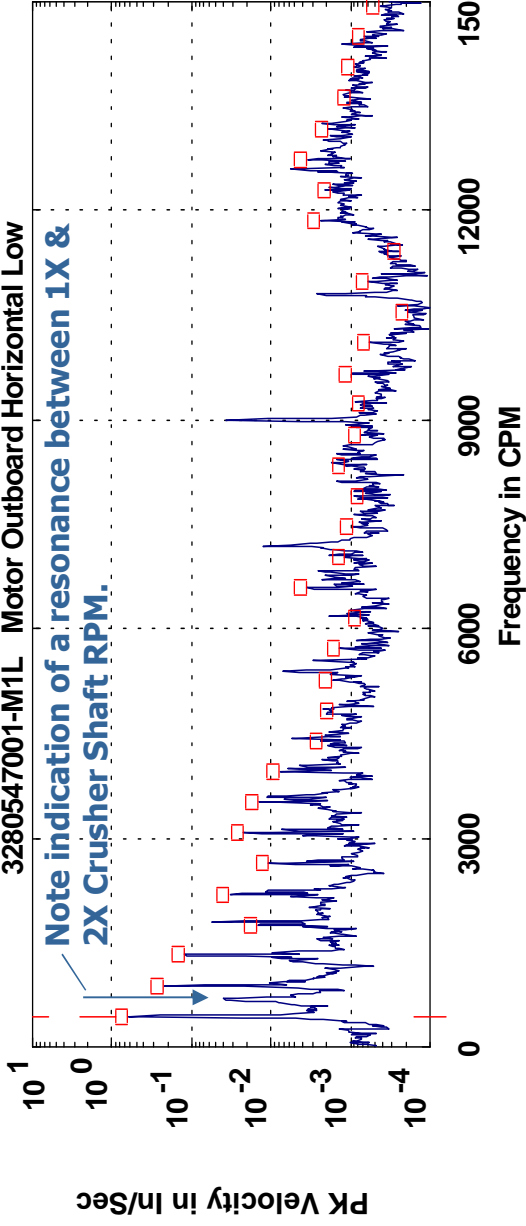


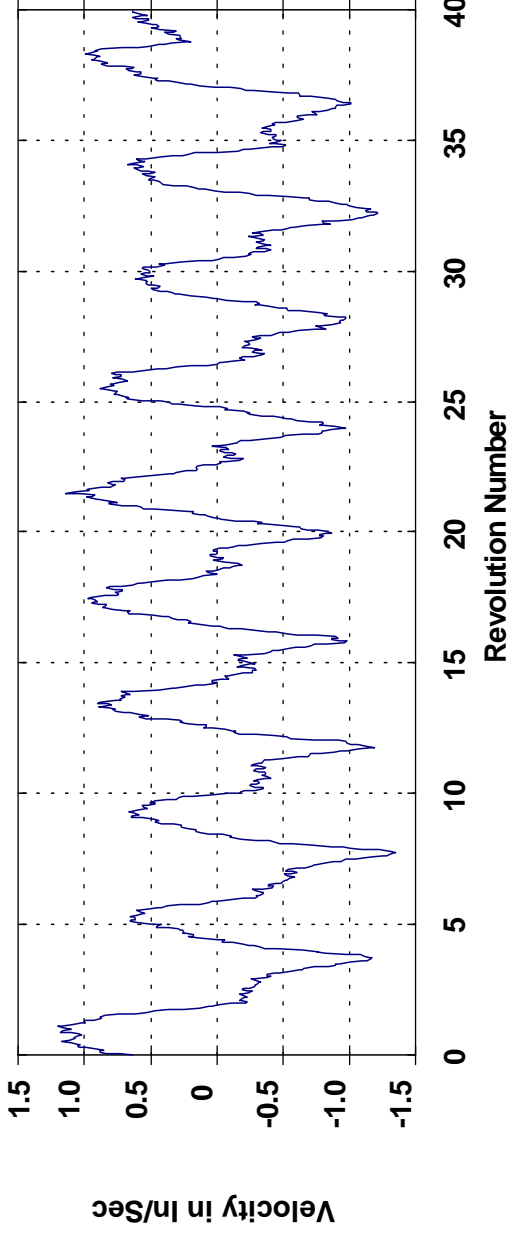
Figure . Vibration Data Measured During the Initial Run Test Before Alignment Changes. The Time Waveform Clearly Showed a "Bump" or Event Occurring at Two Times Each Revolution of the Gearbox Output Shaft.

