MONARCH INSTRUMENT

Instruction Manual

EXAMINER 1000

Vibration Meter with Electronic Stethoscope

CE

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SAFEGUARDS AND PRECAUTIONS

1. Read and follow all instructions in this manual carefully, and retain this manual for future reference.
2. Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.
3. This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product.

In order to comply with EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE): This product may contain material which could be hazardous to human health and the environment. DO NOT DISPOSE of this product as unsorted municipal waste. This product needs to be RECYCLED in accordance with local regulations; contact your local authorities for more information. This product may be returnable to your distributor for recycling; contact the distributor for details.

Monarch Instrument's Limited Warranty applies.
See www.monarchinstrument.com for details.

Warranty Registration and Extended Warranty Coverage information is available online at www.monarchinstrument.com.

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1.0 DESCRIPTION

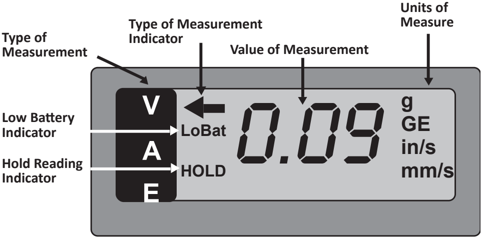
The **EXAMINER 1000** is designed to be used with vibration limits established in ISO Standard 10816 to help you detect signs of malfunction or changes in rotating machinery during operation. This is accomplished with overall vibration (ISO VIB) and envelope measurements. Problems with bearings occur when there is a microscopic crack or flaw or when there is a breakdown in lubrication which leads to metal-to-metal interaction. The EXAMINER 1000 is designed to detect flaws or a lack of lubrication in bearings and gears at an early stage by measuring the high-frequency impacts through acceleration envelope methods.

Vibration measurements are made by pressing the accelerometer sensor against designated Measurement Points on your equipment with either the stringer probe or with the magnetic base.

2.0 CONTROLS AND FUNCTIONS

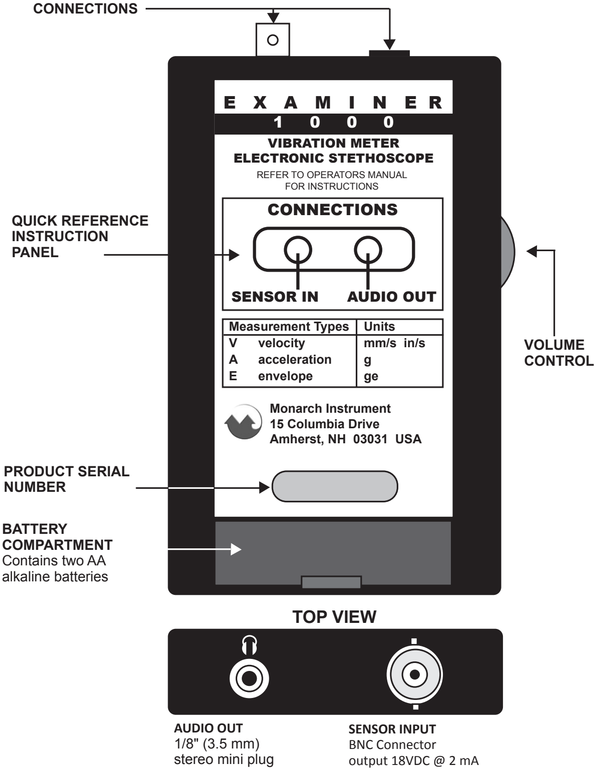
ON/SELECT Button — Press this button to turn power ***on***. Power automatically turns ***off*** after ten minutes of non-use.

After turning the EXAMINER on, press the ON/SELECT button again to select the measurement type. Pressing and holding the ON/SELECT button while collecting data will HOLD the display value, indicated by the word HOLD in the display. To release from HOLD mode, press the ON/SELECT button again.



DISPLAY — The digital display shows the numerical value of the measurement. An arrow indicates the measurement type selected. The units of vibration are automatically displayed as the type of measurement is selected. The user may work in either metric or imperial units in the **V**-velocity mode.

3.0 REAR PANEL CONNECTIONS



4.0 OVERVIEW OF DATA COLLECTION PROCEDURE

1. Press the ON/SELECT button.

2. Press the ON/SELECT button again to select the desired measurement type. Place the accelerometer sensor on the machinery Measurement Point; use proper probe technique as discussed on the following pages.

