IRD *Mechanalysis* Limited

The Vibration People

IRD Mechanalysis

IRD811

Vibration Spike Energy Detector

Operation & Maintenance Manual

Version 2.0
May 2013

IRD Mechanalysis Limited
1/5,MarolCo-opInd. Estate Ltd
Off. M. Vasanji Road, Marol
Andhedri (E), Mumbai – 400 059
Tel: 91-22-2852 2906, Fax: 91-22-2852 1814
Email : service1@irdmech.com
Web: www.irdmechanalysis.com

Customer Details
Date Purchased:
IRD Serial Number (s):
P.O. ref:
Organisation:
End User:
Next Calibration Due:

IRD *Mechanalysis* Limited

www.irdmechanalysis.com

IRD Mechanalysis Limited continues to be the industry leading provider of Condition Management Solutions. With over 30 years' experience in machinery vibration and associated condition monitoring technologies, the company designs and manufactures proven instrumentation suitable for rugged industrial environments. A comprehensive range of products and services are available from the offices below.

Location	Addresses	Contact Numbers
Delhi	*Sagar Deep, Plot No.11, LSC Saini Enclave, Vikas Marg, New Delhi 110092*	*Tel: +91-011-22373916* *Fax: +91-011-22370778* *Email:-salesNR@irdmech.com*
Kolkata	*153/A, 2nd Floor, VIP Road, Kolkata 700 054*	*Tel: +91-033-23559214* *Fax: +91-033-23559214* *Email: salesER@irdmech.com*
Mumbai	1/5 *Marol* Co-op. *Industrial Estate Ltd,* Off. *Mathurdas Vasanji Road, Marol, Andheri (East), Mumbai 400 059*	*Tel: +91-022-28522906* *Fax: +91-022-28521814* *Email: sales@irdmech.com*
Chennai	*7-C Chesney Nilgiri Apartments* 65, *Commander-In-Chief Road Chennai 600 105*	*Tel: +91-044-28230726* *Fax: +91-044-28234702* *Email: salesSR@irdmech.com*
National Service Centre & Works	1/5 *Marol Co-op. Industrial Estate Ltd., Off. Mathurdas Vasanji Road, Marol, Andheri (East), Mumbai 400059*	*Tel: +91-022-28520178* *Tel: +91-022-28596214/6573* *Fax: +91-022-28521814* *Email: service@irdmech.com*

INDEX OF ILLUSTRATIONS

TABLE OF CONTENTS

1. INTRODUCTION

This instruction manual describes the IRD Mechanalysis model IRD811 Vibration-SPIKE ENERGY™ Detector. Included in this manual are complete instructions on the preparation, setup, operation, and service of these instruments. Specifications of the model IRD811 and the major accessories are provided in Appendix A. Information on the significance of the measured vibration amplitude levels in displacement, velocity & acceleration and the procedures for evaluating SPIKE ENERGY measurements are well covered in the manual.

The Vibration-SPIKE ENERGY (gSE) Detector is a compact, portable instrument which can be hand-held for taking vibration measurements or for balancing rotating machinery. This instrument measures machinery vibration in units of displacement, velocity, or acceleration. In addition, it also measures the SPIKE ENERGY signals associated with bearing and gear defects over a very wide range of frequency

The operating conditions which may eventually cause the breakdown of a rotating machine can be detected from the measurements provided by the Vibration-SPIKE ENERGY Detector. Periodic measurements of machine vibration, combined with a time log of the vibration levels, provide the basic information needed for an effective Predictive Maintenance Program for rotating machinery (Figure 1). If significant increases develop in the machine vibration levels, then trouble is indicated in the machine. These troubles can then be pinpointed to specific parts of the machine, and scheduling can be more conveniently arranged for effecting repairs.

Figure 1 Periodic Vibration measurements save valuable machine downtime

IRD Mechanalysis offers complete training on vibration measurement, analysis, and balancing in principal cities throughout the world. For details on the training programs and other services that are available, contact your nearest IRD Mechanalysis representative, or write to IRD Mechanalysis, Limited.

Getting you started

2. DESCRIPTION

2.1 GENERAL

Thank you for investing in **IRD Mechanalysis Vibration Meters**. We trust that like many thousands of users before you will continue to enjoy optimum value from your wise investment. IRD Mechanalysis Limited is an independent System Integration Company that designs and manufactures condition monitoring system solutions.

This chapter contains descriptions of the model IRD811 Vibration-SPIKE ENERGY Detector and the standard and optional accessories available for use with this instrument.

Figure 2 Standard package for IRD 811 Vibration-SPIKE ENERGY Detector

The standard package for the instrument shown in Figure 2 contains the following accessories:

Standard Accessories	Qty	Part Number
Accelerometer Multi-purpose, model IRD511 - 100 mV/g, 2.0 Hz - 10 kHz, top connector	1	M5111005001000
Cable Assembly for model IRD811 to IRD511 Accelerometer sensor - 1.5m rubber insulated, shielded	2	M60021
Stinger Al 225mm Straight for Sensor	1	M24827
Carrying Case	1	M25345
Battery Set, 3 Nos. of 9V, 100mAH Dry Cells	1	M30643
Manual Operating	1	M21072
Magnetic Portable Base for IRD Accelerometers	1	M24828

Optional Accessories	Part Number
Inductive Velocity Sensor model IRD544	M45260
Cable for Model IRD544 Sensor 1.5m	M20432
Cable for Model IRD544 Sensor 8m	M21045
Magnetic Portable Base for IRD544 Inductive Velocity Sensors	M24823
Magnetic Deflecting Shroud for model IRD544 Sensor	M60018
Shaft Fish Tail Stick - Absolute Vibration IRD500 Series	M24824
Manual Training - IRD Mechanalysis Vibration Technology 1	M51001

2.2 DESCRIPTION OF ACCESSORIES

2.2.1 STANDARD ACCESSORIES

The standard accessories available for use with the model IRD811 are illustrated in figure 3 and are described below

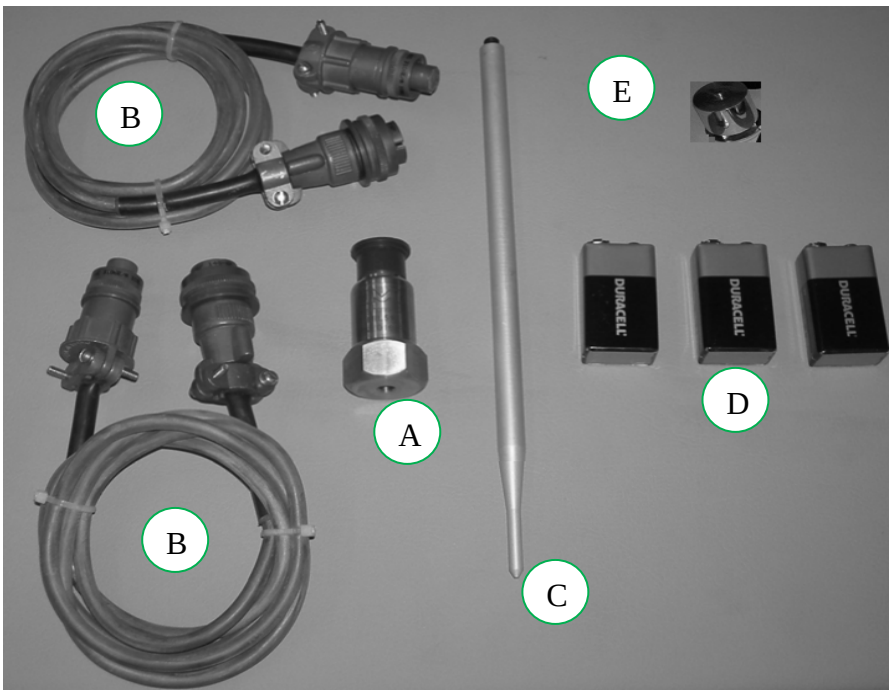


Figure 3 IRD 811 Standard Accessories

A) IRD511 Accelerometer

The IRD511 Accelerometer can be used in any position without loss of accuracy or sensitivity. It is sensitive to vibrations along the long axis, and can be fastened to rotating machinery with a M6 stud. It can also be used with a magnetic Portable Base, or hand-held with or without the 9-inch extension probe installed.

B) Cable for accelerometer 1.5 m – 2 nos.

The sensor cable connects the accelerometer vibration signal to the 6 pin threaded Receptacle at the top end of the instrument. In addition, this cable also carries the DC supply voltage to the internal amplifier of the Accelerometer. The cable connector at the external

end of the cable connects to the 2-pin receptacle on the end of the accelerometer.

C) Stringer

The Stringer, Part No. M24827 is 225 mm in length and connects to the threaded hole at the flat end of the accelerometer. It is used to reach inaccessible places on the rotating machine when the accelerometer is hand held. The probe should not be used to measure vibration signals above 16,000 CPM, except in the Bearing-Gear (gSE) mode of operation.

D) Battery Set, 3 Nos. of 9V, 100mAH Dry Cells

E) Magnetic Portable Base for Accelerometer

The Magnetic Portable Base is used, when required, to hold the accelerometer to the rotating machine. The magnetic holder is stud mounted to the flat end of the Accelerometer and provides a strong magnetic force for securing the sensor to the rotating machine. This holder can be used for vibration measurement of frequency components up to 60,000 CPM. For best results, it is recommended that silicon grease be applied to the contact surfaces

F) Carrying Case (Not shown)

The Carrying Case provides space for carry or storing the instrument along with the standard accessories.

G) Manual Operating (Not shown)

The Operating Manual provides instructions on setup, operation, and service of the model IRD811 Vibration-SPIKE ENERGY Detector. Additional copies of the manual could be obtained from IRD Mechanalysis.

2.2.2 OPTIONAL ACCESSORIES

The optional accessories available for use with the model IRD811 are illustrated in figure 4 and are described below.

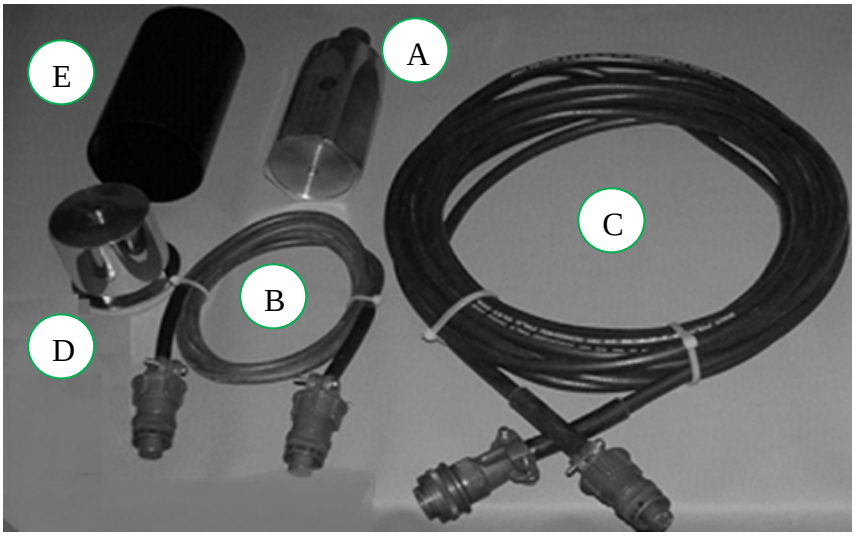


Figure 4 IRD 811 Optional Accessories

A) <u>IRD544 Inductive Velocity Sensor</u>

The IRD544 Inductive Velocity Sensor is used in place of the accelerometer, when preferred,

For vibration measurement in displacement or velocity. The IRD544 can be mounted in any position without affecting the accuracy or sensitivity (within the specification limits listed for this sensor). This sensor is sensitive to vibration along its long axis and can be stud mounted

to the rotating machine, used with a magnetic holder, or hand-held to the machine with or without the extension probe.

B)Cable for IRD544 Sensor 1.5m

The IRD544 Sensor Cable is 1.5 meters in length and connects the sensor vibration signal to the instrument. The 6 pin threaded connector is connected to the corresponding receptacle at the top end of the instrument. The threaded receptacle at the opposite end of the cable connects to the connector on the end of the IRD544 Sensor. This cable may also be used to connect the Model IRD811 to a vibration analyzer.

C)Cable for IRD544 Sensor 8m

The Extension Cable is 8 meters in length and when required, is connected to the external end of the standard cable to increase the overall IRD544 cable length to 29 feet.