Mett - Louis Allis 300HP

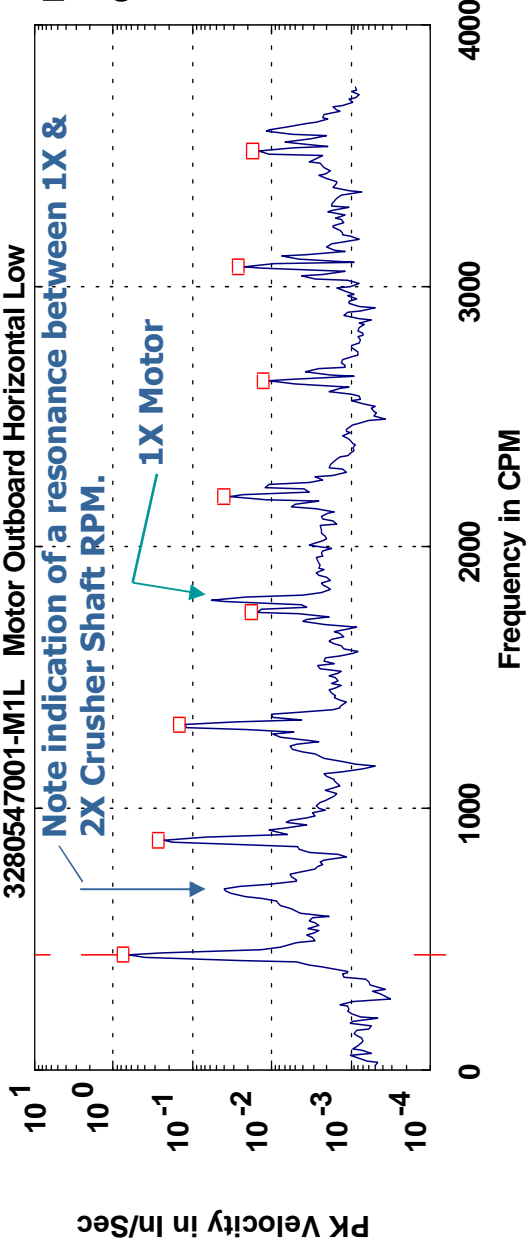
3280547001-M1L Motor Outboard Horizontal Low



