ALL-TEST Pro
Case Study 2004-003

ALL-TEST *PRO*™ OL

Motor Current Signature Analysis on DC Motor

Introduction

Evaluation of a 10 HP, 1.0 SF, Ins F, 1750 RPM, 240 V, 33 Amp armature, 240 V, 1.23 Amp field, DC electric motor from the output of the DC Drive. A DC Drive fault and poor brush condition were indicated.

Discussion

When testing a DC electric motor with the ALL-TEST *PRO*™ OL (ATPOL) motor current signature analyzer, it is recommended that the AT6000 DC Clamp is used for analysis. Data is collected directly from the armature leads.

Figure 1: Running Speed

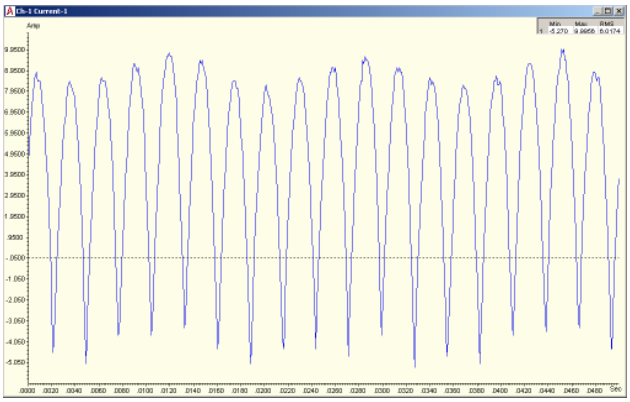


Figure 2: Current 'Ripple' Waveform

Running speed is selected and current ripple viewed. Variations in the current ripple waveform indicate drive problems which can be confirmed as harmonics of supply line frequency and the number of SCR's times the supply line frequency (Figure 4).

The signatures, Figure 1 and Figure 3, indicate power electronic and brush-related problems.

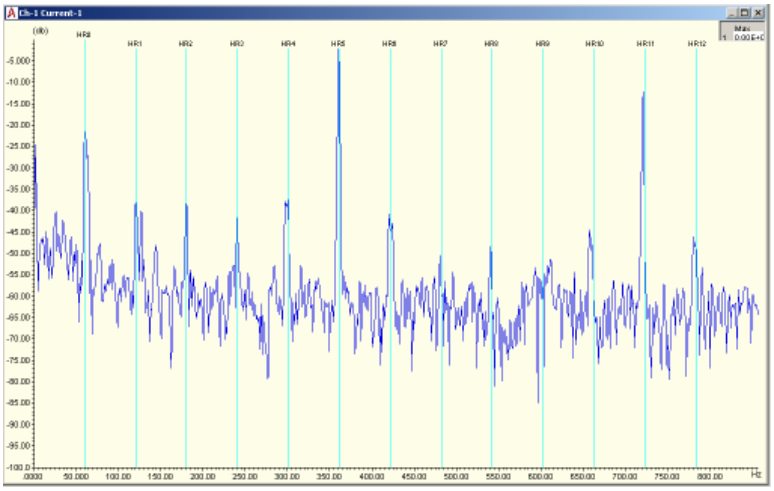
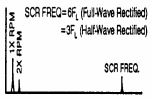
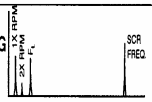
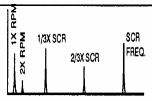
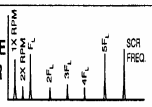
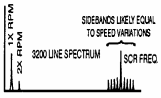
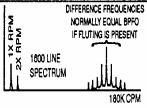


Figure 3: Harmonics of Line Frequency and DC Supply
also, low frequency 'raised noise' indicating brush problems

TABLE I
ILLUSTRATED VIBRATION DIAGNOSTIC CHART

PROBLEM SOURCE	TYPICAL SPECTRUM	REMARKS
DC MOTORS AND CONTROLS **A. NORMAL SPECTRUM**		Many DC Motor and Control Problems can be detected by vibration analysis. Full-wave rectified, motors (6 SCR's) generate a signal at 6X Line Frequency (6F_L=360 Hz=21,600 CPM); while half-wave rectified DC motors (3 SCR's) generate 3X Line Freq. (3F_L=180 Hz=10,800 CPM). The SCR firing Frequency is normally present in a DC Motor Spectrum, but at low amplitude. Note the absence of other peaks at multiples of F_L.
B. BROKEN ARMATURE WINDINGS, GROUNDING PROBLEMS OR FAULTY SYSTEM TUNING		When DC Motor spectra are dominated by high levels at SCR or 2X SCR, this normally indicates either Broken Motor Windings or Faulty Tuning of the Electrical Control System. Proper tuning alone can lower vibration at SCR and 2X SCR significantly if control problems predominate. High amplitudes at these frequencies would normally be above approximately .10 in/sec. peak at 1 X SCR and about .02 in/sec at 2 X SCR Firing Freq.
C. FAULTY FIRING CARD OR BLOWN FUSE		When one firing card fails to fire, then 1/3 of power is lost, and can cause repeated momentary speed changes in the motor. This can lead to high amplitudes at 1/3X and 2/3X SCR Frequency (1/3X SCR Freq. = 1X F_L for half-wave rectified, but 2X F_L for a full-wave rectified SCR). Caution: Card/SCR configuration should be known before troubleshooting motor (#SCR's, #Firing Cards, etc.).
D. FAULTY SCR, SHORTED CONTROL CARD, LOOSE CONNECTIONS AND/OR BLOWN FUSE		Faulty SCR's, Shorted Control Cards and/or Loose Connections can generate noticeable amplitude peaks at many combinations of line frequency (F_L) and SCR firing frequency. Normally, 1 bad SCR can cause high levels at F_L and/or 5F_L in 6 SCR motors. The point to be made is that neither F_L, $2F_L$, $4F_L$ nor 5F_L should be present in DC Motor spectra.
E. FAULTY COMPARITOR CARD		Faulty Comparitor Cards cause problems with RPM fluctuation or 'hunting'. This causes a constant collapsing and regenerating of the magnetic field. These sidebands often approximate the RPM fluctuation and require a high resolution FFT to even detect them. Such sidebands could also be due to generation and regeneration of the magnetic field.
F. ELECTRICAL CURRENT PASSAGE THRU DC MOTOR BEARINGS		Electrically-induced Fluting is normally detected by a series of difference frequencies with the spacing most often at the outer race defect frequency (BPFO), even if such fluting is present on both the outer and inner races. They most often show up in a range centered at about 100,000 to 150,000 CPM. A 180K CPM spectrum with 1600 lines is recommended for detection with measurements on both the OB and IB DC motor bearings.

ALL-TEST *PRO*™ MD Kit

The ALL-TEST *PRO*™ MD kit consists of:

- ALL-TEST *PRO*™ OL motor current signature analyzer
- ALL-TEST *PRO*™ 31 and ALL-TEST IV *PRO*™ 2000 motor circuit analyzers
- EMCAT motor management software
- ATPOL and Power System Manager software modules for EMCAT