3. Wait for the reading to stabilize, then press and hold the ON/SELECT button to hold the measurement as indicated by HOLD in the display.

4. Adjust headphones volume level and listen for any distinct patterns or noises.

5. Record the measurement value in your *Machinery Data Worksheet*.

6. To release the HOLD function, press ON/SELECT again.

7. Repeat the above steps for each Measurement Point.

5.0 WHAT IS PREDICTIVE MAINTENANCE?

Predictive Maintenance can be defined as collecting information from machines as they operate to aid in making decisions about their health, repair, and possible improvements in order to estimate when maintenance should be performed before any unplanned breakdown. Machinery maintenance has evolved because of the demands to become more profitable through reduced maintenance costs. Below is the progression of these maintenance philosophies:

- Break Down Maintenance
- Preventive Maintenance
- Predictive Maintenance

Break Down Maintenance occurs when repair action is not taken on a problem until the problem results in the machine's failure. Run to failure problems often cause costly secondary damage along with expenses resulting from unplanned downtime and unplanned maintenance.

Preventive Maintenance occurs when a machine, or parts of a machine, are overhauled on a regular basis regardless of the condition of the parts. While better than run to failure, preventive maintenance results in excessive downtime due to unnecessary overhauls and the excessive costs of replacing good parts along with worn parts.

Predictive Maintenance is the process of determining the condition of machinery as it operates, to predict and schedule the most efficient repair of problem components prior to failure. Predictive Maintenance not only helps plant personnel eliminate unplanned downtime and the possibility of catastrophic failure, but allows them to effectively order parts, schedule manpower, and plan multiple repairs during scheduled downtime.

5.1 Benefits of Predictive Maintenance

Documented experience proves that plants which establish a predictive maintenance program are able to:

- **Improve Machinery Reliability** — reduced "unplanned failures"
- **Reduce Maintenance Costs** — knowing the exact problem to fix
- **Increase Production** — optimize machinery capabilities
- **Lower Energy Consumption** — less vibration usually means less friction
- **Extend Bearing Service Life** — reduce vibration and lubrication failures
- **Improve Product Quality** — where less vibration improves finish

The benefits are numerous and will vary depending upon the implementation of your Predictive Maintenance Program.

6.0 COMMON PREDICTIVE MAINTENANCE MEASUREMENTS

6.1 Vibration

Vibration is considered the best operating parameter to judge dynamic conditions such as balance (overall vibration), bearing defects (enveloping) and stress applied to components. Many machinery problems show themselves as excessive vibration. Rotor imbalance, misalignment, mechanical looseness, structural resonance, soft foundation, and gear mesh defects are some of the defects that can be measured by vibration. Measuring the “overall” vibration of a machine, a rotor in relation to a machine or the structure of a machine, and comparing the measurement to its normal value (norm) indicates the current health of the machine.

The EXAMINER 1000 measures the vibration of a machine while it is operating. Trending these measurements shows how a machine’s condition changes over a period of time. Analyzing these, along with other measurements, provide insight into the condition of the machine and which components may be wearing or failing. How to best monitor a machine’s condition requires one to know which measurements to take and where and how to take them. Sensors are placed at strategic Points on the machinery to monitor the machine’s condition.

The EXAMINER 1000 processes the accelerometer’s mechanical vibration energy into an electrical signal and displays the measurement value in numerical form for evaluation. Commonly measured physical characteristics in Predictive Maintenance are:

- Vibration (as explained above)
- Temperature
- Oil Analysis

6.2 Temperature

As a bearing fails, friction causes its temperature (or its lubricant’s temperature) to rise. While trending a bearing, if the temperature rises followed by a vibrations increase, then it is safe to conclude there was a loss of lubrication which induced the mechanical failure. If vibration increased first, followed by increased temperature readings, then a mechanical defect caused the lubrication failure.

6.3 Lube Oil Analysis (Ferrography)

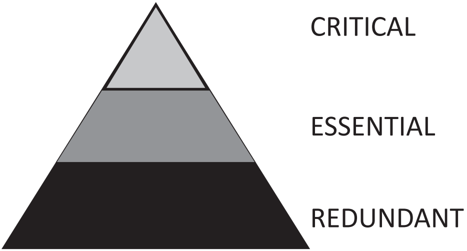
Monitoring oil condition warns of an increase in foreign substances, such as water, which can degrade the lubricating properties of the oil and cause bearing failures. It also detects the presence of metallic particles carried into the oil stream. These metallic particles are analyzed to determine which part of the machine is wearing and how fast. Lubrication analysis is the earliest warning of a developing problem.