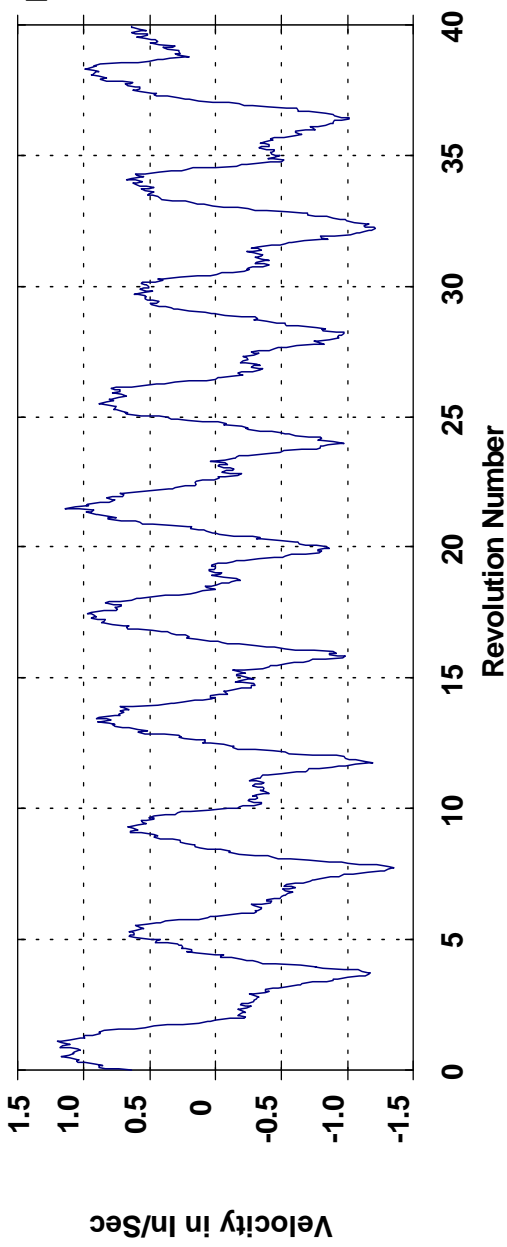
Plot Log Mag



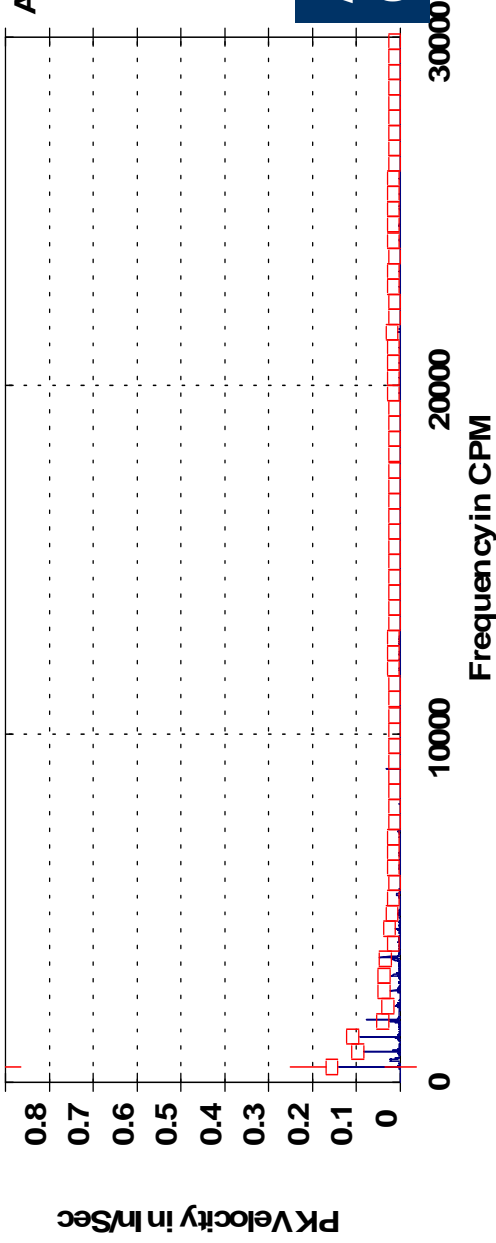
Mett - Louis Allis 300HP
3280547001-M1L Motor Outboard Horizontal Low