D) Magnetic Portable Base for IRD544 Inductive Velocity Sensors

The Magnetic Portable Base is used to hold the model IRD544 Sensor to the rotating machine when required. The magnetic Portable Base stud mounts to the flat end of the sensor and provides a strong magnetic force for holding the sensor to the machine. This holder can be used when measuring vibration containing frequency components up to 60,000 CPM. For best results, it is recommended that silicon grease be applied to the mating surfaces.

E) Magnetic Deflecting Shroud for model IRD544 Sensor

The Magnetic deflecting shroud is used with the model IRD544 Velocity Sensor, when required, to reduce the magnetic field effects to 0.0015 inch/second gauss (l00:I reduction) at 60 Hz. The magnetic Deflecting Shroud fits over the IRD544 Sensor.

F) Vise Grip Plier (Not Shown)

The Vise Grip Plier is used as an item of convenience, if desired, for holding the model IRD544 Velocity Sensor to the rotating machine for balancing. The threaded sensor stud mounts to the pliers and the plier jaws are to be clamped to the rotating machine.

G) Manual Training - IRD Mechanalysis Vibration Technology 1 (MVT1) (Not shown)

This is a comprehensive vibration training course manual for beginners, practicing vibration engineers and plant managers to learn and practice the science of vibration diagnostics and root cause analysis for improved machine uptime and reliability.

2.3 DESCRIPTION OF CONTROLS, INDICATOR AND CONNECTORS

This section contains descriptions of the instrument controls, amplitude meter, and connectors. The front view of the model IRD811 is shown on Figure 5.

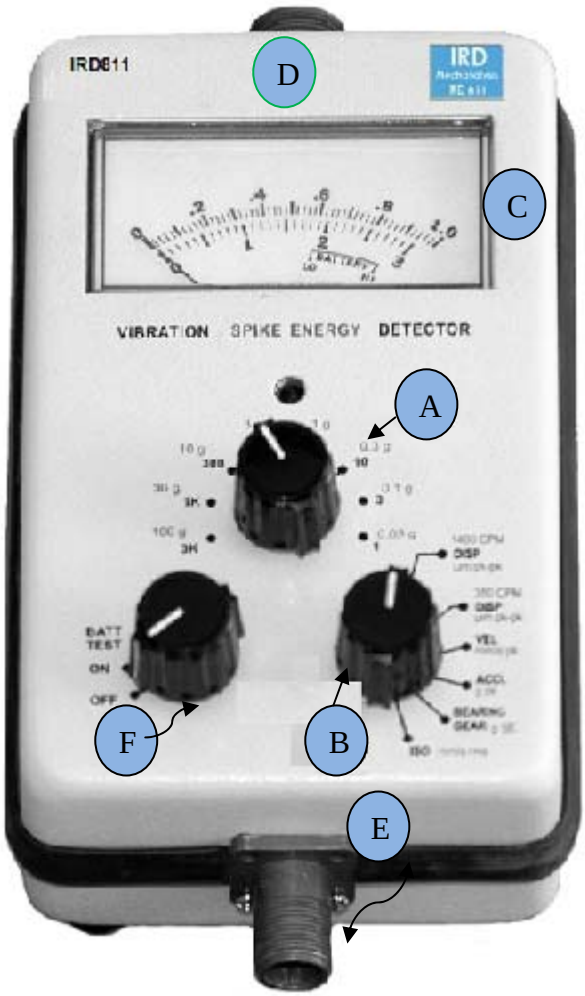


Figure 5 Front view of IRD811 showing all the controls, indicators & connectors

A) Amplitude range selector

The amplitude range selector is used to select the full-scale amplitude range to be read on the Amplitude meter. In Metric units, the ranges extend from 1 to 3000 micrometers pk-pk, or mm/sec pk., In addition, the model IRD811 is also equipped with ISO ranges from 1 to 3000 mm/sec, RMS. The eight amplitude ranges that may be selected on each instrument model are listed in Table 1.

Table 1 Amplitude ranges for IRD811

METRIC UNITS		ISO UNITS
microns pk –pk /mm/sec pk	g's pk	mm/sec RMS
0 – 1.0	0 – 0.03	0 – 1.0
0 – 3.0	0 – 0.01	0 – 3.0
0 – 10	0 – 0.3	0 – 10
0 – 30	0 – 1.0	0 – 30
0 – 100	0 – 3.0	0 – 100
0 – 300	0 – 10.0	0 – 300
0 – 1000	0 – 30.0	0 – 1000
0 – 3000	0 – 100	0 – 3000

B) Mode Selector

The MODE selector is used to select the desired units of measure which are described as follows:

i) DISP 350 CPM: provides measurement in DISPLACEMENT (micrometers pk-pk) from 350 to 120,000 CPM, or 5.8 to 2000 Hz with the accelerometer or- from 600 to 60,000 CPM or 10 to 1000 Hz with the model IRD544 Velocity Pickup.

ii) DISP 1400 CPM: provides measurement in DISPLACEMENT (micrometers pk-pk) from 1400 to 600,000 CPM or 23.3 to 10,000 Hz with the accelerometer; or from 1400 to 60,000 CPM or 23.3 to 1000Hz with the model IRD544 Velocity Pickup. This mode reduces the low frequency energy in the output, and allows for a faster response time.

iii) VEL: provides measurement in VELOCITY (mm/sec pk) from 350 to 600,000 CPM or 5.8 to 10,000 Hz with the accelerometer; or from 600 to 60,000 CPM or 10 to 1000 Hz with the model IRD544 Velocity Sensor.

iv) D. ACCEL: provides measurement in ACCELERATION (g's peak) from 120 to 600,000 CPM or 2 to 10,000 Hz), and is used only with the accelerometer.

v) BEARING/GEAR gSE: provides measurement of SPIKE ENERGY units of Acceleration (g's SE) of bearings, gears, or other machine ports. This mode is used only with the accelerometer.

vi) ISO: provides International Standards Organization measurement in VELOCITY (mm/sec rms, from 600 to 600,000 CPM or 10 to 10,000 Hz). This mode is used only with the accelerometer.

C) Amplitude Meter

The Amplitude Meter indicates the vibration amplitude, and the condition of the internal batteries in the 'BATT TEST' mode of the POWER SWITCH. The upper scale on the meter is used for Amplitude Range selector settings of 1, 10, 100 or 1000 on the upper scale and the lower scale for the 3, 30, 300, or 3K settings. The condition of the batteries is shown in the LO-BATT -HI area of the lower scale in the BATT TEST mode. The meter scales to be used for the various units and range settings selected are listed in Table 2 below.

Table 2 Measure units, ranges and meter scale used in IRD811

METRIC UNITS			
Micrometer and mm/sec Ranges	**Meter Scale Reading**	**g's Ranges**	**Meter Scale Reading**
0 – 1	UPPER	0 – 0.03	LOWER
0 – 3	LOWER	0 – 0.1	UPPER
0 – 10	UPPER	0 – 0.3	LOWER
0 – 30	LOWER	0 – 1	UPPER
0 – 100	UPPER	0 – 3	LOWER
0 – 300	LOWER	0 – 10	UPPER
0 – 1000	UPPER	0 – 30	LOWER
0 – 3000	LOWER	0 – 100	UPPER

D) Sensor signal input receptacle

The SENSOR SIGNAL INPUT receptacle is a 6-pin threaded connector. It is located at the top end of the instrument, and is used for connection of the sensor cable from the accelerometer (or optional model IRD544 Velocity Sensor).

E) Scope/Tape Recorder/Analyzer output connector

The SCOPE (oscilloscope)/Tape Recorder/Analyzer output connector provides the output signal for connecting to oscilloscope, tape recorder, or other vibration analyzer. A 2- pin threaded connector is required for connection to this receptacle. The full-scale output signal voltage is 301 mV, RMS, for Metric units. The load impedance required is 100K ohms.

F) Power Switch

The Power Switch is used to connect the internal battery supply to the instrument circuits, and to check the batteries for proper output voltage. If set to OFF, the internal power is disconnected. The switch is set to ON for normal operation. If the switch is set to BATT TEST, and the batteries have sufficient output voltage, the Amplitude meter will indicate a reading in the LO-BATT -HI area of the lower scale.

NOTE:
If the meter indicates at or below the LO point of the scale, then the batteries must be replaced before the instrument can be used. For extended battery life it is recommended to switch the unit off when not in use.
.

The Vise Grip Pliers must not be used for vibration measurement except when balancing a rotating machine. In addition, do not use the Vise Grip Pliers with the accelerometer.

3. PREPARATION FOR OPERATION

3.1 GENERAL

This section consists of instructions for setting up and checking the basic operation of the Vibration-SPIKE ENERGY Detector. Also described in this chapter are the procedures for mounting the Accelerometer or Velocity Sensor on the rotating machine, connecting the signal input and output cables, and checking the condition of the internal batteries.

3.2 CHECKING INSTRUMENT OPERATION

The basic operation of the Vibration-SPIKE ENERGY Detector is checked as follows:

1. Set the instrument POWER SWITCH to the BATT TEST position, and check that the Amplitude Meter indicates within the LO-BATTERY-HI area. If this indication is obtained, then the internal batteries have sufficient output voltage for operating the instrument and accelerometer circuits. If the meter indicates at or below the LO point, the batteries must be replaced before the instrument can be used. (Replacement details are included in Chapter V.)

2. Connect one end of the sensor cables to the threaded receptacle on the Accelerometer, and connect the opposite end to the 6 Pin receptacle on the top end of the instrument.

3. Set the POWER SWITCH to ON. Set the MODE SELECTOR to VELOCITY, and the AMPLITUDE SELECTOR to the 30 mm/sec pk range. Then, shake the accelerometer and check that a vibration reading is indicated by the Amplitude Meter (the meter indicator should move up-scale when the accelerometer is shaken, and should settle back to zero when the accelerometer is held still)

4. Instrument check with optional Calibrator (P/N M21073) – The optional Calibrator provides a fast and accurate method for checking the calibration of the Vibration-SPIKE ENERGY Detector and the integrity of the sensor cable. The procedure for using the Calibrator is described below:

    a) Disconnect the external end of the 4-foot Sensor Cable from the accelerometer.

    b) Connect the sensor end of this cable to the threaded receptacle on the calibrator. The 6 Pin threaded connector at the opposite end is connected to the instrument.

    c) Set the AMPLITUDE RANGE selector on the IRD811 instrument to the position listed in the table below for the mode to be tested, then check that the Amplitude meter indicates a reading within the required limits.

Table 3 Amplitude ranges for IRD811 Vibration Spike Energy Detector

Mode	Range Selector	Meter Scale	Readout Limits
ISO – mm/sec rms	10	0 to 1	6.86 to 7.00
ACCEL – g pk	1	0 to 1	0.85 to .090
VEL – mm/sec pk	10	0 to 1	9.41 to 10.00
DISP (350 or 1400) – um pk-pk	30	0 to 3	21.4 to 23

NOTE:
The readout limit values reflect the combined tolerance of the instrument (±3%) and the calibrator (±1%).
.

If the Amplitude meter indications are within the proper limits, then the instrument circuits and the sensor cable are functioning correctly. The sensor cable may then be disconnected from the Calibrator and the POWER switch set to OFF. If the proper meter indications are not obtained, check for weak internal batteries, defective cable or instrument, or instrument circuits that are out of calibration.

3.3 ACCELEROMETER MOUNTING

The Accelerometer may be hand-held for most periodic vibration checks, or stud-mounted for more permanent measurement applications. When required, limited measurements of vibration can be obtained when the sensor is held to the machine by use of the magnetic Portable Base, or hand-held with the extension probe attached. When measuring SPIKE ENERGY signals, the extension probe is normally used and the sensor hand-held. The accelerometer should not be used in environments where the temperature exceeds +250^{0}F (+121^{0}C).

When the sensor is stud mounted, it should be located on a flat surface of the rotating machines at or near the housing of the bearing to be checked, using the ¼-28 x ¼ inch threaded hole at the flat end of the sensor. The long axis of the accelerometer must be positioned in the direction of the vibration to be measured. The mounting stud must not extend into the sensor shell by more than ¼-inch, maximum; otherwise, the sensor could be damaged.

The accelerometer mounting surface must be reasonably flat, smooth, and clean (free of hardened grease, dirt, scale, paint of other matter). Coating the flat end of the accelerometer with clean silicone grease will help ensure proper bonding between the sensor and mounting surface. The accelerometer should be threaded onto the mounting stud, and hand-tightened to the machine.

