REV A.1

CMCP810S SERIES RUNOUT KIT

INSTRUCTION MANUAL

About the Runout Kit

The CMCP810S Series Electrical Runout Kit uses industry standard sensors to detect and locate areas of high electrical runout. Electrical runout must be minimized to allow eddy current probes to work properly while the machine is in operation. The kit combines the typical industrial sensors normally used for permanent vibration detection in order to allow for in shop detection of electrical runout using the supplied oscilloscope. Electrical runout can be detected and recorded using the waveform function and then processed for reporting using the PicoScope software.

The Basics of an Eddy Current Probe Signal

An Eddy Current Probe is a non-contact sensor capable of the measuring the position of a ferrous material with high resolution. The output of the probe can be viewed as a waveform showing the motion towards and away from the probe.
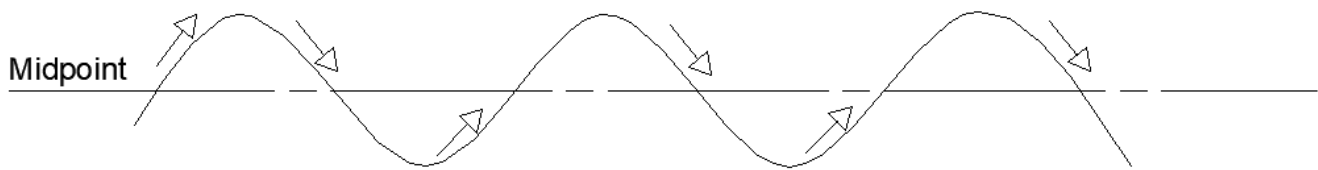
In order to display a positive and negative going signal in electronics an offset voltage must be provided to allow the voltage signal to swing up and down. To do this the eddy probe driver creates a DC offset voltage for the AC voltage signal to ride on. The DC voltage is referred to as the "gap" voltage and is typically set to -12VDC. Since most modern oscilloscopes only allow for up to a 5VDC offset a bucking circuit must be used to move the -12VDC offset to within the oscilloscopes measurement range.

About the Sensor Interface Module (SIM)

The CMCP810SIM **S**ensor **I**nterface **M**odule provides a single access point for the sensors and oscilloscope, eliminating the need of having dual power supplies and a mix of wiring in between. An internal lithium-ion battery provides -24VDC for the Eddy Current Probe and +15VDC for the Phase sensor. The battery can be recharged using the charger provided with the CMCP810SIM module. Spare batteries may also be purchased. The main purpose of the Sensor Interface Module is the bucking amplifier capabilities. The CMCP810SIM is capable of removing the entire DC offset so that only the AC signal is viewable on the oscilloscope.

Front Panel

The front of the CMCP810SIM module features a On/Off switch with an LED On indicator, Voltage Adjust knob and two BNC connectors for the signal outputs. Once the sensors and oscilloscope are connected, the Voltage Adjust knob can be set so that the Eddy Current Probes signal is within the oscilloscopes viewing range.

Rear Panel

The back side of the CMCP810SIM module features the Phase and Eddy Probe sensor inputs and battery charger socket. A 3-wire adapter is provided to allow the CMCP810SIM to connect to the Eddy Probe Driver's wire terminals.

About the Sensors

Eddy Current Probe (AKA Proximity Probe):

The supplied Eddy Current Probe is the same type of sensor normally permanently installed to measure vibration. This model sensor provides a 200mV output per mil (0.001") of electrical runout on a 4140 series shaft. An Eddy Current Probe is -24VDC powered and power is provided from the Sensor Input Module (SIM) provided with the kit. To learn more about how Eddy Probes operate see our application note on Radial Vibration in the Knowledge Base section on our website.
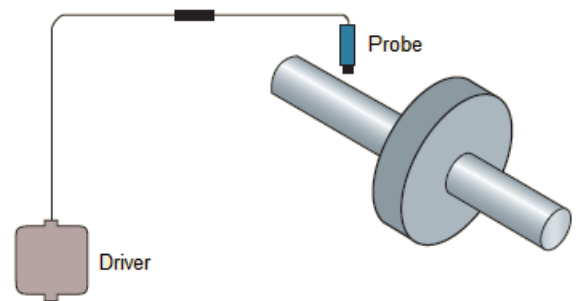
Optical Sensor (Phase Sensor):

The optical reference sensor included with the CMCP810S Runout Kit provides a phase (location) reference to the electrical runout. The optical sensor is +15VDC powered and provides a 5VDC pulse when a reflective material passes in front of the sensor. The +15VDC power is provided by the Sensor Interface Module (SIM). A green LED on the back of the sensor will light up when the reflective surface passes in front of the sensor. The oscilloscope should be setup so that at least one revolution of the shaft is displayed on the oscilloscope screen while the shaft is turning. This will allow the operator to see the area of the high electrical runout.