Expand to Display
4000 CPM Fmax



Mett - Louis Allis 300HP
3280547001-M1L Motor Outboard Horizontal Low



After Alignment
Changes

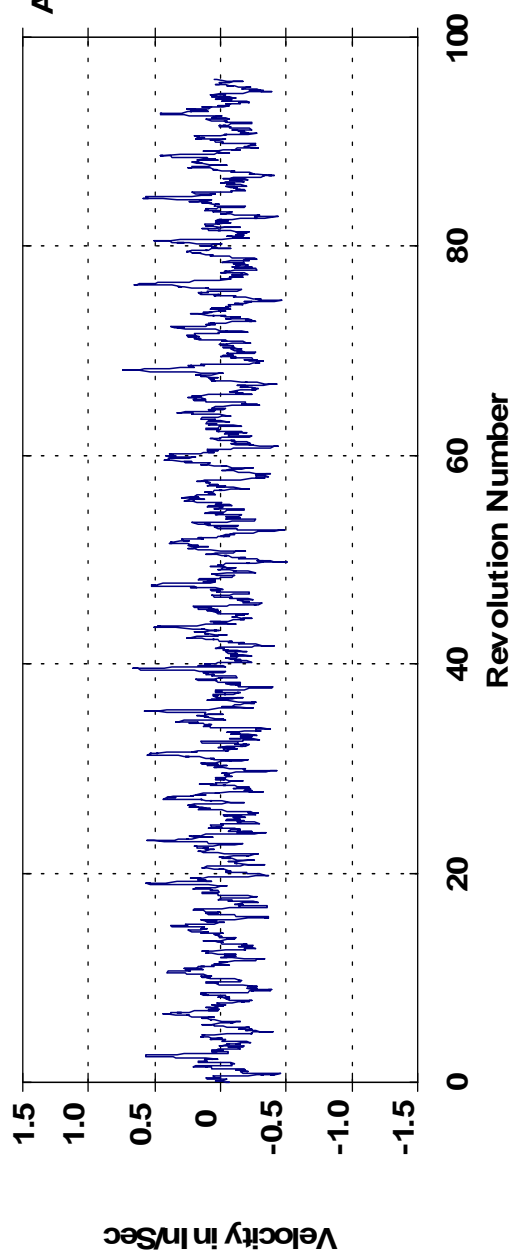
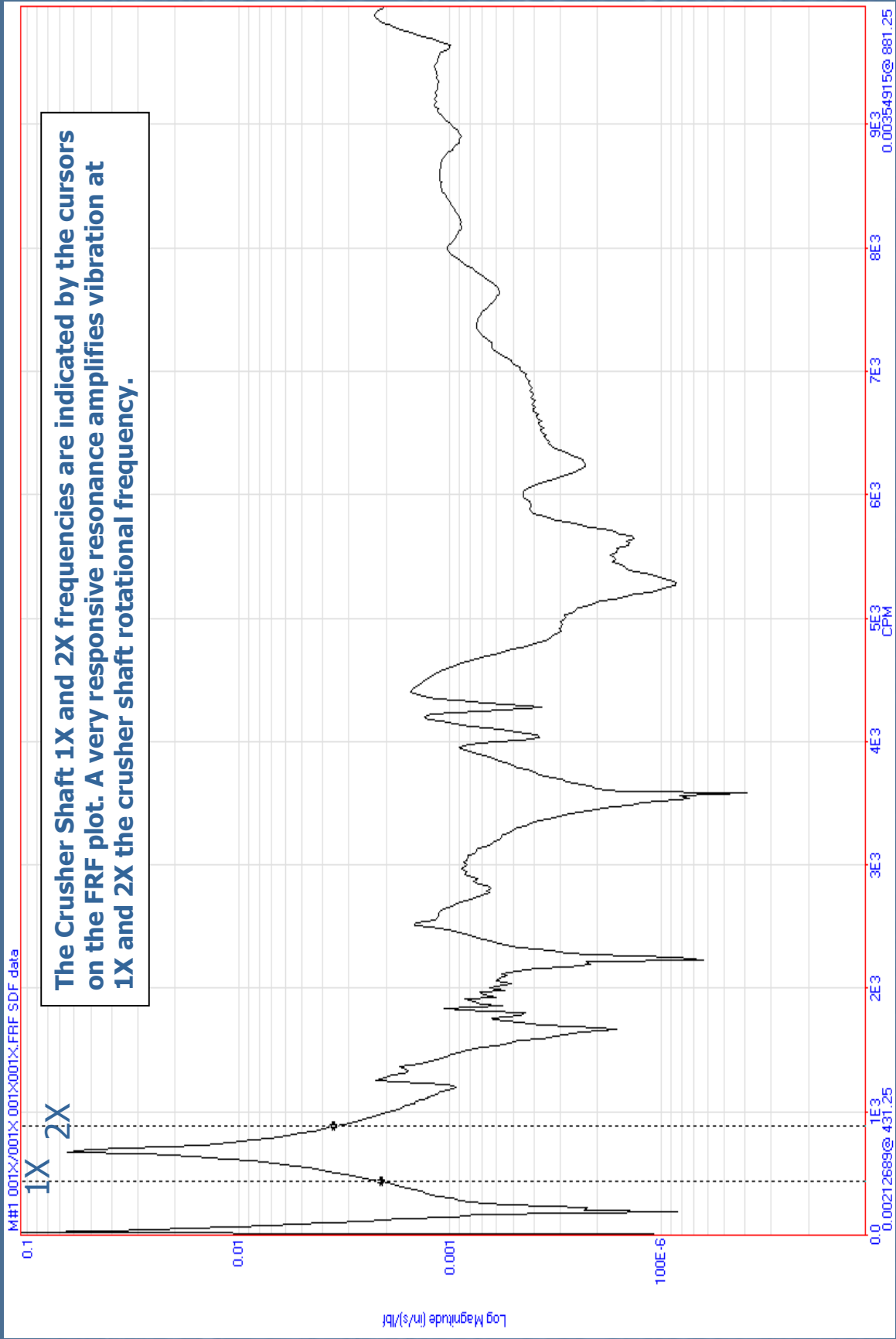