DO NOT WRENCH THE ACCELEROMETER TO THE MOUNTING SURFACE.

The accelerometer can be hand-held to the rotating machine, if desired, for measurement of vibration displacement, velocity or acceleration up to a frequency of 420,000 CPM. To hand-hold the sensor, the flat end should be held firmly against the machine housing so that the long axis is positioned in the same direction as the vibration to be measured. The sensor should be held against a reasonably flat surface, as any unsteadiness of the hand which allows the direction of the axis to vary may result in unsteady vibration readings. Sufficient holding force must be used to keep the sensor from chattering or “walking” on the surface. A tingling sensation in the holder’s hand is an indication that more force is needed.

The optional magnetic holder may also be used to secure the accelerometer to the rotating machine. The magnetic holder is attached to the pickup using the ¼-28x1/4-inch threaded hole and M6 stud. Silicone grease is normally applied to the mating surfaces. The maximum vibration frequency to be measured when using the holder should not exceed 120,000 CPM

For limited vibration measurements, and for the measurement of SPIKE ENERGY signals, the extension probe can be attached to the sensor and the sensor then hand-held with the tip of the probe contacting the various measuring points on the rotating machine. The probe tip should be in firm contact with the bearing housing to prevent the probe from chattering or 'walking" on the contact surface. When using the extension probe, the maximum vibration frequency which can be measured (in displacement, velocity, or acceleration) is 16,000 CPM. The extension probe enables the operator to obtain vibration measurements from parts of the rotating machine that are not readily accessible.

3.4 IRD544 VELOCITY SENSOR MOUNTING

The optional model IRD544 Velocity sensor should be mounted to the rotating machine in the same manner as described for the Accelerometer. However, the model IRD544 can be used in temperatures up to $+500^0$F ($+260^0$C).

When possible, the sensor should be stud mounted or hand-held flush against the machine surface. Vibration measurements may also be obtained using the optional magnetic Portable Base for this sensor, or by hand-holding the sensor with the extension probe attached. If the sensor is hand-held without the extension probe attached, the maximum vibration frequency that may be measured is 60,000 CPM. If the magnetic holder is used to secure the sensor, vibration frequencies as high as 37,000 CPM may be measured. If the sensor is hand-held with the extension probe attached, then the maximum frequency to be measured is 16,000 CPM.

NOTE:
The IRD544 sensor is not used for SPIKE ENERGY signal measurement.
.

The Optional magnetic Deflecting Shroud can be used along with the IRD544 Velocity sensor to reduce magnetic interference that may be present. The Magnetic Deflecting Shroud fits over the sensor, and is held by the mounting adapter supplied with the shroud.
If desired, vise-grip pliers can be used to hold the velocity sensor to the rotating machine for balancing. The sensor stud mounts to the vise-grip pliers, and the plier jaws must be securely clamped to the rotating machine. The vise-grip pliers are an item of convenience for balancing only, and should not be used when measuring the machine vibration as the maximum measurable frequency is limited to 7200 CPM.

3.5 CABLE CONNECTIONS

SENSOR CABLE: The threaded connector at the external end of the sensor cable connects to the threaded receptacle at the top end of the accelerometer, or IRD544 Velocity Sensor. This connector should be aligned with the guide key and contact

pins in the receptacle and then hand-tighten to the receptacle. The treaded connector at the other end of the cable connects to the corresponding receptacle of the Top end of the instrument. This connector should be aligned with the receptacle, and then tightened DO NOT WRENCH EITHER SENSOR CABLE CONNECTOR.

ANALYSER/SCOPE/TAPE RECORDER OUTPUT: The model IRD811, instrument can be used to provide acceleration measurement capability on any analyser that is velocity compatible (model 350, etc). To use the vibration SPIKE ENERGY Detector with an analyser to measure acceleration, connect the threaded end of the 4-foot IRD544 Velocity sensor to the output receptacle at the bottom of the model IRD811 instrument. The other end of the cable is connected to the twist-lock input receptacle of the analyser. Set the analyser units switch to VELOCITY, and the AMPLITUDE RANGE TO '1' ("10" for metric instruments). Then, set the Vibration-SPIKE ENERGY Detector to the ACCEL mode and adjust the AMPLITUDE RANGE selector to obtain an on-scale meter reading on this instrument.

The appropriate frequency analysis procedures for the analyser being used may then be followed The values read on the analyser Amplitude meter are based on the range setting of the Vibration-SPIKE ENERGY Detector. Although the analyser is set to the '1" AMPLITUDE RANGE ("10" for metric instruments), the full-scale value to be read on the analyser Amplitude meter will be the same as the full-scale reading on the model IRD811 instrument.

To connect an oscilloscope or tape recorder to the model IRD811, instrument a signal cable with a velocity sensor connector must be used. The output signal provided by the IRD811 instrument has a full-scale voltage level of 301 mV, rms, in Metric units.

NOTE:
FILTERED SPIKE ENERGY signal voltages are not provided at the output connector.

4. OPERATION

4.1 GENERAL

The Vibration-SPIKE ENERGY Detector is designed to measure the overall machine vibration amplitude and the SPIKE ENERGY signal levels produced by moving-element bearing and high speed gears. All vibration readings obtained with the instrument should be compared to known standards of vibration for the type of machine, bearing, or gear being checked. If the measured vibration or SPIKE ENERGY level has significantly increased since the last periodic check, or if the levels measured exceeds the permissible standards, then mechanical trouble in the machine is indicated.

Vibration in rotating machinery is most often caused by unbalance, defective bearings, misalignment, or mechanical looseness. For this reason, the vibration pickup should be mounted at or close to the machine bearing housing. If the bearing housing of interest is not accessible, the sensor can be mounted on the machine structure or support which is located as close as possible to the bearing.

If the vibration sensor cannot be attached using the stud-mount method, it can be secured with a magnetic holder, or hand-held with or without an extension probe. However, the measurable vibration frequencies will be reduced as explained in Chapter III.

If the vibration is to be measured quickly at many places on the rotating machine, then the sensor should be held by hand. If vibration measurements are required at places not readily accessible, the extension probe may be attached to the sensor to provide easier and safer access to these places.

This chapter contains instructions on setup of the instrument controls, and includes general instructions on measuring vibration, determining the severity and dominant frequency of the vibration, classifying the vibration, and step-by-step instructions on in–place balancing.

4.2 SETUP

1. Prepare the Vibration – SPIKE ENERGY Detector and accessories for operation as instructed in chapter III.
2. Set the instrument POWER SWITCH to ON.
3. Set the MODE SELECTOR SWITCH to the desired units.
4. Set the AMPLITUDE SELECTOR SWITCH to the desired full-scale Range.

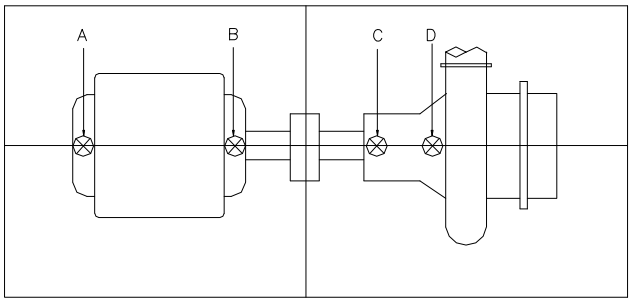
NOTE:
Initially the Amplitude Selector should be set to the least sensitive range, and then progressively rotated to more sensitive ranges until the level of vibration indicated on the Amplitude Meter is 1/3rd of the Full Scale Value or greater. Instructions on correctly reading the meter scales for various ranges of amplitude are included in Chapter 3.

4.3 VIBRATION MEASUREMENT

The vibration should be measured in the vertical, horizontal and axial planes of each bearing housing. The vibration levels are then indicated on the AMPLITUDE METER. All pertinent rotating machine information, along with the vibration readings, should be recorded on a datasheet similar to the one shown in Figure 6. The recorded data is used to determine the general operating condition of the machine. The data sheet also provides a permanent record of the machine condition.

APPLICATIONS

BASELINE PUMP DATA SHEET



CHECKED		PERIODIC VIBRATION CHECKS DISP.:_____ VEL.: _____ ACCEL.:____								PERIOD : WEEKLY VIBRATION TREND CHART 0 2 4 6 8 10
DATE	BY	A(H)	B(H)	C(H)	D(H)	E( )	F( )	G( )	H( )	
1/22	CJ	0.19	0.15	0.21	0.12					
1/29	CJ		0.14	0.21						
2/6	CJ		0.15	0.22						
2/19	CJ		0.18	0.3						
2/20	CJ		0.5	0.6						
2/21	CJ	0.12	0.11	0.19	0.10					
2/22	CJ		0.10	0.13						
3/2	CJ		0.11	0.14						
3/9	CJ		0.12	0.16						
3/19	CJ		0.13	0.16						
3/28	CJ		0.17	0.22						
3/30	CJ		0.20	0.34						
4/8	CJ		0.23	0.29						
4/15	CJ		0.26	0.33						

MACHINE: 12 BOILER FEED PUMP
LOCATION: LOWER LEVEL
NORMAL

VEL.: ACCEL.: ____

	E	F	G	H
.19 .12				
TICA .11 .08				
.08 .08				

LIMITS:
B: 0.6 C: 0.6 D: 0.6
F: ____ G: ____ H: ____

Figure 6 A typical vibration measurement datasheet

4.4 DETERMINING VIBRATION SEVERITY

Vibration measurements without a standard for comparison are seldom of any use. There needs to be some guide to show how much is too much. Table 4, provides a guide for Machine Tool Vibrations. The values listed merely indicate the range in which satisfactory parts have been produced. Actual tolerances must be determined by your own experience as to what vibration levels permit the meeting size and finish tolerance.

For general machinery, the vibration severity chart shown in Figure 7 may be used. Please note that vibration displacement and vibration acceleration values are for a specific frequency of vibration while velocity readings may be used regardless of the frequency.

Table 4 Tentative guide to vibration tolerances for machine tools

Type of machine	**Displacement of vibration as read with pickup spindle bearing housing in the direction of cut**
Grinders	**Tolerance Range**
Thread Grinder	0.25 - 1.5 microns
Profile or contour Grinder	0.75 - 2.0 microns
Cylindrical Grinder	0.75 - 2.5 microns
Surface Grinder (Vertical Reading)	0.75 - 5.0 microns
Gardner or Besly type	1.25 - 5.0 microns
Centreless	1.0 - 2.5 microns
Boring Mill	1.5 - 2.5 microns
Lathe	5.0 - 2.5 microns

NOTE:
The above tolerance ranges consist of machine vibration displacement values at which acceptable parts can generally be produced and are supplied as a guide for judging the indicated vibration as a warning of impending trouble. The measurements were obtained with the vibration sensor mounted on the spindle bearing housing in the direction of the machine cutting.

These values come from the experience of IRD personnel who have been trouble shooting machine tools for over 10 years with the IRD equipment. They merely indicate the range in which satisfactory parts have been produced and will vary depending upon size and finish tolerance.
The units in which vibration severity may be measurement displacement, velocity or acceleration – are interrelated to one another. Displacement is used for measuring the condition of slower speed machinery, particularly where displacement standards have been established or where excessive unbalance is present. However, Velocity_measurements provide a measure of the combined effects of vibration frequency as well as displacement and can be universally applied regardless of machine speed or type of trouble. This type of measurement provides a direct indication of the vibration severity and is generally the best indicator of the machine balance or condition. Acceleration_is generally used when vibration occurs at high frequencies and often where the frequency of the source is many times the shaft RPM.

The vibration amplitude should be obtained in velocity and in whatever other units are desired. Measurements in displacement or acceleration will provide an indication of the vibration severity only if the dominant frequency of the machine vibration is known. Since the vibration velocity is consistent with rotational speed, vibration severity measured in terms of vibration velocity is most common. If the vibration severity value read from the chart is too high, then trouble may be indicated with the machines as explained in Section 4.5. As already explained, acceleration as vibration severity parameter is used when vibration occurs at many times shaft RPM, usually due to rolling element bearing excitation, gear defects or aerodynamic problems such as cavitation. One such acceleration severity chart is shown in Figure 8.