Sensor Mounting Options:

The CMCP810S Kit comes with 2 sensor mounting options, the adjustable magnetic arm holders and custom vice grips. The holders can be used with either sensor and in any orientation that allows the sensors to sit securely above the target positions. It is important that the proximity probe does not move during the measurement process!

Sensor Placement

Eddy Current Probe (Runout):

The Eddy Current Probe should be installed in one of the supplied holders and positioned above the burnished area of the shaft or where specified in the shop drawings. The probe requires a gap between the shaft and the probe tip in order for it to operate correctly. The gap should be set so that the Eddy Probe driver outputs roughly -12VDC, or 60 mils. To measure the gap voltage with the PicoScope simply select DC Voltage as the sensor input. After gapping the probe be sure to change the PicoScope to measure AC Voltage. During runout measurements, the Eddy Current Probe should be set to Channel 1, also known as Channel A, which is displayed on Trace A in the PicoScope software.

Optical Sensor (Phase):

The optical sensor should be installed in one of the supplied holders and positioned near the Eddy Current Probe. A 1" piece of the supplied reflective tape needs to be placed on the shaft below the sensor. The gap between the optical sensor and the reflective tape can be up to 6". A visible laser will help align the probes top with the reflective tape. To verify that the sensor is sensing the reflective tape rotate the shaft and visually inspect that the green light on the back of the optical sensor flickers once per revolution. During the runout measurement the optical sensor should be set to Channel 2, also known as Channel B, which is displayed on Trace B in the PicoScope software

PicoScope Settings:

Note: Prior to being used, the PicoScope settings must be configured to operate with the supplied runout sensors. The settings should be verified every time program is opened. Familiarity with the operation of the PicoScope and PicoScope Software is necessary, refer to the PicoScope operators training manual for more information.

General Setup (First Measurement)

Note: For the purposes of measuring runout Channel A, also referred to as Channel 1, is used with the Eddy Current Probe for taking the electrical runout measurements. Channel B, also referred to as Channel 2, is used with the optical sensor to show phase (location) relative to the runout. Follow the cable connection guide at the back of this manual to get started.

Making the Runout Measurement:

In order to collect the runout measurement the shaft needs to be rotated on shaft support blocks either by hand or by motor at a slow and constant speed. The following guide can be used as a basis for setting up the PicoScope software to for measuring runout.

Phase Probe Setup (Channel B)