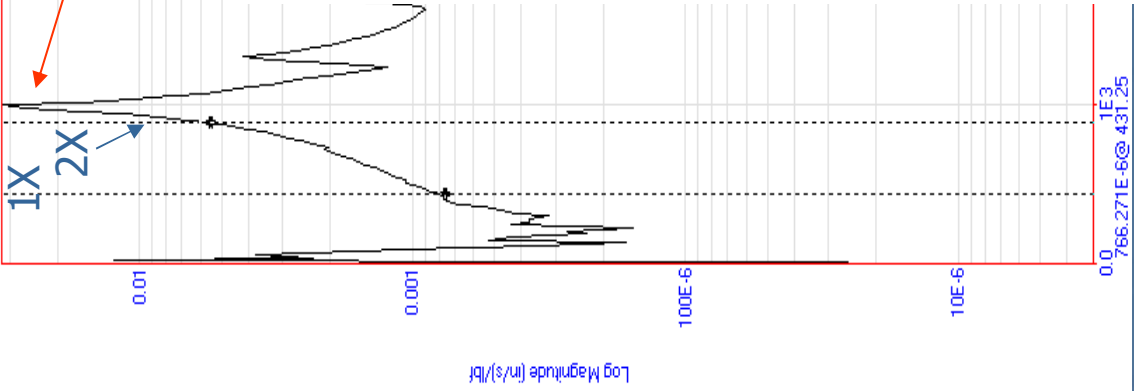
Figure . Vibration Data Measured During the Final Run Test After Alignment Changes.



The Crusher Shaft 1X and 2X frequencies are indicated by the cursors on the FRF plot. A very responsive resonance amplifies vibration at 1X and 2X the crusher shaft rotational frequency.

Figure . Impact Test of Motor Outboard Bearing Housing In the Horizontal Direction. The Units are In/Sec/Lbf.

MH2.001Z\001Z\001Z001X.FRF SDF data



The resonant frequency response is higher in the vertical direction and is also closer to 2X the Crusher Shaft rotational frequency thus causing greater amplification of vibration as shown in the spectrum.