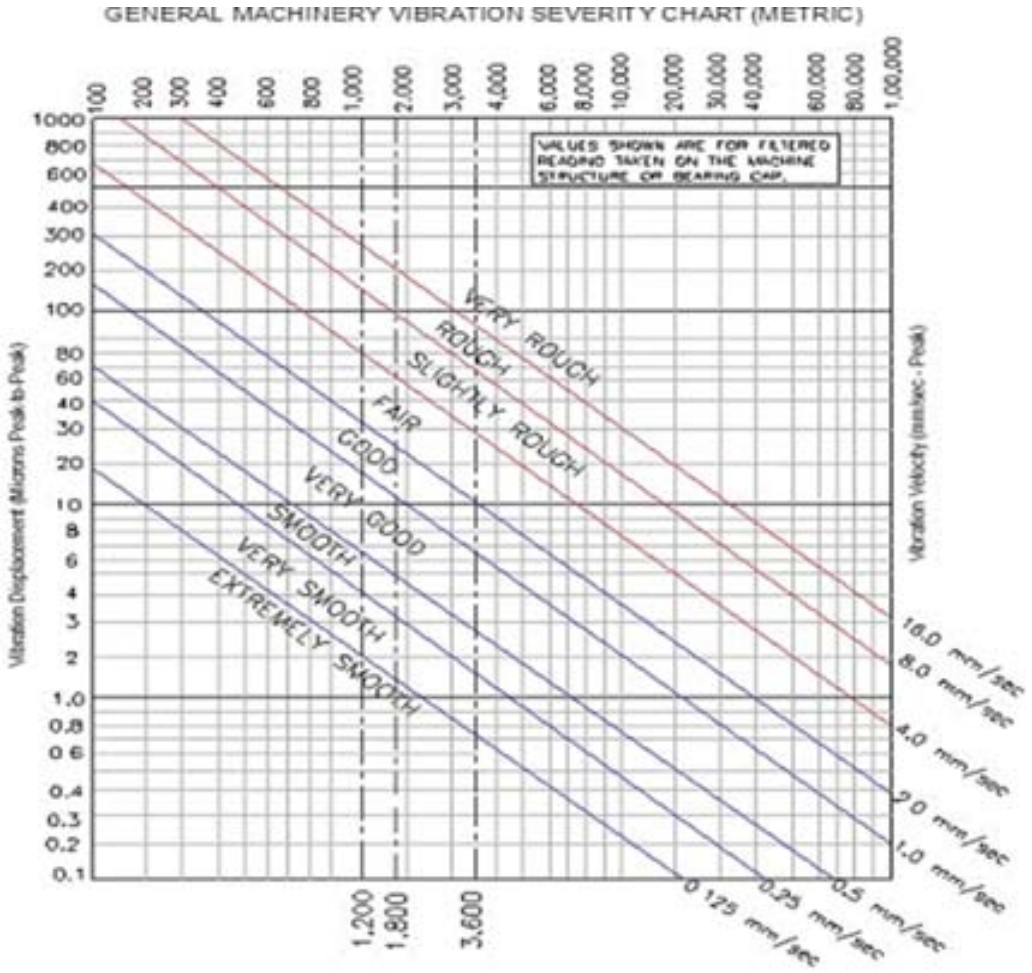


Figure 7 A general machinery vibration severity chart (Metric)

The SPIKE ENERGY mode circuits are used for the detection of deteriorating and defective rolling element bearings and gear teeth. These circuits are completely independent of those which measure the RMS vibration components in the displacement, velocity or acceleration modes. The SPIKE ENERGY signal level is indicated on the Digital Display for machine which operates from 600 to 3600 RPM, a SPIKE ENERGY level of 0.5 g or higher (as measured with the pickup hand-held and the extension probe attached) may indicate that the corresponding bearing or gear is defective.

Whether or not the bearing or gear is defective must be verified by experience and observation of the machine trends, since individual machines may have different vibration response characteristics. The acceptable level of SPIKE ENERGY amplitude for machines whose operating speed is outside the 600 to 3600 RPM range should also be developed individually from comparisons to similar machines and from careful study of the vibration amplitude trends of the machine.

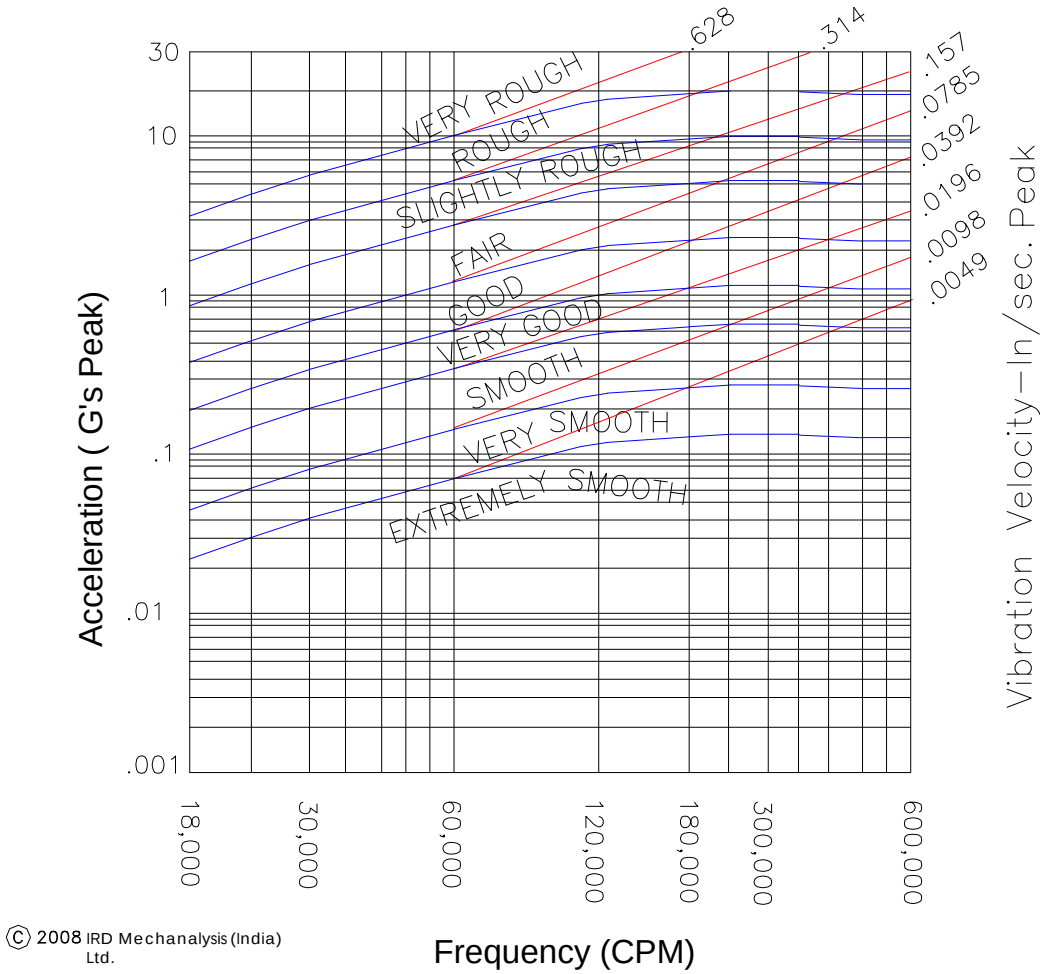


Figure 8 General Machinery Acceleration Severity Chart

4.5 DETERMINING DOMINANT VIBRATION FREQUENCY

If a single frequency is dominant in the machine vibration, the Vibration-SPIKE ENERGY Detector can be used to determine what this dominant frequency is. If the vibration level indicated on the Amplitude Meter does not fluctuate more than 5% of the full-scale value, the dominant vibration frequency can generally be computed by dividing the vibration displacement level into the vibration velocity level, and multiplying the resulting quotient by the constant 19,120 as shown in Equation 1,:

EQUATION 1:

DOMINANT FREQUENCY (CPM) = (VEL/ DISP) X 19,120

NOTE: In English units, velocity is measured in inches per second, peak; and displacement is measured in mils, peak to peak. In Metric units, velocity in millimeters per second, peak; and displacement is measured in micrometers, peak to peak

For example, if a given belt-driven blower has a motor speed of 1750 CPM, and a fan speed of 2600 CPM; and vibration readings of 6 mm/s, peak (velocity), and 44microns, peak to

peak (displacement) are obtained at the fan bearing; then the dominant vibration frequency would be computed from Equation 1 as follows:

DOMINANT FREQUENCY (CPM) = (VEL/ DISP) X 19,120 DOMINANT

FREQUENCY (CPM) (6mm/sec/44microns)X19,120

⇒ **Dominant Frequency = 2607 CPM**

Since the dominant vibration frequency (2607 CPM) is closer to the fan speed (2600 CPM) than to the motor speed (1750 CPM), the fan is more likely the cause of the excessive vibration.

The dominant vibration frequency can also be determined from the chart in Figure 9, by relating the vibration velocity and displacement values obtained on the Amplitude Meter of IRD811 instrument to this chart.

The dominant vibration frequency value can often be used to determine the machine part causing the vibration. This frequency could occur at the rotating speed of the faulty part, at a multiple of the rotating speed, or at some other frequency.

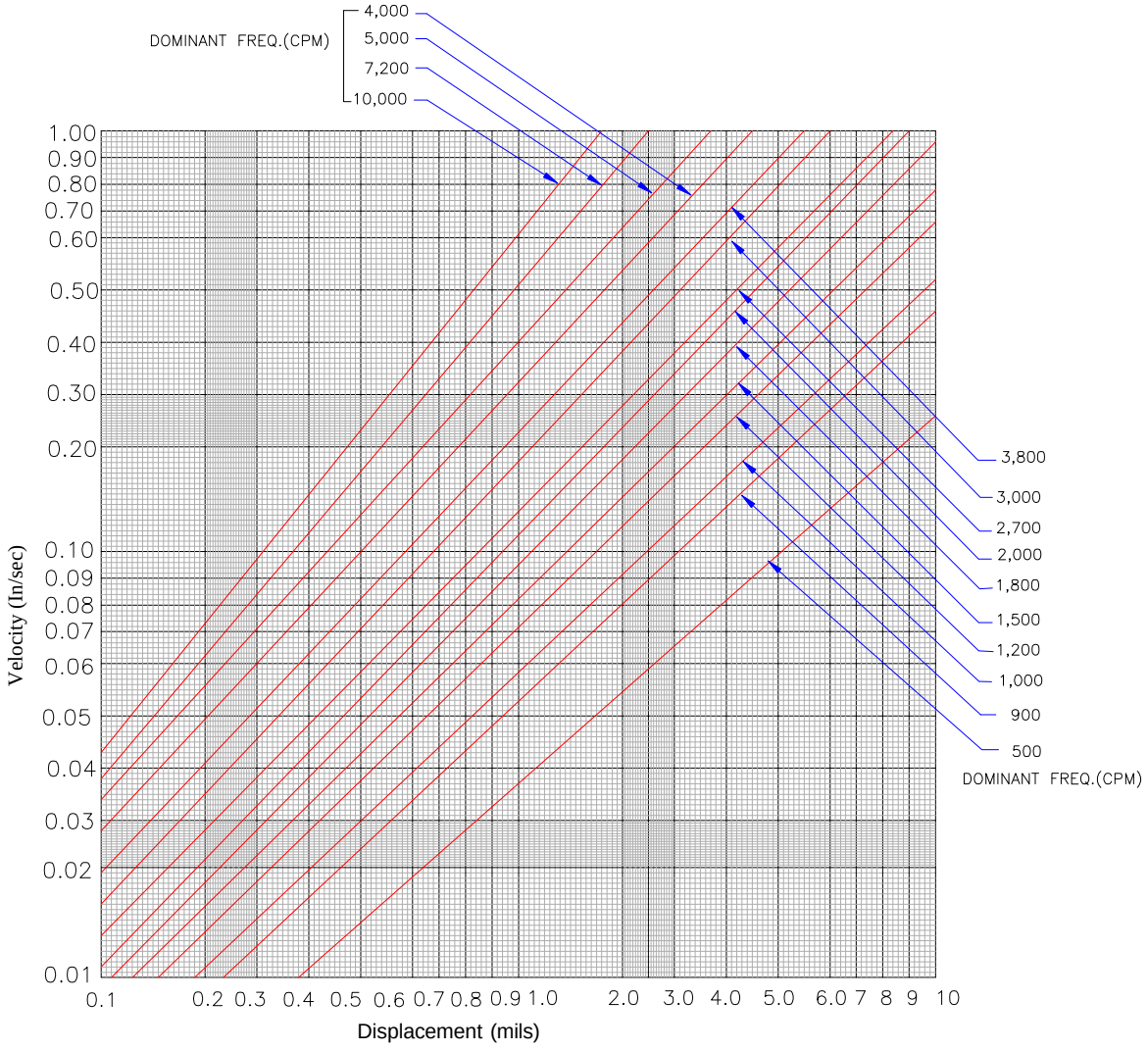


Figure 9 Dominant Vibration Frequency Chart

In the blower example discussed above, if the vibration is measured at either motor bearing, the vibration will include the motor vibrations plus all other transmitted via the drive belt and the blower structure from the fan. Or, if the vibration is measured at a fan bearing, the vibrations include the fan vibrations plus all other transmitted by the drive belt and blower structure from the motor. To ensure adequate definition of the machine vibration, the measurements should generally be obtained from each bearing housing.