1. Install optical sensor in tool holder and place within 12" of the shaft.
2. Connect optical sensor cable to CMCP810SIM "Phase Probe Input" jack.
3. Connect a BNC cable from the "Phase Signal Out" connector on the CMCP810SIM to Channel B on the PicoScope.
4. Power on CMCP810SIM
5. Place a small piece reflective tape, approximately 1" wide, on shaft where the optical sensors red beam indicates.
6. Rotate shaft and verify green LED blinks on the back of the optical sensor when the reflective tape passes in front of it.
7. If the green LED does not blink, adjust optical sensor so red beam passes across reflective tape.
8. Open the PicoScope software and set Channel B for ±5V resolution and DC coupling. The PicoScope software should show a pulse each time the reflective tape passes in front of the optical sensor.
9. If needed, adjust the time base so that at least two pulses show on the screen.
10. The area between two pulses is a single shaft revolution.
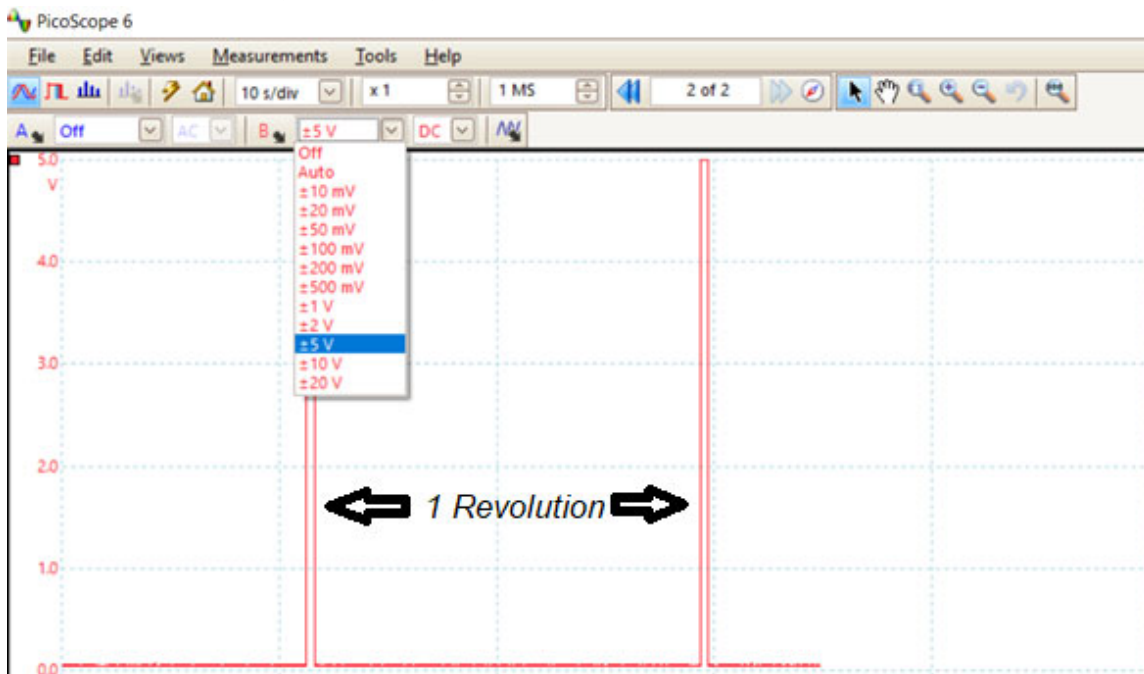
Runout Probe Setup (Channel A)

1. Install the eddy current probe into the tool holder.
2. Connect the 3 pin wire harness to the eddy probe driver.
   White Wire to OUT (signal output)
   Black Wire to COM (0V)
   Red Wire to -Vt (-24VDC power in)
3. Connect the eddy probe cable to the driver.
4. Connect a BNC cable from the "Runout Signal Out" connector on the CMCP810SIM to Channel A on the PicoScope.
5. Using the plastic feeler gauges set the eddy probe so that the tip of the probe is 60 mils (0.06") away from the shaft surface. Tighten the tool holder so that the probe does not move and remove the feeler gauges.
   A 60 mil gap will provide roughly a -12VDC gap voltage when checked with a voltmeter.
6. Open the PicoScope software and set Channel A for ±200mV resolution and AC coupling
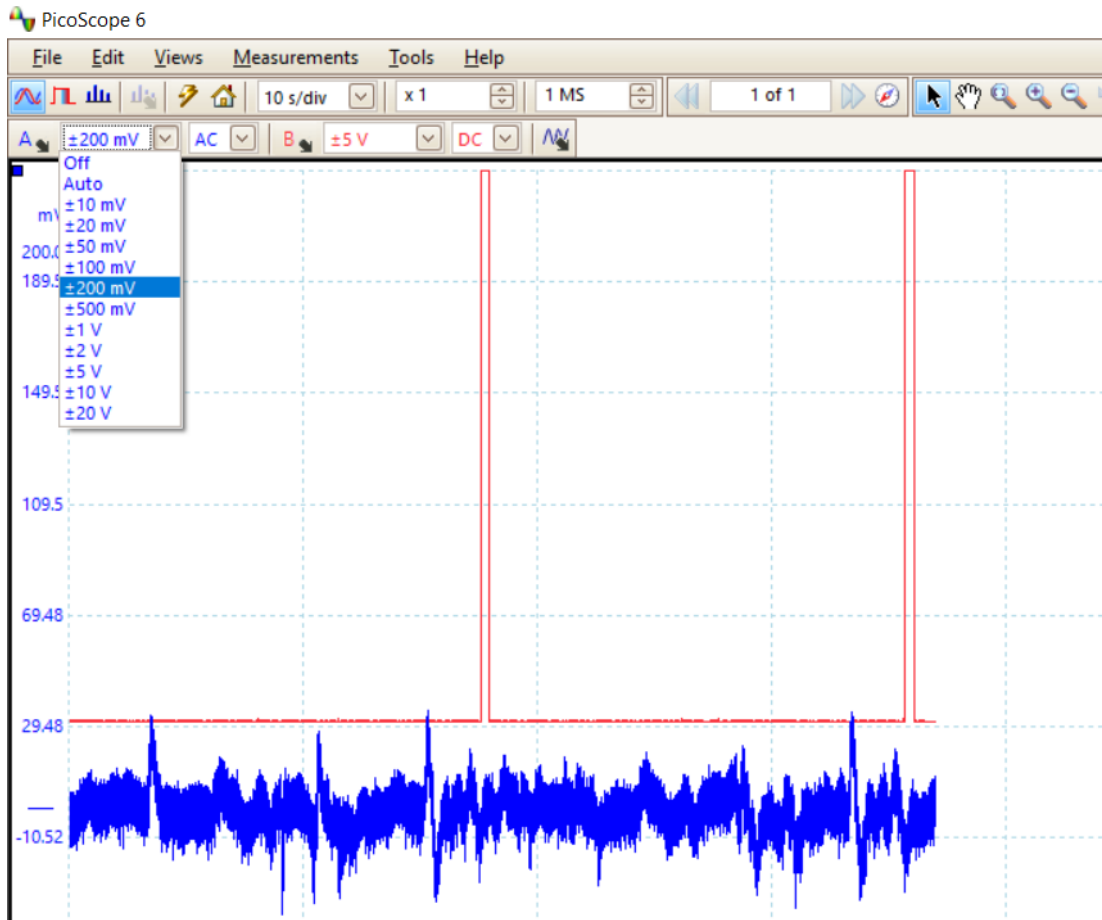
Obtaining a Runout Measurement