7.0 SELECTING MACHINERY AND MEASUREMENTS

Maintenance personnel have always made visual and hands-on inspections of their machinery on a periodic basis. Systematic data collection and trending allows for recall and comparison of events over time but is not a replacement for good maintenance practices. Collecting machinery data is an aid to the maintenance professional, which is used in addition to good maintenance practices.

7.1 Selecting and Classifying Machinery

Setting up an effective Predictive Maintenance Program requires a careful study of the needs of the plant. It is necessary to know each machine and its response to change. The following is an example of machinery classification:



7.1.1 Critical Machines

Critical Machines are typically expensive premium equipment that would have catastrophic health, safety, environmental or customer-related consequences if it failed. This category of equipment should be very well maintained and monitored, so continuous monitoring systems are better suited for this type of equipment. ***Personnel safety is always the first priority in selecting machinery to monitor***.

7.1.2 Essential Machines

Essential Machines are typically medium size equipment that may be bypassed economically for a short period of time. Less attention is typically paid to these machines even though their repair costs can be as high as critical machines. It is highly recommended to select some of these machines for your Predictive Maintenance Program.

7.1.3 Redundant Machines

Redundant Machines are typically small size equipment that have redundancy. This group typically has the largest percentage of all machines in a plant and yet they are usually neglected. At many facilities, this group consumes the largest percentage of the annual maintenance budget. If you want to have an immediate impact in your Predictive Maintenance Program, begin with these machines. Also include machines with known problems or a history of problems.

7.2 Selecting Measurements

Establish measurement types that most accurately reflect the condition of the equipment. Different causes or "mechanisms" are acting on the machine; various types of measurements have been developed to measure each type of mechanism. Those mechanisms are:

Stress: a force on the machine or components which deflects the part. Best measured in Displacement. The EXAMINER 1000 does not measure Displacement as it is a very low vibration frequency, below 10 Hz (600 RPM).

Fatigue: repeated cycles of stress on a component. If you bend a part back and forth enough times it will fatigue. As a general rule, fatigue failures result from vibration frequencies 10 -2000 Hz and Velocity measurements are used. Velocity will be the primary measurement taken.

Force: mass x acceleration. Measured in Acceleration. Acceleration is the rate of change of velocity. Acceleration is used for high frequencies above 2000 Hz (120,000 RPM). Bearing defects and gear mesh frequencies are usually found in this range.

Impact Forces: the result of fatigue. Impact forces are cyclical events which can be detected with Acceleration Enveloping. These are high frequency-low amplitude events and a filter in the EXAMINER 1000 is set at 10-30 kHz to measure them.

7.3 Selecting Measurement Intervals

Measurement intervals are set based on the classification of the machine, its repair history, and the amount of data required for a detailed trend analysis. At the beginning of a Predictive Maintenance Program, collect data frequently to build a rapid history of each machine. Adjust your program as you go. *If measurement results are indicating signs of change, measurements should be performed more frequently.*

8.0 TYPES OF MEASUREMENTS IN THE EXAMINER 1000

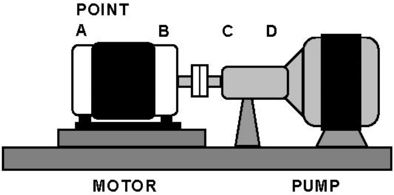
Velocity — good for frequency ranges 10-2000 Hz (600-120,000 RPM)

Acceleration — used for higher frequencies or speeds above 2000 Hz (120,000 CPM)

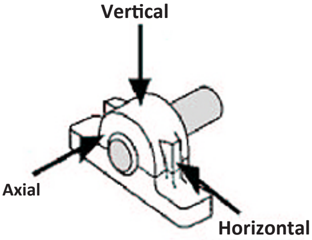
Acceleration Enveloping — uses a high pass filter to measure high-frequency, repetitive bearing and gear mesh vibration signals; used for early detection of developing bearing or lubrication problems. Use this type in combination with the other types to detect changes in machinery.