When the dominant frequency of the vibration has been determined, the data in table 5 can be used to help identify the specific problem. However, one must remember that only a preliminary identification of the vibration can be accomplished by using a model IRD811 instrument. A positive confirmation of the diagnosis requires a vibration analyser.

Table 5 Dominant machine excitation frequencies and most likely causes

DOMINANT FREQUENCY	MOST LIKELY TROUBLE
1 X RPM	Unbalance and / or misalignment If axial vibration is large Check for bent shaft or Misalignment
2 X RPM	Looseness, misalignment
3XRPM	Misalignment
Many times RPM	Bad roller or ball bearings or gears
Less than 1XRPM	Oil whirl (Less than ½ RPM)
Synchronous (AC Line frequency)	Electrical problems
2X Synch. Frequency	Torque pulses
Many times RPM (Harmonically related)	Bad gears Aerodynamic forces Hydraulic forces Mechanical looseness Reciprocating forces
High frequency (Not harmonically related)	Bad antifriction bearings

NOTE: This table is just a guideline for root cause analysis of a machine problem. There are many other causes of vibration not listed. To pinpoint all but the simplest requires a thorough analysis and interpretation of the vibration patterns of a machine using a IRD Vibration Analyser.
.

4.6 IN-SITU BALANCING

Imbalance is the most common cause of vibration in rotating machines and the vibration resulting from unbalance can be measured. This section contains instructions for in-situ balancing of rotating machines using a Model IRD811 instrument. To balance a rotating machine using the following method, the machine must be stopped and restarted several times.

Locations for attaching balancing weights are provided on many types of rotating machines and the locations for mounting these weights are generally included in the

manufacturer's specifications. On some machines, methods such as bolting or welding the weights to various machine parts are used. In addition, provision for the removal of existing weights for balancing are provided in some cases.

NOTE: *If possible, a Vibration Analyser / Dynamic Balancer such as a IRD Model 350, 360, 840 or 880 should be used for the balancing since these instruments contain a tunable filter and an external strobe light which provides separation of the various vibration frequency components. However the machine can be balanced with a Model IRD811D instrument under the following conditions.*

.

Before taking up the balancing of the rotating machine, following should be ensured:

- **Unbalance must be the main cause of the vibration** (check to make certain that other causes such as misalignment of couplings or bearings, bent shafts, defective anti-friction bearings, defective gears, or mechanical 100 sense etc are not present before attempting to balance.

- **The vibration indication must be steady** (the meter indicator must not fluctuate or drift more than ± 5% of full scale).

- **The dominant frequency of the vibration must be equal to the rotating speed of the part to be balanced.**

Balancing Procedure

1. Install the accelerometer/Sensor at or near the machine bearing having the highest vibration (long axis of the pickup must be positioned in the same direction as the rotating machine vibration displacement).

2. Measure and record the original unbalance vibration amplitude as value "O".say100 microns

3. Stop the rotating machine, then prepare a Trial Weight "TW"-say 20 grams and install this weight at a known angle and radius (record the weight value.)

4. Restart the rotating machine and allow it to come up to the normal operating speed.

5. Measure and record the new unbalance vibration value as value "TI".-say 178 microns

6. Stop the rotating machine then move the Trial Weight 180° from the original position (Step 3) at the same radius value.

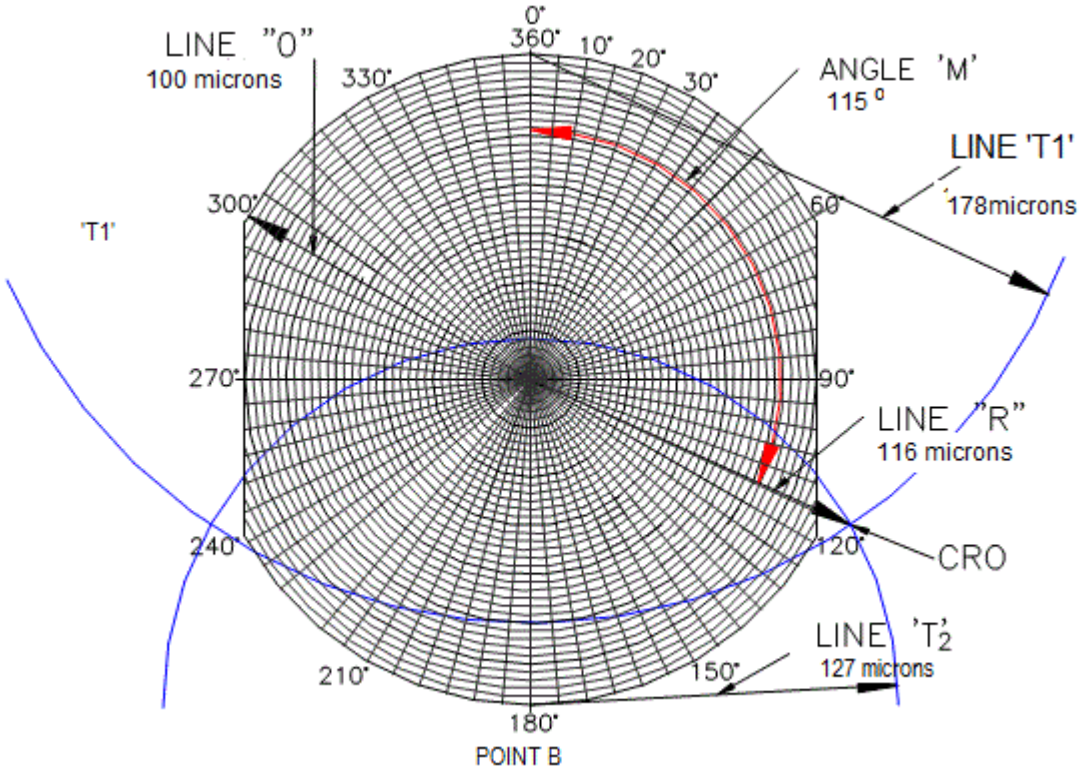
7. Restart the rotating machine and allow it to come up to the normal operating speed.

8. Measure and record the new unbalance vibration value as value "T2"–say 127 microns.

9. Construct a vector diagram as illustrated in Figure 10 by using the “O”. “T1” and “T2” value obtained in Step 2, 5 and 8 for the rotating machine being balanced. (A scaling of 10cm per microns of unbalance is used in this figure).

10. In the vector diagram, project a vertical line through the original circle and label the intersection at 0° as Point “A” and the intersection at 180° as Point “B”.

11. At the same scaling used in Step 9, draw an arc at radius “T1” from Point “A”, as illustrated (using the “T1” value obtained in Step 5).



Note:-
Angle from 0° is positive in clockwise direction.

Figure 10 Sample Balancing Vector Diagram

12. At the same scaling used in Step 9, draw an arc at radius “t2” from Point “B” as illustrated (using the”T2” value obtained in Step 8).

NOTE:
The radius lines projected in Step 11 and 12 will cross one another at two points located at equal angular distance from Point “A”.

13. Project a straight line from the center of the vector diagram to either cross-over point of the radius-line projections drawn in Steps 11 and 12 and label as Line “R”.-116 microns.

14. Compute the final amount of correction weight required from Equation 2 which follows :

EQUATION 2:

$$\text{REQUIRED CORRECTION WEIGHT} = \frac{\text{'O'} \times \text{"TW"}}{\text{R}}$$

(Value "O" was obtained in Step 2, value "TW" in Step 3 and value "R" in Step 13).

NOTE:

In Figure above the "O" value is 100 microns (original unbalance), the "TW" value is 20 grams and the "R" value (unbalance at the intersection of the two arcs) is 116microns. If these values were obtained for the rotation machine being balanced, then the amount of correction weight required for balancing the machine would be computed from Equation 2 as follows:

$$\textbf{Required correction weight} = \frac{100 \text{ microns} \times 20 \text{ grams}}{116 \text{ microns}}$$

⇒ **Required correction weight** = 17.2 grams

15. With a protractor, measure the angular distance from where Line "R" and the two arc lines intersect to Point "A". The angle at which Line "R" is drawn is angle "M" and in Figure equals 115°.

16. Fabricate a correction weight to the weight computed from Equation 2 and install on the rotating machine at the point located clockwise from the original "TW" position (see Step 3) by angle "M"-115° , at the same radius used in Step 3.

17. Start the rotating machine and allow it to come up to the normal operating speed.

18. Measure the machine unbalance, if the desired balancing is obtained, then the proper correction weight is installed otherwise, proceed with Step 19.

19. Stop the rotating machine then move the weight counter-clockwise from the original "TW" position (see step 3) by the angle "M"-115° value determined in Step 15.

20. Restart the rotating machine and allow it to come up to the normal rotating speed.

21. Measure the machine unbalance. If the desired degree of balance is obtained and if the correction weight(s) is properly installed, the balancing procedure is now completed.

5. SERVICE

5.1 FIELD MAINTENANCE

The model IRD811 instrument generally requires very little field maintenance. The extent of the maintenance provided by the user may vary, depending on the availability of competent service facilities. The following service procedures can be easily performed in the field without the use of electronic test equipment:

A. Checking or Replacing the instrument Batteries
B. Checking the Accelerometer Cables.
C. Checking the instrument Operation with the Optional Calibrator

Checking Internal Batteries

To check the internal batteries, set the POWER switch to the BATT Test position, and observe that the Amplitude meter indicates a reading within the LO-BATT-HI area on the meter scale. If the meter indicates below the LO marker, the batteries must be replaced before the instrument can be used.

Replacing Instrument Batteries

The instrument batteries are replaced as follows and depicted in Figure 11

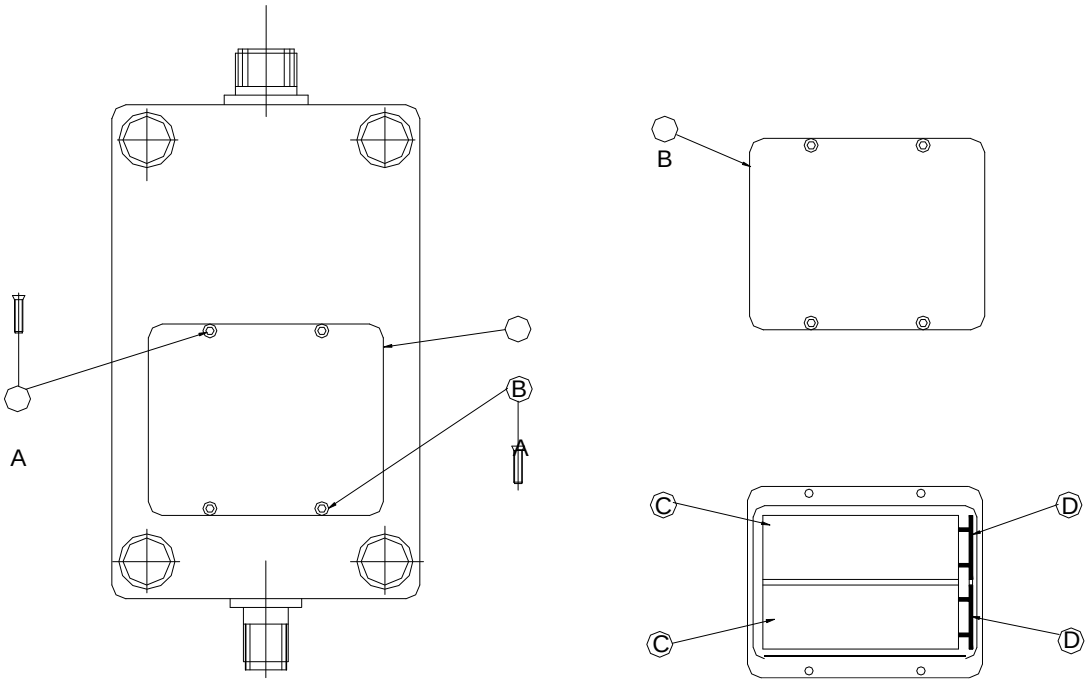


Figure 11 Battery replacement details

1. Set the Power Switch to off.
2. Remove the two Phillips-head screws from the small panel on the back side of the instrument, then remove this panel.