1. Adjust the time base until at least two pulses show on the screen
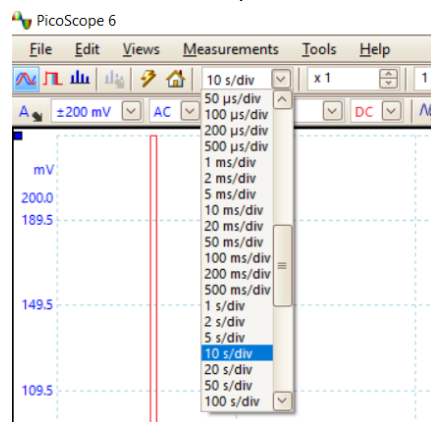
2. The blue trace shown in the application is the runout signal. The runout signal must be measured in between on shaft revolution.

3. Once a full shaft revolution appears on the screen click the Stop Sign in the lower left corner to freeze the measurement.
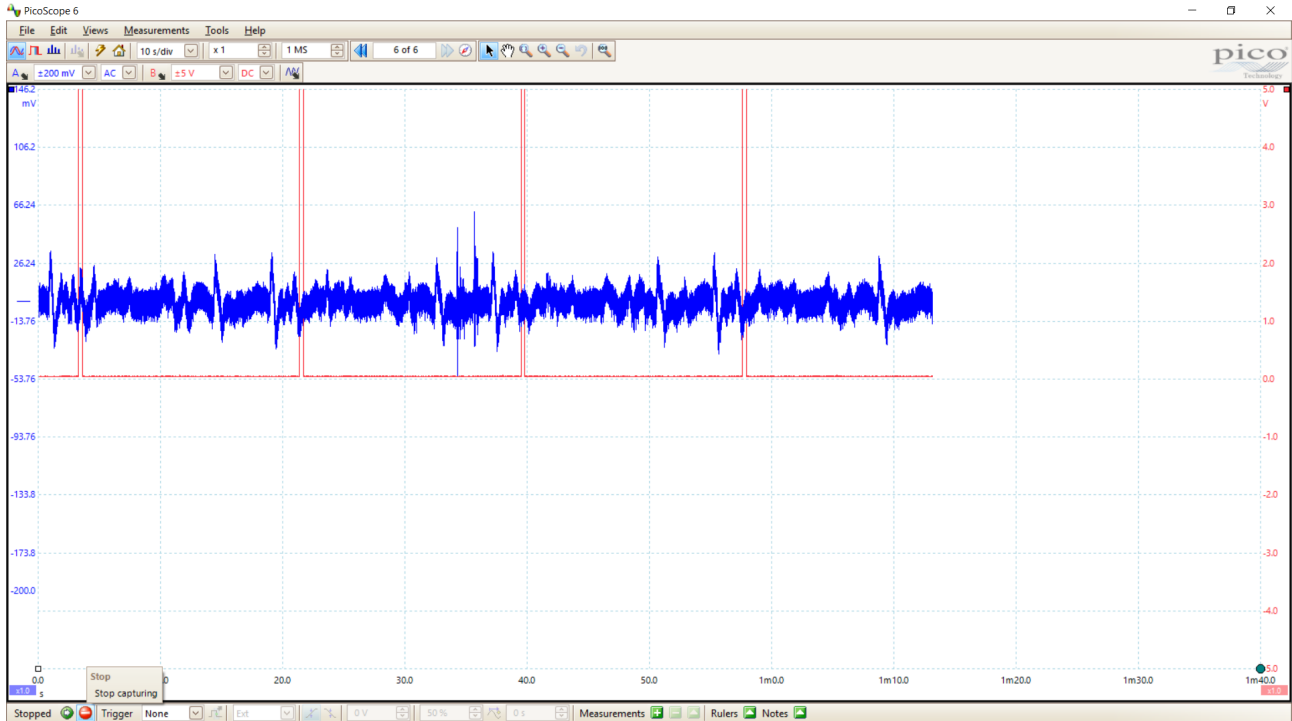