9.0 GETTING STARTED IN YOUR PLANT

Planning is essential for a successful Predictive Maintenance Program. In order to setup up a trending program you must collect data on the same point with the same measurement type at a defined interval. The EXAMINER 1000 is a helpful tool to collect this data. As an overall vibration meter with electronic stethoscope, the EXAMINER 1000 can be used as a stand-alone device for the collection of vibration data for trending or as a diagnostic instrument for troubleshooting machinery defects. The EXAMINER 1000 Kit comes with *Machinery Data Worksheet* that allows for record keeping of collected data.



Establish a standard naming convention so you can communicate your results to the rest of maintenance. Uniquely identify each machine and establish a starting point for each machine measurement. Begin from the OUTBOARD END of the DRIVE UNIT calling this Point A. Proceed to label Points (bearings) as needed until you have reached the outboard end of the driven unit.



Vibration readings should be taken on the bearing caps or as close to the bearings as possible. The vibration sensor can be placed in a Vertical, Horizontal, or Axial direction. For Vertical and Horizontal readings, the sensor is placed in a radial position.

Always collect data the same way, at the same point on the machine each time. **Repeatability is required for accurate trending.**

10.0 ESTABLISHING A DATA COLLECTION ROUTE

The *Machinery Data Worksheet* helps organize data for routine data collection. Vibration readings are taken on the Points (bearings) established in your route and recorded using your naming convention on the worksheet. Vibration, speed, temperature, pressure or any process data may be recorded using this type of systematic approach.

Steps for Route collection:

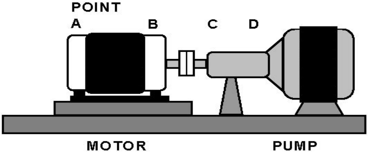
1. Determine the machines which require data collection.
2. Define each measurement type for data collection Points on each Machine. Several Points will have numerous readings i.e. VEL and ENV and Temp.
3. Establish a Route with the Machines grouped by physical location.
4. Walk the Route collecting and recording data for each Point in your *Machinery Data Worksheet*.

11.0 RECORDING DATA FOR A MACHINE

The vibration sensor is placed on each data collection Point. The Point, direction of the sensor, and the value are recorded on the *Machinery Data Worksheet*.

In the example shown right, Point AVV is taken on the outboard end of the motor, in the vertical position with a velocity type reading.

AHV = Point A in the horizontal position with a Velocity type.



Machine Identification Water Pump #707

Machine Description AC motor 1800 RPM, flexible coupling, 3 vane pump. CAUTION HOT WATER!!!

Date	Point	Direction	Type	Value
Jan 2 2021	A	V	V	0.06 in/s
Jan 2 2021	A	H	V	0.04 in/s
Jan 2 2021	A	X	V	0.03 in/s
Jan 2 2021	B	V	V	0.07 in/s
Jan 2 2021	B	H	V	0.05 in/s
Jan 2 2021	B	V	Env	0.001 ge

Example of Machinery Data Worksheet

12.0 WHAT ARE YOU MEASURING?

Vibration is the behavior of a machine's mechanical components as they react to internal or external forces. Since most rotating machinery problems show themselves as excessive vibration, we use vibration signals as an indication of a machine's mechanical condition. Also, each mechanical problem or defect generates vibration in its own unique way. We therefore analyze the "type" of vibration to identify its cause and take appropriate repair action. With overall vibration monitoring (VIB ISO) using the EXAMINER 1000, analysis of the cause of excess vibration relates to the monitoring equipment's probe position; either horizontal, vertical, or axial.

Horizontal: typically, unbalanced shafts tend to cause excess radial (horizontal and vertical) vibrations, depending on the machine support design.

Vertical: excessive vertical vibration can indicate mechanical looseness as well as imbalance.

Axial: excessive axial vibration is a strong indicator of misalignment.

It's important to note that these are general guidelines and that knowledge of your machinery and proper hand-held probe techniques are necessary to accurately analyze the cause of excessive vibration.

12.1 Multi-Parameter Monitoring

Use different measurement types to monitor your machinery for changes. This allows for early detection of specific machinery problems that may not show under normal overall vibration monitoring. For example, if a rolling element bearing has a defect on its outer race, each roller will strike the defect as it goes by and cause a small, repetitive vibration signal. However, this vibration signal is of such low amplitude that under normal overall vibration monitoring, it is lost in the machine's rotational and structural vibration signals. Acceleration Enveloping can measure these signals better than overall readings. Use both measurement types for bearings and gearboxes. As ENV values begin to decrease, rely on VEL readings.