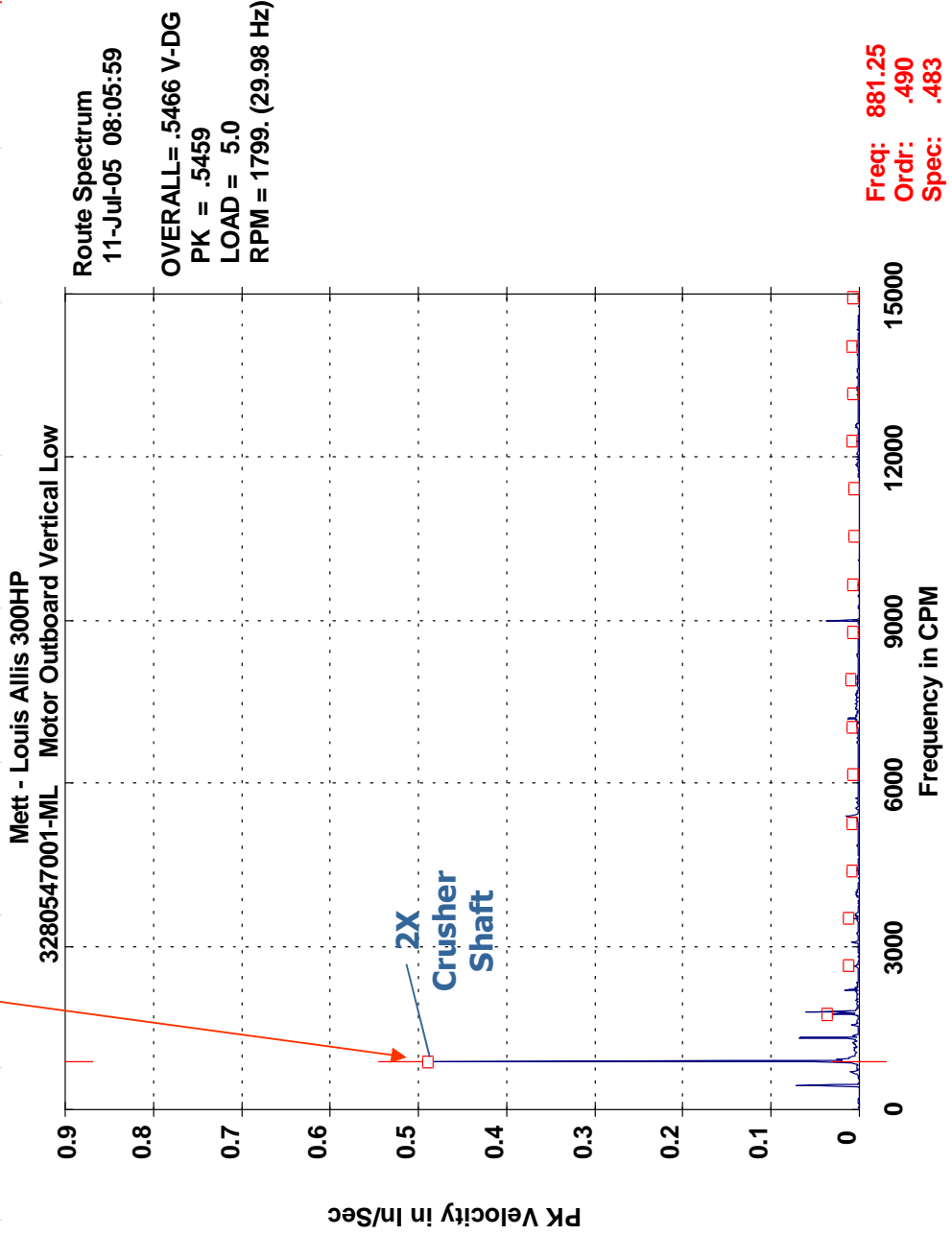


Figure . Impact Test of Motor

The dynamic force was calculated using the spectrum and FRF data as follows:

$$F_{Dynamic_{1X}} = \frac{1}{FRF_{ips/lb_f}} \times Vib_{ips} = \frac{1}{0.00212689_{ips/lb_f}} \times 0.649_{ips} = 305_{lb_f}$$

Based on the FRF Mobility measurement at the motor OB Brg Housing, 305lbf would be required to generate 0.649 ips vibration.

Our tests have shown that misalignment often will generate hundreds of lb_f. These forces are generally much higher than would be expected from rotor unbalance.

	Before Alignment		After Alignment		Dynamic Force Reduction lbf
	Vib in/sec pk	Force lbf	Vib in/sec pk	Force lbf	
Motor OB Hor					
1X Gearbox Output Frequency 440 CPM	0.649	305	0.144	67	238
2X Gearbox Output Frequency 880 CPM	0.231	66	0.034	9.7	56.3
Motor OB Ver					
1X Gearbox Output Frequency 440 CPM	0.073	95	0.025	32.6	62.4
2X Gearbox Output Frequency 880 CPM	0.483	87.8	0.189	34.4	53.4

Table 1: Comparison of vibration and force levels after alignment of the gearbox and bearing housing.

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Vibration & Dynamic Force @ 1X Crusher Shaft Before Alignment & After Alignment Changes

.025 in/sec pk 32.6 lbf
.073 in/sec pk 95 lbf



Vibration & Dynamic Force @ 2X Crusher Shaft Before Alignment & After Alignment Changes



The End