4. Select the blue curser blocks at the top of the screen and position them at the lowest and highest peaks in between a single shaft revolution.
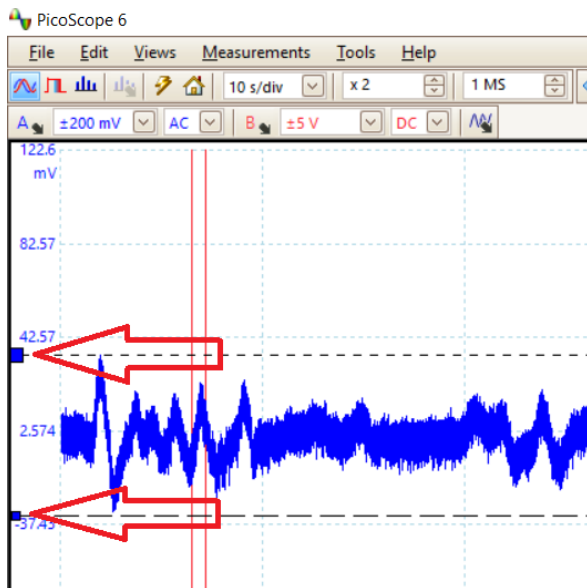
5. After the cursors have been placed at the top and bottom of the runout signal, the PicoScope will calculate the total amplitude between the two lines and display it in a popup dialog box. The dialog box will show the amplitude of the lowest and highest peak along with the total Peak to Peak value. Electrical runout is defined as the total Peak to Peak value in a single shaft revolution.

6. To calculate to total amount of runout divide the PicoScope' s reading by the output calibration of the probe. See the section on probe calibration for additional information.