Overall Vibration Monitoring — monitors normal, low frequency machine vibration. Detects rotational and structural problems like imbalance, misalignment, and mechanical looseness.

Enveloping — amplifies high-frequency, repetitive bearing and gear mesh vibration signals for early detection of bearing problems, but does not detect non-repetitive rotational or structural events like imbalance, misalignment, and looseness. Provides earliest detection of high frequency metal-to-metal contact or poor lubrication in problem bearings.

13.0 MEASUREMENT TECHNIQUES

In general, vibration of anti-friction bearings is best monitored in the load zone of the bearing. Equipment design often limits the ability to collect data in this zone. Simply select the measurement Point which gives the best signal. Avoid painted surfaces, unloaded bearing zones, housing splits, and structural gaps. When measuring vibration with a hand-held sensor, it is very important to collect consistent readings, paying close attention to the sensor's position on the machinery, the sensor's angle to the machinery, and the contact pressure with which the sensor is held on the machinery.

Location — always collect at the same point on the machine; mark location

Position — vibration should be measured in three directions:

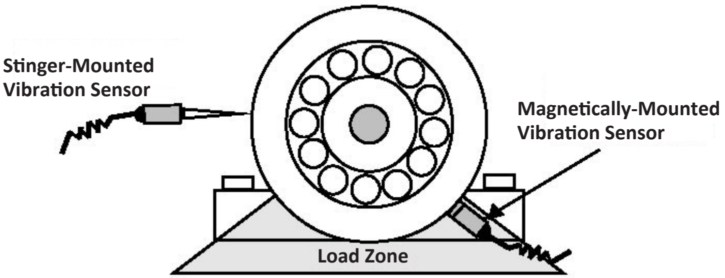
- A - axial direction
- H - horizontal direction
- V - vertical direction

Angle — always perpendicular to the surface (90^o $+10^o$)

Pressure — even, consistent hand pressure must be used (firm, but not so firm as to dampen the vibration signal). For best results use the magnetic base. If using the stinger/probe is the only method available to collect data, it is best to use a punch to mark the location for the probe-tip to ensure a consistent coupling to the housing.

14.0 OPTIMUM MEASUREMENT CONDITIONS

Perform measurements with the machine operating under normal conditions. For example, when the rotor, housing, and main bearings have reached their normal steady operating temperatures and with the machine running under its normal rated condition (for example, at rated voltage, flow, pressure and load). On machines with varying speeds or loads, perform measurements at all extreme rating conditions in addition to selected conditions within these limits. The maximum measured value represents the vibration severity.



15.0 EVALUATING THE OVERALL VIBRATION MEASUREMENTS

Three general principles are commonly used to evaluate your vibration measurement values:

ISO 10816 Standard Comparison: compare values to the limits established in the ISO 10816 Standard. See Vibration Severity Chart.

Trend Comparison: compare current values with values of Baseline for the same Points over a period of time.

Comparison with Other Machinery: measure several machines of a similar type under the same conditions and judge the results by mutual comparison.

If possible, you should use all three comparisons to evaluate your machinery's condition. ISO 10816 and trend comparisons should always be used.

15.1 ISO 10816 Standard Comparison

The ISO 10816 Standards provide guidance for evaluating vibration severity in machines operating in the 10 to 200 Hz (600 to 12,000 RPM) frequency range. Examples of these types of machines are small, direct-coupled, electric motors and pumps, production motors, medium motors, generators, steam and gas turbines, turbo-compressors, turbo-pumps and fans. Some of these machines can be coupled rigidly or flexibly, or connected through gears. The axis of the rotating shaft may be horizontal, vertical or inclined at any angle.

Machinery class designations are:

Class I: Individual parts of engines and machines integrally connected to the complete machine in its normal operating condition. (Production electrical motors of up to 15 kW are typical examples of machines in this category.)

Class II: Medium-sized machines (typically electrical motors with 15 kW to 75 kW output) without special foundations, rigidly mounted engines or machines (up to 300 kW) on special foundations.

Class III: Large prime movers and other large machines with rotating masses mounted on rigid and heavy foundations which are relatively stiff in the direction of vibration measurement.