3. Lift out the batteries, and disconnect the snap-on connectors).

4. Replace the batteries with 9 volt Alkaline, or Zinc-Carbon type with reduced average life.
5. Reassemble in the reverse order, then check for the proper voltage output as described in the preceding paragraph.

Checking Sensor Input Cable

Check that the connectors at each of the sensor cable (Accelerometer or IRD544) are correctly assembled to the corresponding sensor or instrument receptacle. Then, with the instrument power ON, check the cable for an intermittent connection by moving it slightly near the ends, or by substituting with another cable. The connection to the vibration sensor may be checked by setting the RANGE selector fully clockwise and then hand-shaking the sensor. The Amplitude meter should indicate a vibration reading when the sensor is moving, and should settle back to zero when the sensor is held still.

Checking Instrument Operation with Optional Calibrator

The instrument circuits and sensor cable can be conveniently checked for proper operation and calibration with the optional Calibrator. To install the Calibrator, set the POWER switch to OFF. Disconnect the external end of the accelerometer input cable, and connect the cable to the threaded receptacle on the Calibrator. Then, check the instrument by performing the circuit tests listed in Chapter 3.

5.3 Instrument Calibration Procedure

The test equipment required for calibration of the model IRD811 instruments are listed below. Also, the circuit connections required is shown in Figure 12. The equipment should be installed with the test leads connected to the model IRD811 input receptacle as shown in this figure.

The calibration procedure described herein is supplied for the customer information. No attempt to disassemble or calibrate the unit should be made except by an experienced, qualified technician using the proper test equipment. IRD Mechanalysis assumes no responsibility for the operation or units repaired or calibrated outside the factory or at an unauthorized service centre.

Test Equipments required

1. Digital Voltmeter.
2. Signal Generator.
3. Frequency Counter.
4. 100K ohm load resistor.
5. Vibration Input Connector.

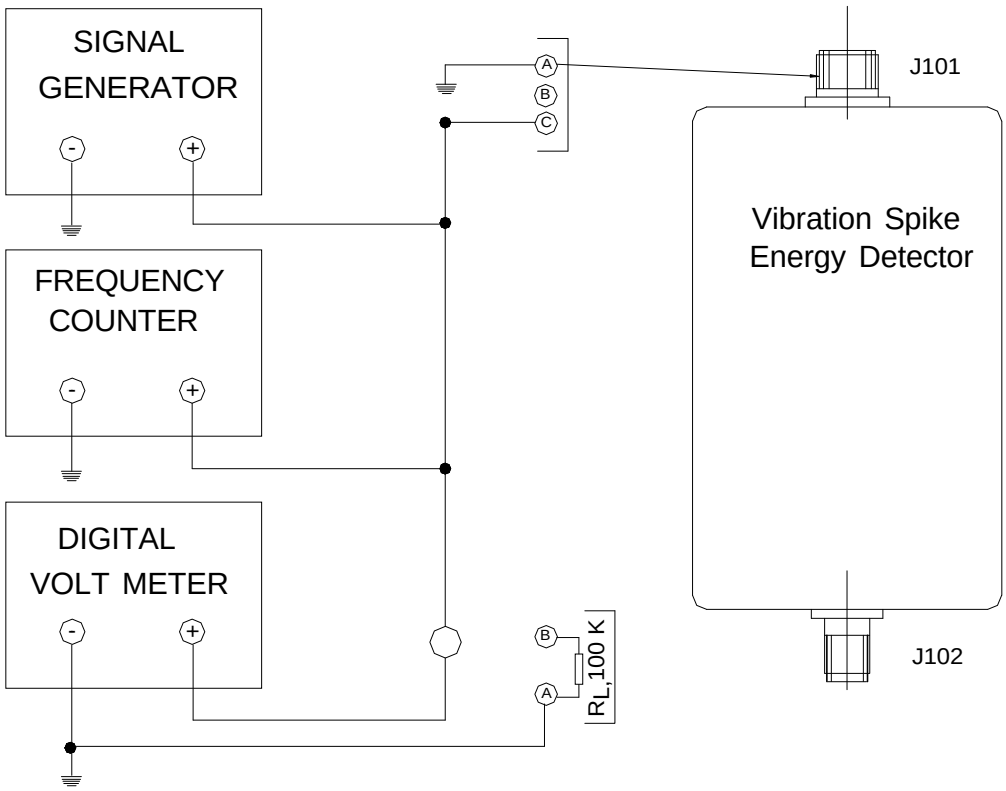


Figure 12 Calibration Test Connections

Preliminary steps

1. Meter Adjustment – If necessary, adjust the Amplitude meter zeroing screw on the front panel for a "0" indication.

2. Battery Test – The internal batteries must be checked for an adequate output before the instrument can be calibrated.

3. Case Disassembly – To gain access to the calibration controls, the lower case must be separated from the chassis. The Two screws at either cable receptacle which attach to the lower case must first be removed. Then, the four screws that are hidden by the rubber feet may be removed and the case disassembled.

Acceleration calibration

1. Connect the test equipment to the instrument input connector as shown in Figure 12. Pin C is the velocity (+) input, and Pin A is ground.

2. Set the MODE selector to ACCEL, and the AMPLITUDE RANGE TO "I g"
3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 63.63 mV RMS
   FREQUENCY – 100 Hz

4. Connect a 100K ohm load resistor across Pins A and B of the Analyser/Scope Output Receptacle (J102).

5. Adjust RI53 (Accelerometer Calibration Pot) for an Amplitude meter reading of .90

NOTE:

For SA instrument versions, ignore Steps 6 and 7.
.

6. Set the DVM to measure AC voltage, and connect the test leads to the Analyser/Scope Output receptacle as follows :

   (+) SIGNAL – Pin B
   GROUND – Pin A

7. Adjust R154 (AC Output Cal) for a DVM reading of 271 mV RMS at the output receptacle. Disconnect the DVM test leads from the Scope Output receptacle.

Velocity Calibration

1. Check that the generator (+) signal lead is connected to Pin C and the ground to Pin A on the input connector.

2. Set the MODE selector to VEL, and the AMPLITUDE RANGE to 300

3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 70.7 mV RMS
   FREQUENCY – 100 Hz

4. Adjust R151 (Velocity Calibration pot) for a reading of 15.6 mm/sec pk on the Amplitude meter.

Displacement Calibration

1. Check that the generator (+) signal lead is connected to Pin C and the ground to Pin A on the input connector.

2. Set the MODE selector to DISP 1400, and the AMPLITUDE RANGE TO 100
3. Adjust the signal generator to obtain the following output:
   SIGNAL AMPLITUDE – 70.7 mV RMS
   FREQUENCY – 100 Hz
4. Adjust R152 (Displacement Calibration pot) for a reading of 49.7 microns pk – pk on the Amplitude meter.

5. Set the MODE selector to DISP 350, and check that the Amplitude meter indicates approximately the same reading.

Bearing/Gear (gSE) Calibration

1. Check that the generator (+) signal lead is connected to Pin C and the ground to Pin A on the input connector.

2. Set the MODE selector to BEARING/GEAR and the AMPLITUDE RANGE to “1”

3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 35.35 mV RMS
   FREQUENCY – 10K Hz

4. Adjust R155 (B/G Cal) for a reading of 0.5 on the Amplitude meter.

ISO Mode Check (model IRD811 only)

1. Check that the generator (+) signal lead is connected to Pin C and the ground to Pin A on the input connector.

2. Set the MODE selector to ISO, and the AMPLITUDE RANGE TO “30”.

3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 70.7 mV RMS
   FREQUENCY – 61.4 Hz

4. Check the Amplitude Meter for a reading of 18 millimeters/sec (in RMS velocity units).

IRD544 Velocity Calibration

1. Connect the signal generator and the DVM test leads to the input receptacle as follows:

   (+) SIGNAL – Pin B
   GROUND – Pin A
   *Also, ground Pin F to Pin A

2. Set the MODE selector to VEL and the AMPLITUDE RANGE selector to 30

3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 688 mV RMS
   FREQUENCY – 100 Hz

4. Adjust R150 (IRD544 Velocity Calibration pot) for an Amplitude meter reading of 23.

IRD544 DISPLACEMENT (350 CPM) MODE CHECK

1. Check that the generator (+) signal lead is connected to Pin B and the generator ground to Pins A and F on the input connector.

2. Set the MODE selector to DISP 350, and the AMPLITUDE RANGE TO 30.

3. Adjust the signal generator to obtain the following output:

   SIGNAL AMPLITUDE – 764 mV RMS
   FREQUENCY – 318 Hz

4. Check that the Amplitude meter indicates a reading of approximately 25.4 micrometer.

IRD544 DISPLACEMENT (1400 CPM) MODE CHECK

1. Check that the generator (+) signal lead is connected to Pin B and the generator ground to Pins A and F on the input connector.

2. Set the MODE selector to DISP 1400. The AMPLITUDE RANGE is set to 30.

3. Check that the signal generator is adjusted as follows:

   SIGNAL AMPLITUDE – 764 mV RMS
   FREQUENCY – 318 Hz

4. Observe the Amplitude meter, and check that a reading of 25.4 micrometers is indicated.

5. Disconnect the test leads from the instrument.

NOTE:

This completes The calibration procedures for the Vibration-SPIKE ENERGY Detector.
.

6. SPECIFICATIONS

6.1 IRD811 Portable Vibration Meter (Accelerometer)

Part Number M81101

The IRD Mechanalysis model IRD811 plays a dual role in machinery maintenance: - It is used for periodic vibration checks for unbalance, misalignment, looseness, etc. With an industry standard high frequency detection circuit, it pinpoints incipient bearing and gear deterioration.

Its solid-state circuitry provides wide dynamic range and long battery life. From precision bearing inspection to plant-wide maintenance, the IRD811 has the sensitivity for measuring fractions of a micrometer to 3000 micrometers with 8 easy to read overlapping ranges.

The IRD811 also includes the widely acclaimed IRD Spike energy circuit. The broadband measurement of Spike Energy (units of gSE™) has proved to have the advantage of simplicity and earlier warning of bearing and gear defects.

By detecting and measuring “bursts” of spike energy at ultrasonic frequencies, defects such as micro spalls and cracks and lack of lubrication can be quickly identified.