    Ex.   PicoScope Reads 68.64
            68.64÷200 = 0.3432 mils of electrical runout
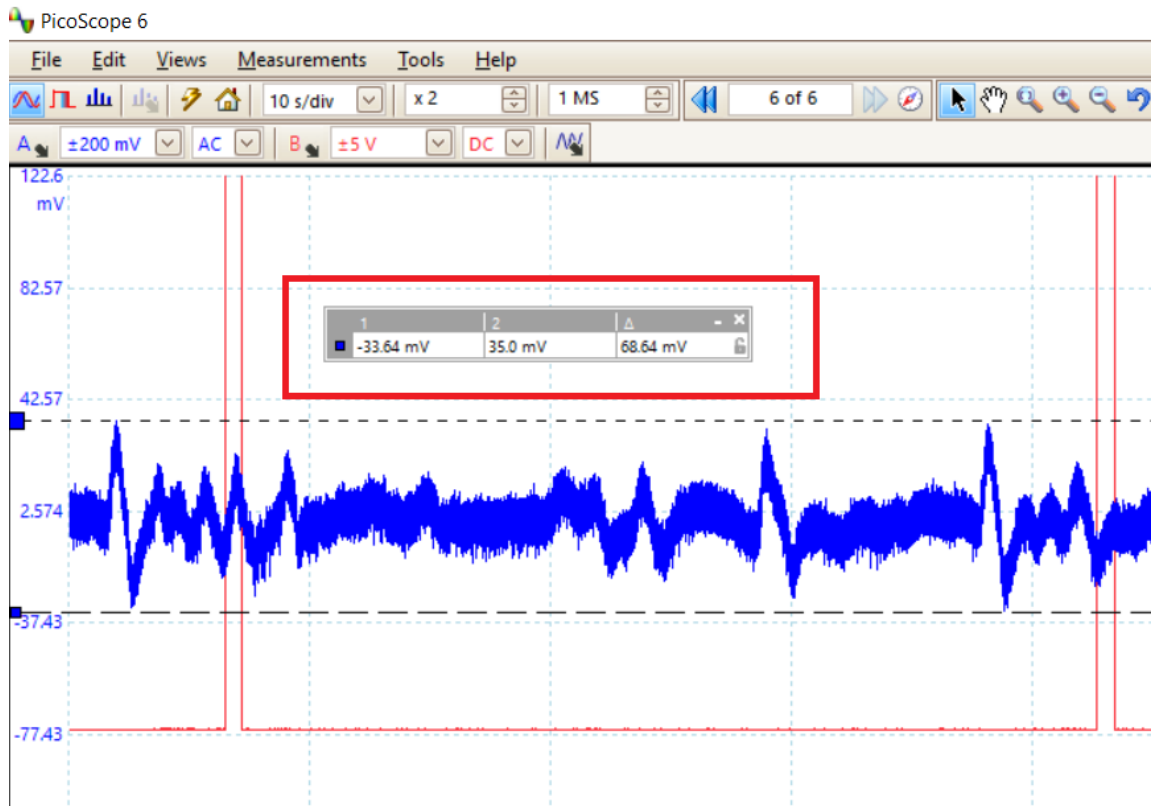
7. The measurement can now be saved and imported into the Electrical Runout Report spreadsheet provided by STI, sample provided at the back of this manual.

API 670 on Runout:

"The combined total electrical and mechanical runout does not exceed 25 percent of the maximum allowed peak to peak vibration amplitude or 0.25 mil (6 micrometers), whichever is greater. The shaft surface finish should be from 16 to 32 micro inches (0.4 to 0.8 micrometers) root mean square."

Runout Reduction:

Diamond Burnishing

A diamond burnishing tool is used to work the shaft surface into a uniform finish.

Degaussing

Residual magnetism in a shaft can cause major electrical runout and can cause unstable runout readings. It is necessary to measure the magnetism to ensure that it is not over 2.0 gauss or if the area has variations over 1.0 gauss. If either is found the shaft should be degaussed. The CMCP810 Series Runout Kit can be supplied with the optional Gauss Meter.

Further Machining

If the amount of runout cannot be reduced with a diamond burnishing tool then the target area can be reground.

Polishing

Similar to diamond burnishing but not as highly effective.

Eddy Current Probe Sensitivity with Alternate Materials:

All standard eddy current probes are calibrated to 4140 series steel. When measurements need to be taken on different shaft materials the true eddy current probe sensitivity needs to be known in order to calculate the proper electrical runout reading. To measure the probes sensitivity with specific materials follow the steps below.

Step 1:

Using plastic feeler gauges, or other non-metallic materials, place a 60 mil thick piece of material between the probe tip and the shaft and measure the millivolt output from the driver. Record this voltage.

Step 2:

Add a 10 mil thick piece of material on top of the 60 mil piece and measure the output driver. Record this voltage.
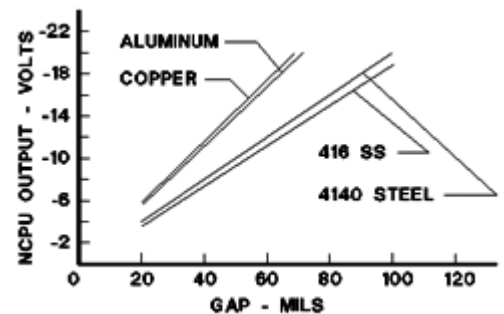
Step 3:

Add a 5 mil thick piece of material on top of the 60 mil and 10 mil pieces and measure the output from the driver. Record this voltage.


Step 4:

Take the total measurement in millivolts (mV) and divide by 15. This is the probes sensitivity to be used for calculating the total runout with that specific material.