Class IV: Large prime movers and other large machines with rotating masses mounted on foundations which are relatively soft in the direction of vibration measurement (for example, turbo-generator sets, especially those with lightweight substructures).

Note: These ISO 10816 Standard classes do not apply to prime movers or driven equipment in which the major working components have a reciprocating motion.

15.2 Trend Comparison

The most efficient and reliable method of evaluating vibration severity is to compare the most recent reading against previous readings for the same measurement Point, allowing you to see how the Point's vibration values are "trending" over time. This trend comparison between present and past readings is easier to analyze when the values are plotted in a "trend plot". A trend plot displays current and past values plotted over time. Measurement records should also include a baseline (known good) reading. The baseline value may be acquired after an overhaul or when other indicators show that the machine is running well. Subsequent measurements are compared to the baseline to determine machinery changes.

15.3 Comparison with Other Machinery

When several similar machines are used under the same operating conditions, evaluation can be carried out by measuring all machines at the same Points and comparing the results.

16.0 EVALUATING ACCELERATION ENVELOPE MEASUREMENTS

Use the same techniques of comparison as for Overall Vibration readings. Remember, acceleration envelope is an advanced "early warning" of a developing problem. High values do not necessarily indicate bearing failure. They can also indicate:

A. Lack of lubrication or decreasing oil viscosity due to high-bearing temperature caused by overload or external heat source
B. Breaking of the lubricant film by excessive imbalance, misalignment, or housing deformation. Loss of boundary lubrication
C. A rubbing seal or cover
D. Gear mesh interaction (bad lubrication, defects)
E. Dirt or particles in the lubricant, or a seal or filter problem

16.1 Trend Comparison

Use Trend Comparison similar to Overall Vibration to establish severity levels. Accelerating Envelope readings tend to decrease as Overall Vibration readings increase. This happens when the defect in the bearing is becoming more severe and the frequency is generates becomes lower, which makes it better read with the Velocity-type readings.

16.2 Audio Comparison with Other Bearings on the Same Machinery

When several bearings are used under the same operating conditions, evaluation can be carried out by listening to the audio signals to determine changes. This method will help to locate the defective bearing quickly. Measure all machines at the same Points and compare the results. Listen for increases in signal and for "clicking" patterns which indicate wear.

17.0 SPECIFICATIONS

Specifications*	EXAMINER 1000 Vibration Meter
Vibration Sensor	Piezoelectric accelerometer 100 mV/g with magnetic base, probe and 5 ft. cable to BNC
Display	LCD 3.5 digits Indicators: Measurement, Hold, Low Battery, Units of Measure
Measurement Range	Acceleration: 0.01-19.99 g (RMS) Velocity: 0.01-19.99 in/sec, 0.1-199.9 mm/sec (RMS) Envelope: 0.01-19.99 gE (peak)
Frequency Range	Overall: 10 Hz - 10 kHz Envelope: 0.5 kHz - 10 kHz
Output	Sensor excitation: 18VDC @ 2 mA (BNC) Audio output: 3.5 mm mini plug; 250 mW into 8 ohms, 150 mW into 32 ohms; adjustable volume control with off position
Power	Two (2) AA cells
Operating Time	20 hours continuous without headphones
Weight	Instrument: 7 oz. [0.19 kg] Complete kit: 2.85 lbs. [130 kg]
Dimensions	6.3 x 3.3 x 1.25 in. [152 x 83 x32 mm]
Operating Conditions	-14°F to 122°F [-10°C to 50°C]

*Specifications are subject to change without notice.

18.0 GLOSSARY (for vibration purposes)

Acceleration	A scalar quantity that specifies time rate of change of velocity; expressed in either g-force (g) or m/sec^2 where 1 g = 3.86.1 in/sec^2 and 9.8066 m/sec^2
Acceleration Enveloping	A high-frequency, filtered data collection method expressed in gE
Accelerometer	A transducer which converts acceleration motion into an electrical output
Amplitude	The magnitude of vibratory motion; can be measured as peak-to-peak, zero-to-peak, or RMS
Axial	The direction parallel to the axis of rotation
Baseline	Recorded values taken when a machine is known to be good; the standard to which all additional readings will be compared
CPM	Unit of frequency measurement — cycles per minute
Displacement	A scalar quantity specifying the change of position of a body measured from the resting position
Dynamic Force	A force that varies with time
Force	Energy applied to a mass producing a deflection (static force) or motion (dynamic force)
Frequency	The repetition rate of a periodic event, expressed in cycles per second (Hz), CPM, RPM, or multiples of running speed (orders)
g's	Units of acceleration referenced against the force of gravity (1 g = 32.1739 ft./sec/sec; 1 g = 9.8066 m/sec/sec)
Gear Mesh Frequency	A frequency generated by a gear; defined as the number of gear teeth on a gear times its shaft-rotating frequency
Hertz (Hz)	A unit of frequency measurement, cycles per second
High-Pass Filter	A filter that allows only those components above a selected frequency to pass