Standard Accessories	Qty	Part Number
Accelerometer Multi-purpose, model IRD511 - 100 mV/g, 2.0 Hz - 10 kHz, top connector	1	M5111005001000
Cable Assembly for model IRD811 to IRD511 accelerometer - 1.5m rubber insulated, shielded	2	M60021
Stinger Al 225mm Straight for Sensor	1	M24827
Battery Set, 3 Nos. of 9V, 100mAH Dry Cells for model IRD811	1	M30643
Carrying Case	1	M25345
Manual Operating	1	M21072

Optional Accessories	Part Number
Inductive Velocity Sensor model IRD544	M45260
Cable for Model IRD544 Sensor 1.5m (4 ft)	M20432
Cable for Model IRD544 Sensor 8m	M21045
Magnetic Portable Base for IRD544 Inductive Velocity Sensors	M43320
Magnetic Portable Base for IRD Accelerometers	M24828
Magnetic Deflecting Shroud for model IRD544 Sensor	M10449
Scope/Analyser AC output	M58570
Manual Training - IRD Mechanalysis Vibration Technology 1	M51001
Shaft Fish Tail Stick - Absolute Vibration IRD500 Series Sensors	M24824

6.1 SPECIFICATION (contd.)

Frequency – with Accelerometer

Displacement (350 CPM):	- 350 to 60,000 CPM	(5.8 Hz to 1,000Hz)
Displacement (1400 CPM):	- 1400 to 60,000 CPM	(23.3 Hz to 1,000 Hz)
Velocity:	- 350 to 600,000 CPM	(5.8 Hz to 10,000 Hz)
Acceleration:	- 350 to 600,000 CPM	(5.8 Hz to 10,000 Hz)
Bearing/Gear	- Up to ultrasonic frequencies	
RMS	- V_{RMS} – ISO 10816-3 & BS4675	

Amplitude

Acceleration Range:	- 0 to 100 g Pk in 8 overlapping ranges
Bearing/Gear Check Range:	- 0 to 100 gSE™ in 8 overlapping ranges
Spike Energy:	- Special circuit designed to detect gSE™
Displacement Range:	- 0 to 3,000 microns pk to pk in 8 overlapping ranges
Velocity Range:	- 0 to 3,000 mm/sec pk in 8 overlapping ranges:

Frequency – with IRD544 velocity sensor

Displacement (350 CPM):	- 600 to 60,000 CPM	(10 Hz to 1,000 Hz)
Displacement (1400 CPM):	- 1400 to 60,000 CPM	(23.3 Hz to 1,000 Hz)
Velocity:	- 600 to 60,000 CPM	(10 Hz to 1,000 Hz)

Amplitude

Displacement Range:	- 0 to 3,000 microns Pk to Pk in 8 overlapping ranges
Velocity Range:	- 0 to 3,000 mm/sec Pk in 8 overlapping ranges:

Input / Output

Inputs:	- Accelerometer
	- IRD544 Velocity Sensor
	- Quick-connect receptacle
Outputs:	- Analog amplitude meter, microns, mm/sec, g, gSE™
	- Scope/Tape Recorder/Analyser AC output receptacle

Power Requirements

Internal Batteries:	- Battery Set, 3 Nos. of 9V, 100mAH Dry Cells
Battery Test:	- Battery condition check indicated on meter

Environmental

Operating temp:	- -1°C to 65°C
Storage temp:	- -20°C to 65°C

Packaging

Case:	- Aluminum with dust and splash proof seal
Battery compartment:	- Easy access for quick change of batteries
Carrying case:	- Holds instrument and standard accessories

Weight & Dimensions

Instrument:	- 1.05 Kg
Dimensions:	- 210mm (L)× 116mm (W) × 78mm (H)
Carrying case:	- 2.25 Kg (inc. meter, standard accessories)

™ Spike Energy and gSE is a trademark of IRD Mechanalysis Inc.

6.2 IRD511 Accelerometer

Accelerometer: Top Connector
General Applications

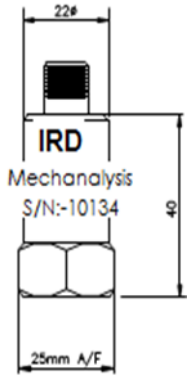
Model No: IRD511

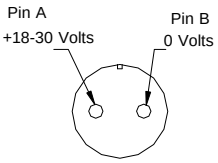
Part Number: M5111005001000

The IRD Mechanalysis model IRD511 is a general-purpose accelerometer with a 2 pin IRD cable top socket for rugged industrial machinery vibration sensor; used with portable and on-line measuring instruments.

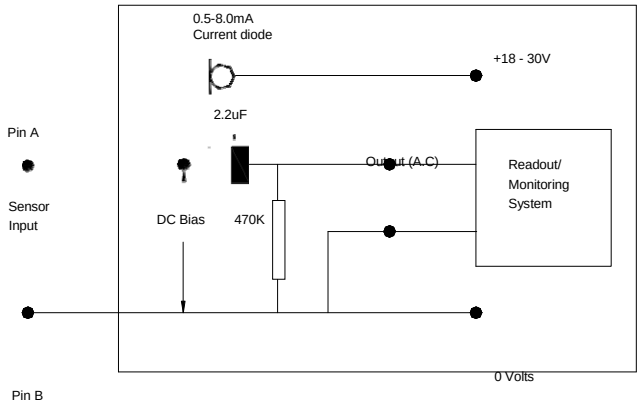
Applications: Applies to most Process Plants using Compressors, Blowers, Conveyors, Cooling Tower Fans, ID, FD, PA Fans, CW Pumps, Gear Boxes, Motors, Paper Machinery, Turbines etc.

Supplied Accessories	Qty	Part Number	Optional Accessories	Qty	Part No.
Mounting Hardware Stud	1	M6	Cable 15.2m IRD connector	1	M60048
Calibration Certificate	1	CCIRD511	Magnetic Holder	1	M24746





Typical Connection



Technical Performance

Mounted Base Resonance	22 kHz (nominal)
Sensitivity	100 mV/g ± 10% Nominal 80 Hz at 22°C
Frequency Response	2 Hz to 10 kHz ± 5% 0.8 Hz to 15 kHz ± 3 dB
Isolation	Base isolated
Measurement Range	± 80g
Transverse Sensitivity	Less than 5%

Electrical

Electrical Noise	0.1 mg max
Current Range	0.5 mA to 8 mA
Bias Voltage	10 – 12 Volts DC
Settling Time	2 seconds
Output Impedance	200 Ohms max
Case Isolation	$>10^8$ Ohms at 500 Volts

Environmental

Operating Temperature Range	-55 to 140°C
Sealing	IP67
Maximum Shock	5000 g
Emissions	EN61000-6-4:2001
Immunity	EN61000-6-2:1999

Mechanical

Case Material	Stainless Steel
Sensing Element /Construction	PZT / Compression
Mounting Torque	8 Nm
Weight	110 gms (nom)
Maximum Cable length	1000 meters
Connector	2-pin IRD-C-5015
Mounting	¼" – 28 UNF Female
Options	Integral cable, filters, temperature output, various connector assemblies, other sensitivities

IRD Mechanalysis Ltd. continuously improves products; it therefore retains the right to change the above specification without notice

7. Appendix A

Use of Spike Energy measurement to detect defects in rolling element bearings and gears

1) SPIKE ENERGY CIRCUITS

The SPIKE ENERGY detection circuits are designed to sense the amplitude of the microsecond range pulses caused by impacts between bearing elements which have microscopic flaws. In addition to detecting pulse amplitude, these circuits also detect the rate of occurrence of the pulses and the amplitude of the high frequency random broad band vibratory energy associated with bearing defects. These three parameters of pulse amplitude, pulse rate and high frequency random vibratory energy are electronically combined into a single quantity called 'g-SE", which is a measure of bearing condition. The term 'g-SE" (i.e. acceleration units of SPIKE ENERGY) has been selected to indicate that this type of measurement is more comprehensive than g-peak and g-RMS measurements.

2) ESTABLISHING A BEARING DEFECT DETECTION PROGRAM

To establish a program for checking the condition of rolling element bearings, a "comparison" method can be used. That is, the g-SE levels of the similar machines are measured and any levels which significantly depart from the average are singled out for further analysis, and closer watch, as potential bearing problems. This method rapidly leads to the establishment of criteria levels which distinguish good and bad bearings. It should be noted that the g-SE levels depend on the machine rotation speed (RPM), and typically double for each doubling of RPM. From a vibration severity standpoint, however, it should be kept in mind that low speed bearings can usually tolerate more damage than high speed bearings, since low speed bearings tend to deteriorate more slowly than high speed types.

The use of "trending" is another way of detecting defective bearings. In this method, the machine bearings are measured periodically and their g-SE levels recorded. No change in the level over a period of time indicates a good bearing, while a significant upward trend indicates a deteriorating bearing.

As an additional aid in establishing g-SE level criteria for good and bad bearings, general experience indicates that when making bearing checks of machines in the 600 to 3600 RPM range with the 9-inch probe a g-SE level of 0.5 or greater is often an indicator of a defective bearing. This number should, of course, be used with caution since many factors can affect the level measured, such as bearing type, machine type, etc. It should also be noted that where greater sensitivity to bearing defects is desired, the transducer can be flush mounted (i.e., without 9-inch probe) to the bearing housing; or, alternately a magnetic holder may be used. In all cases the probe, or transducer should contact the bearing housing with a light, steady pressure in such a manner that no chatter occurs. NOTE: The g-SE levels will vary depending upon the method of attachment used. Thus, the severity-criteria developed must be related to the attachment used.

3) GEAR DEFECTS

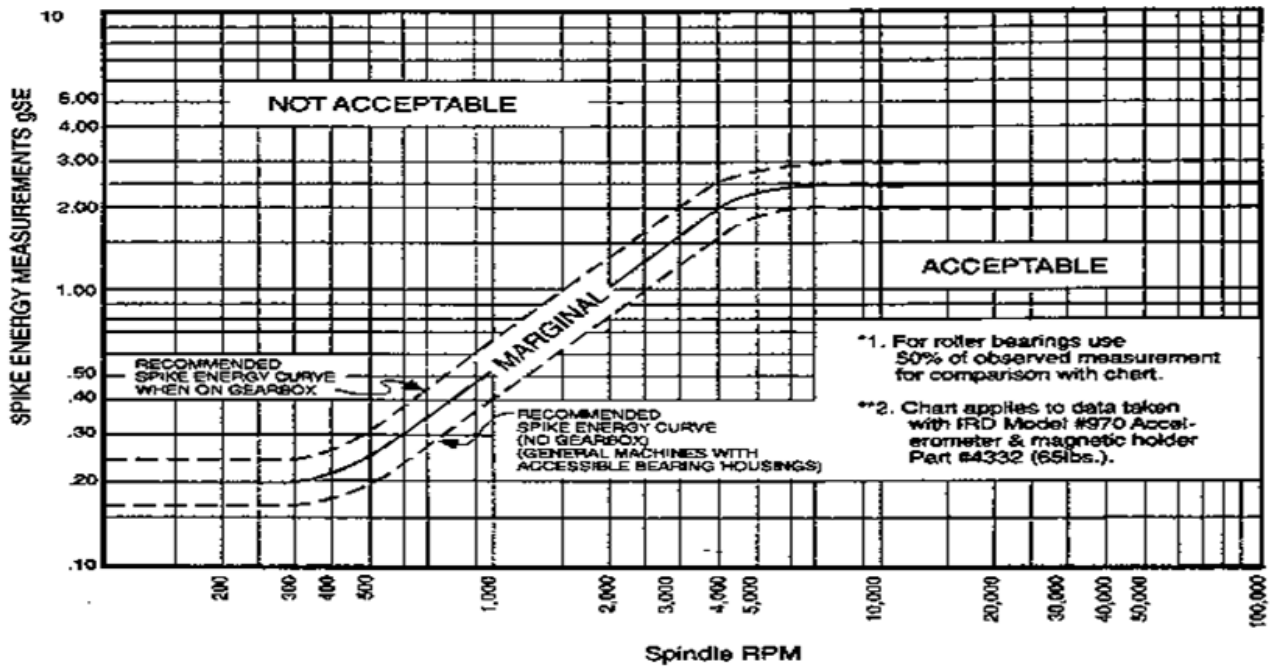
A program to detect incipient gear defects can be established in the same manner as that described above for rolling element bearings.

4) OTHER SOURCES OF SPIKE ENERGY SIGNALS

When taking bearing checks, it must be kept in mind that there are sources other than bearings which give off SPIKE ENERGY signals. Gears, cavitation, rubbing or striking of metal parts such as seals and coupling guards, are some of the more common sources which are likely to be encountered. These sources, if close to the bearing frequencies being measured, should be checked to avoid possible misinterpretation of the data.

5) ROLLING ELEMENT BEARING g-SE SEVERITY CHART

A “Rolling Element Bearing g-SE Severity Chart” is shown in the figure below. This chart can be used as an aid in establishing g-SE severity criteria. No specific severity levels such as “smooth”, “good”, etc., are assigned, since many variables (bearing types machine types, speed, loads, etc.) can affect the levels measured. Some case histories, however, are plotted on the chart to illustrate the type of results which can be obtained. By plotting the g-SE levels of your machines included in the bearing-check program on a chart, severity criteria can be readily developed for the individual machines.



Recommended Spike Energy severity chart (IRD Spike Energy)
Severity Chart Guidelines For Ball Bearings*
Figure 1

3600 RPM = 1.4 gSE
1900 RPM = .70
1200 RPM = .50
900 RPM = .35
600 RPM = .25

} Normal gSE alarms for standard RPM machs. (IRD 970 Accelerometer & Magnet WITHOUT GEARBOX)

ROLLING ELEMENT BEARING g-SE SEVERITY CHART

Keeping you going

8. Support Services

Keeping you going is a IRD Mechanalysis commitment. Product support is an essential aspect of any progressive business. IRD Mechanalysis Limited is no exception; the company has been supporting former IRD, then Entek well as IRD's products for the past 25 years. Indeed the acceptance and usage of these products by Indian industry is directly attributed to the dedicated support IRD has provided. IRD continues to invest in Customer Support. Just 'keeping you going' is not enough; we have facilities to ensure systems match world standards. Our instruments and systems are calibrated to National Standards.