Ex.   15 mils = 1350mV

1350 ÷ 15 = 90 mV/mil

Eddy Current Probe Conformance Check:

All Eddy Current Systems (Probe, Cable and Driver) should be tested periodically to ensure the probe is operating within its specified range. This can be done by using a CMCP610 Static Calibrator (sold separately), -24 VDC Power Supply and a Digital Volt Meter. The Probe is installed in the tester with the target set against the Probe tip. The micrometer with target attached is then rotated away from the Probe in 0.005" or 5 mil increments. The voltage reading is recorded and graphed at each increment.

Eddy Probe Graph
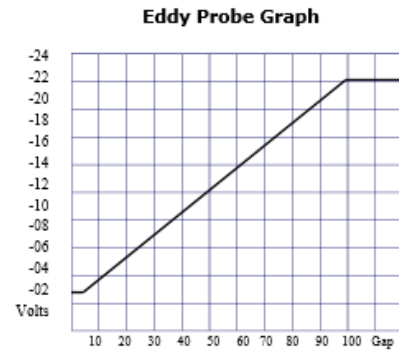
If you have any question or require technical support please feel free to contact our technical services group.

STI Vibration Monitoring Inc.
League City, Texas USA
Tel.: 281.334.0766
Fax: 281.334.4255

Tech Support email: mhoward@stiweb.com

Electrical Runout Report

Report Data:
Client:
Location:
Sales Order:
Report Date:
Technician:

Material Information:
Material ID: 416
Location 1: 6.5" from IB Tip

Shaft Diameter: 3.5"
SRS:

Test Results:

Probe Sensitivity:	198.38	mv/mil
Location 1 Total ERO:	0.3428	mils
Pass/Fail:	Fail	

ERO Probe Calibration

Material Type: 4140

Range in Mils	Voltage	Deviation from a Straight Line (-0.2 to 0.2)	5% of 200 mv/mil (0.95 to 1.05)
0	1.37	-2.41	NA
5	1.37	-1.41	0.00
10	1.36	-0.40	-0.01
15	1.82	0.14	0.46
20	2.82	0.14	1.00
25	3.84	0.12	1.02
30	4.85	0.11	1.01
35	5.91	0.05	1.06
40	6.94	0.02	1.03
45	7.95	0.01	1.01
50	8.96	0.00	1.01
55	9.97	-0.01	1.01
60	11.00	-0.04	1.03
65	12.02	-0.06	1.02
70	13.05	-0.09	1.03
75	14.07	-0.11	1.02
80	15.11	-0.15	1.04
85	16.16	-0.20	1.05
90	17.23	-0.27	1.07
95	18.27	-0.31	1.04
100	19.31	-0.35	1.04
105	20.37	-0.41	1.06
110	21.18	-0.22	0.81

Probe:
Model No: 330400-05
Serial No.: 1508002XA
Length: 5M

Ext. Cable:
Model No.: Not Used
Serial No.:

Driver:
Model No.: 330400
Serial No.: 1508002AB

Voltage:
Supply Voltage: -24VDC

Sensitivity= 198.38 mV/mil
Calibration per API 670

PROBE CALIBRATION GRAPH
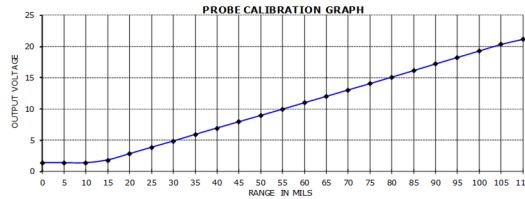
Location 1
Runout Screenshot
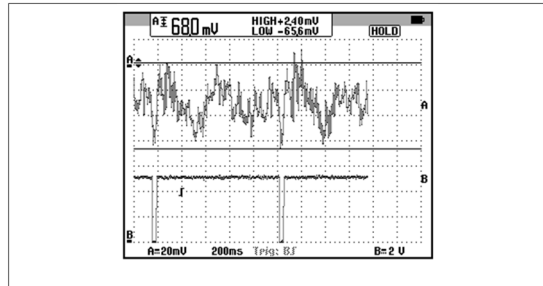
Probe Sensitivity per Graph 198.3750 mV/mil

Location 1 Meter Reading: 68.0000 mV

Location 1 Total ERO: 0.3428 mils

I hearby declare that the above measurements have been taken using NIST traceable equipement and taken per the ERO kit instructions.

Signed:

Technician:
Name
email:
Phone:

Supervisor:
Name:
email:
Phone:

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