Integration	The time-based process of converting acceleration and velocity to velocity or displacement
in/sec, ips	Abbreviations for inches per second, a measure of velocity
Mass	The measurement of body resistance to acceleration; proportional to, but not equal to, weight (mass = weight/gravity)
Measurement Point	A location on a machine or component where all subsequent measurements should be made for accurate comparison
Mechanical Impedance	Ratio of applied force to resulting velocity during simple harmonic excitation
Overall	The amplitude of vibration within a specified frequency range
Peak Value	The absolute value zero to the maximum excursion on a dynamic waveform; also true peak and zero-to-peak
Periodic Monitoring	Measurements recorded at intervals of time
Piezoelectric	A material in which electrical properties change when subjected to force
Process Measurements	Variables such as temperature, pressure, speed and flow used to assess internal conditions of efficiency
Radial	Direction perpendicular to the shaft centerline
Repeatability	A measure of deviation between successive measurements made under the same conditions
RMS	Peak vibrations x 0.707 (in/s or mm/s)
Rolling Element Bearing	A bearing consisting of balls or rollers operating between fixed and rotating races
Route	A sequence of measurements arranged for convenience during data acquisition
Sensitivity	Used to describe a transducer's electrical output for a unit variation of the mechanical quantity measured

Stress	Force per unit area
Synchronous	Frequency components that are an integer multiple of running speed
Transducer	A system consisting of a sensor and signal conditioner to convert a physical quantity into an output for display, monitoring and analysis
Transmission Path	The path from source (excitation) to sensor
Trending	The plot of a variable over time used as an indicator of change
Velocity	A vector quantity of the time rate change of displacement

19.0 VIBRATION CONVERSIONS

$$D = 19.10 \times 10^{3} \times (V/F)$$
$$D = 70.4 \times 10^{6} \times (A/F^{2})$$

$$V = 52.36 \times 10^{-6} \times D \times F$$
$$V = 3.68 \times 10^{3} \times (A/F)$$

$$A = 14.2 \times 10^{-9} \times D \times F^{2}$$
$$A = 0.27 \times 10^{-3} \times V \times F$$

where:
D = Displacement (mils peak-to-peak)
V = Velocity (in/s zero-to-peak)
A = Acceleration (in/s^2 zero-to-peak)
F = Frequency (CPM)

20.0 VIBRATION SEVERITY PER ISO 10816-1

Use the chart below as a guide to judge the overall vibration severity of your equipment. Refer to Section 15.0 for further details.

VIBRATION SEVERITY PER ISO 10816-1

Vibration Velocity Vrms: in/s	mm/s	Class I small machines	Class II medium machines	Class III large rigid foundation	Class IV large soft foundation
0.01	0.28	good	good	good	good
0.02	0.45	good	good	good	good
0.03	0.71	good	good	good	good
0.04	1.12	satisfactory	good	good	good
0.07	1.80	satisfactory	satisfactory	good	good
0.11	2.80	unsatisfactory	satisfactory	satisfactory	good
0.18	4.50	unsatisfactory	unsatisfactory	satisfactory	satisfactory
0.28	7.10	unacceptable	unsatisfactory	unsatisfactory	satisfactory
0.44	11.2	unacceptable	unacceptable	unsatisfactory	unsatisfactory
0.71	18.0	unacceptable	unacceptable	unacceptable	unsatisfactory
1.10	28.0	unacceptable	unacceptable	unacceptable	unacceptable
1.77	45.0	unacceptable	unacceptable	unacceptable	unacceptable

The Professional's Choice

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Portable Tachometers

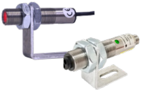
Track-It™ Data Loggers

Panel Tachometers

Fixed Mounted Strobes

Portable Strobes

Frequency Converters



Speed Sensors

DataChart™ Paperless Recorders

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