National Service Centre, Mumbai

The very nature of industrial electronic instruments, both portable and permanent, demands regular calibration. From time to time it becomes necessary to repair of damaged items such as cables, sensors, power supplies and occasionally electronic circuitry etc. IRD Mechanalysis is well equipped for such eventualities

When equipment is in need of repair, a reliable repair centre that is responsive, convenient, and cost effective is required. IRD Mechanalysis Ltd offers in-house as well as site calibration (traceable to National Standards) and repair services. This also covers our partner's product range; IRD also supports many obsolete products where components are still available or have been indigenized.

As the original equipment manufacturer (OEM), we are the most knowledgeable and the qualified to service our products. Supported by more than 50 combined years of technical service experience, our repair technicians provide the highest quality service for your IRD products. At our **National Service Centre** in Mumbai we stock a comprehensive supply of spare parts to ensure a quick turnaround.

BENEFITS and FEATURES

For IRD Mechanalysis Ltd's customers, the **National Service Centre** offers the following:

- Fast in-house turnaround options
- Expert factory technical assistance
- Industry competitive repair charges
- In-house calibration of vibration sensors (traceable to National Standards)
- Regular cleaning and calibration to extend product life and reliability
- Instrument hire during repair period to minimize programme interruption
- 1 Year warranty on Product Exchange Programme
- Fixed Price Repair – Whole Product 3 months warranty
- 90-day parts warranty on all repair and calibration services

PRODUCTS SUPPORTED

The **National Service Centre** has the capability to support the following products:

- Data Collectors: IRD817, IRD818, IRD890, IRD Fast Track®, dataPAC®1000, dP1250, dP1500; Enpac® series. Also Commtest VB series of vibration Analysers and profiler
- Portable Instruments: IRD306, IRD306, IRD306C, IRD306D, IRD306DD, IRD308, IRD350, IRD355, IRD360, IRD810, IRD811, IRD811, IRD811D, IRD820, IRD838, IRD870, IRD880, IRD885
- Protection Monitors: 5802, 5806, 5815, 5915, 5800 Cards, 6100, 6600 Series, IRD8700 Series, IRD8800 Monitor
- Machinery Diagnostic Systems: Beran 766, 767, 768
- Machinery Protection Transmitters: IRD7100 Series, IRD7200 Series, IRD7300 Series
- Balancing Systems: 245, 246, IRDB50 and IRDB150

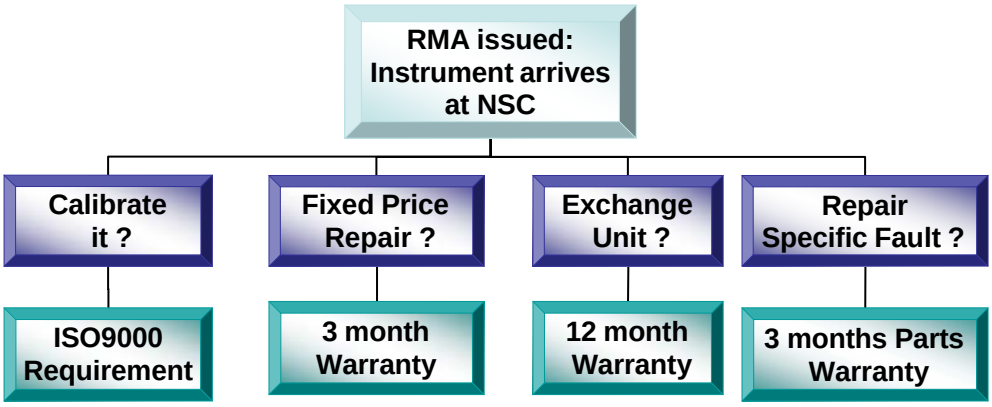
™ dataPAC, Enpac, and Fast Track are trademarks or registered trademarks of IRD IRD Mechanalysis

Turnaround time and repair capabilities are dependent upon condition of equipment and spare parts availability at the time of the product assessment.

How the National Service Centre Optimises Clients Investments

- Annual Maintenance and Calibration ensures years of trouble free operation to maximize the investment in your condition monitoring equipment.
- A complete in-house supply of spare parts assures quick turnaround for product repairs.
- State of the art Sensor Calibration automatically over the full frequency range traceable and up to date to National Standards of the UK.
- IRD Mechanalysis Ltd ISO 9001:2008 certification guarantees quality repairs and service.
- Our highly qualified Repair Centre technicians, supported by more than 50 combined years of technical service experience, give you the best available service and results.
- As the only authorized service centre for IRD Mechanalysis Ltd Products, our **National Service Centre** provide the most knowledgeable, experienced and committed support for all of our products.
- We offer a IRD Product Exchange Programme, Fixed Price Repair or Standard Repair and Calibration Only Services: the applicable warranty benefits are given below:

Service Options & Process



HOW TO GET SERVICE?

1. Before dispatching any instrument, cable, sensor etc it must be given an RMA number issued by the **NSC,** see below
2. For a Return Material Authorization number (RMA) this can be downloaded from our web site: www.irdmechanalysis.com
3. To discuss any instrument servicing issues please call Tel: +91(0)22-2852-0178 or one of our Regional Offices
4. Alternatively Email us at : service@irdmech.com
5. Complete the RMA and fax back to IRD Mechanalysis at Fax: +91(0)22-2832-1814
6. When the RMA has been issued, the Client sends the instrument with all accessories together with the Purchase Order making reference to the RMA Number.
7. Upon receipt, IRD will evaluate the instrument and make a recommendation to the Client (if no instructions on type of service have been received earlier).
8. Only when the repair has been completed and payment has been received, will the instrument be returned to the Client.
9. Warranties will apply depending on the Repair Category option

LOCATIONS

National Service Centre
Marol Co-op. Industrial Estate Ltd,
Off. Mathurdas Vasanji Rd,
Marol
Andheri (East)
Mumbai
400 059
INDIA
Tel: +91(0)22-2852-0178
Tel: +91(0)22-2859-6214 / 6573
Fax: +91(0)22-2832-1814
Email:-service@irdmech.com

Head Office (Registered) 1/5,
47 – 48 Jolly Maker Chambers II
Nariman Point
Mumbai
400 021
INDIA
Tel: + 91(0)22-2202-7430
Fax: +91(0)22-2285-0480
Email: ceopa@irdmech.com
Web:-www.irdmechanalysis.com

RMA (Return Materials Advisory) Form

ATTN: IRD Mechanalysis Ltd, National Service Centre, 1/5 Marol Co-op, Industrial Estate Ltd, Off Mathurdas Vasanji Road, Marol, Andheri (E), Mumbai 400 059, India. +91(0)22-2852 0178 / 2906

FAX BACK RMA FORM: +91(0)22-2852 1814 or Email to : service@irdmech.com

Product Model:	Serial No:
Fault details (if applicable): *Please tick appropriate box*	

Warranty	Calibration	Fixed Price Repair	Exchange Units	Standard Repair

This is to advise that we are planning to dispatch the above instrument for Calibration / Repair, as detailed above, on (date):_____

Customer's Purchase Order No:		**Date:**	
P.O. Value: Rs. (if agreed)			
AMC Contract No (if applicable)**:**			

A purchase order must be provided before inspection will commence unless an AMC Contract is in place.

When NSC receives the Return Material Authorization it will issue an RMA number. Only then send in the instrument with its RMA Nos tagged on the instrument for tracking purposes. A PO must accompany the instrument referencing the RMA Nos.

Please complete the details below to enable us to process your requirements as quickly as possible.

MUST BE COMPLETED IN ALL CASES

Invoice Address	
Company:	
Department	
Address:	
City	
State	
PIN	
Contact Name:	
Telephone:	
Mobile:	
Fax:	
Email	

Delivery Address	
Company:	
Department	
Address:	
City	
State	
PIN	
Contact Name:	
Telephone:	
Mobile:	
Fax:	
Email	
Users Name:	
Designation	
Signature	
Date	

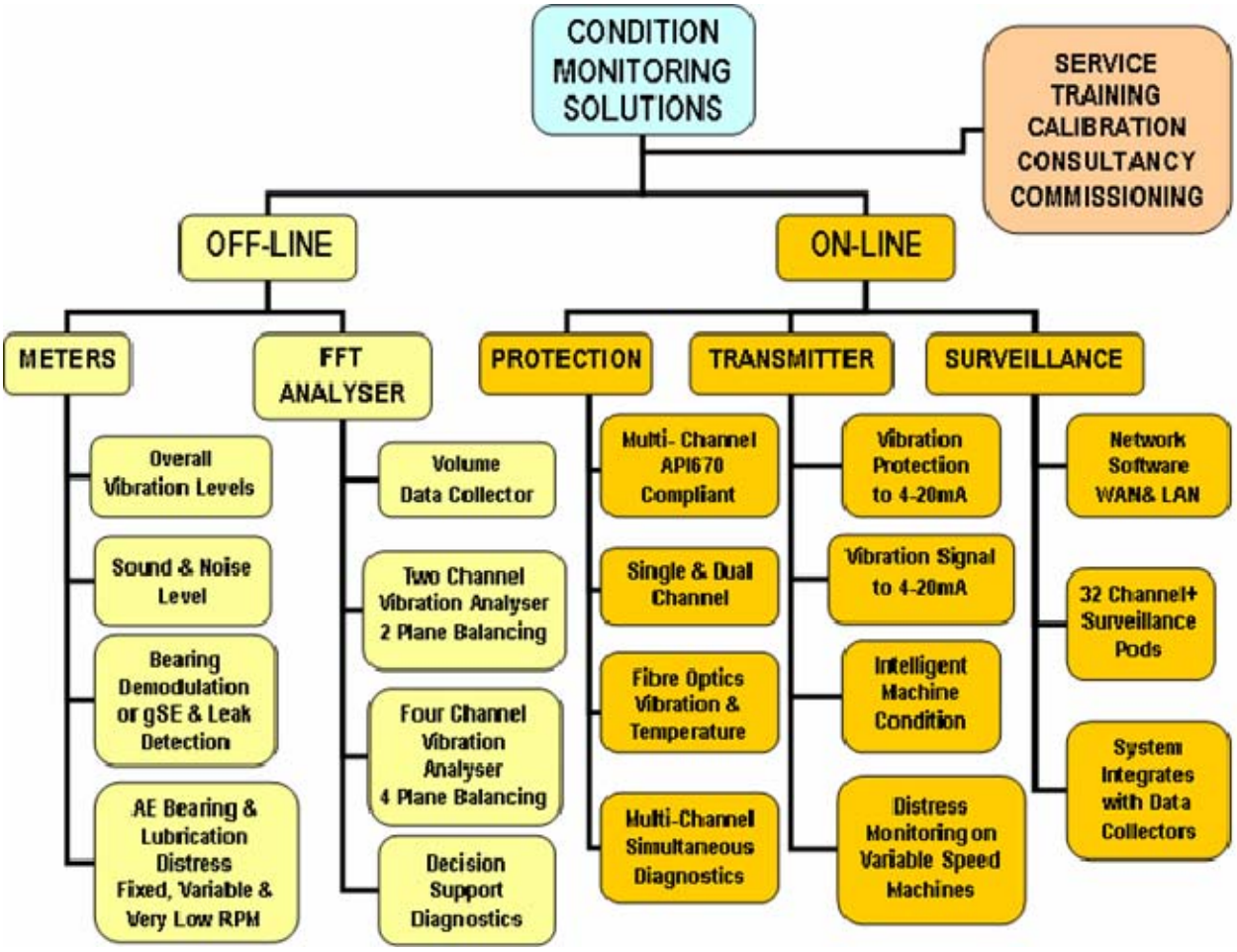
NSC RMA NUMBER ISSUED: RMA/

Taking you further

8. Vibration Based Condition Monitoring Solutions

IRD Mechanalysis Ltd is a leading provider of condition management solutions with over 30 years' experience in machinery vibration measurement. IRD is credited with pioneering the concept of vibration based condition monitoring programmes in India. With the advent of computerization, IRD has established and maintained over 250 automated vibration based CM systems and has a user base of over 2200 major Producers and OEMs In India. IRD will continue to introduce new technologies to match your needs and reduce the cost of Condition Management. IRD is now rapidly expanding its International Export Division globally.

We take you further by providing reliable, easy to use, rugged and a comprehensive range of vibration monitoring products & solutions (as depicted in the chart given below) and enable you to enhance your productivity and investment. We look forward to your continued support and patronage.



****