Table of Contents.

1.0 Introduction.

Congratulations on your purchase of the ENTRON EN-212 Microprocessor based Vibration Meter & Electronic Stethoscope. This meter is suitable for making accurate vibration levels in rotating machinery, and will alert you of the machine condition automatically. Alarm levels of the ISO10816-1 severity chart are already pre-programmed in the meter, and will compare the measured value with the alarm levels in memory and alert the user of the machine condition. You simply set your machine class into the meter, and then take your measurement, - NO NEED FOR USING SEVERITY CHART - the meter will do it for you, and will tell you of the machine condition directly on the display whether your measured vibration is GOOD, SATISFACTORY, UNSATISFACTORY, or UNACCEPTABLE.

This meter can also be an invaluable tool for performing trending and predictive maintenance so as to assist in forecasting and planning of your maintenance workload and management of the maintenance aspect of your plant or factory.

It features data storage of up to 100 data points via static RAM so data is retained even after power off, the unit will display crest factor and vibration in peak and rms values and also metric and imperial units. The meter will also alert you if the sensor is not properly connected, and will alert you of the condition of the sensor cable. The meter is of a robust and heavy duty construction. Careful use of this meter will provide years of reliable service.

2.0 Description

The ENTRON Model EN-212 Vibration Meter is intended for use in situations where a portable instrument is required and where there is the need for making data recordings for later review. This unit will provide indication of acceleration, crest factor, velocity and displacement using the input from an industry standard 100 mV/g accelerometer. The unit is supplied with rechargeable lithium ion batteries and also includes a USB recharger that operates from 220 V. AC line to recharge the batteries when necessary. The unit can also be conveniently charged from the USB port of any PC computer. The charge cycle rating of the batteries is 500 cycles, which yields an average lifetime of two years or more, and so it is not necessary to change the batteries frequently. This also helps to protect our environment since there is no garbage resulting from periodic disposal of alkaline or manganese batteries. The unit features an industrial headphone which enables you to listen to the sound of roller bearings to assist in evaluating machine conditions.

3.0 Method of Operating the Vibration Meter.

Connect the accelerometer to the meter as shown in fig. 1., also shown are the controls that are used for operating the meter, details of which are as follows:

3.1 ON/OFF PUSHBUTTON

To turn the meter on or off, depress the pushbutton on the front panel for about 1 second, then release. The meter will automatically turn off after a period of approximately 15 minutes, and if it did turn itself off automatically, you can turn it back on by simply depressing the on/off pushbutton and it will turn back on for a further 15 minutes.

3.2 RMS/PEAK SLIDE SWITCH

This is the slide switch located on the left side of the meter and is used for selecting the displayed units in either peak or rms values.

The unit of rms is widely used in Europe and S.E. Asia and also ISO10816-1 chart is primarily in rms values, so this is a preferred unit to use.

3.3 PARAMETER SLIDE SWITCH

This is the slide switch located on the right side of the meter, and is used for selecting the desired parameters of measurement. Available parameters are ACCELERATION and the available units are G's., m/s^2 .,ft/s^2 (1 G = 9.81 mm/s^2.), VELOCITY and the available units are mm/s., cm/s., in/s., DISPLACEMENT and the available units are μm. CREST FACTOR which is the ratio of peak/rms values. Units are selectable by using the UNITS pushbutton.

3.3.1 CREST FACTOR

To read crest factor, set the meter to ACCELERATION and the values will be displayed as in fig. 3.1 below.

fig. 3.1

3.4 UNITS PUSHBUTTON

This button is used to select the units of measurements. Default units are metric, i.e. G's for acceleration, mm/s for velocity, and μm(microns) for displacement. Other available units are, for ACCELERATION: G's, m/s^2 .,ft/s^2, VELOCITY: mm/s., cm/s., in/s., DISPLACEMENT: μm. The UNITS button is also used in conjunction with the HOLD button to change the machine class from class I, class II, class III or class IV.

3.5 RECORD/READ PUSHBUTTON - Recording Data.

This button is used for recording the displayed value, and also for reading the recorded value. At the bottom of the display LOC : 001 indicates the next available memory slot., eg. fig. 3.2 indicates 015 is available. To record the current value, just press and release the RECORD/READ button and the value will be stored in
LOC : 015, also the word REC will flash at the left corner of the screen, and location counter will increment to LOC :016

fig. 3.2 – RECORDING

3.5 Recording data (continued)

Each time the RECORD/READ pushbutton is pressed, the LOC indicator at the bottom of the screen will increment up to the next available location for storing data. The unit can store up to a maximum of 100 data points.

3.6 RECORD/READ PUSHBUTTON - Recalling saved data

3.6.1 Depress the RECORD/READ button until the display indicates READ MODE as shown in fig. 3.3.

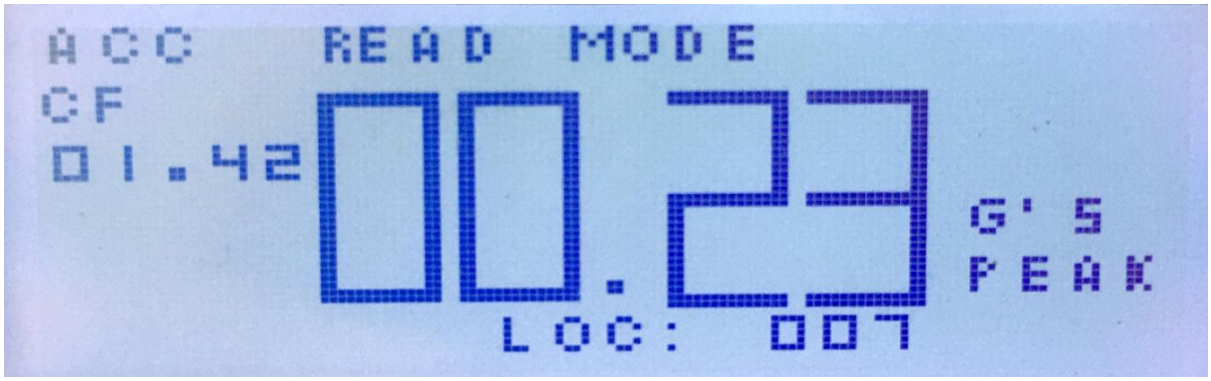


fig. 3.3

The meter is now in READ mode and recorded values can be viewed based on their known locations. To move to the desired location, use the MAX HOLD key for

incrementing the locations by 10, and use the RECORD/READ button for incrementing location by 1. eg. to go to location 005, press the RECORD/READ button
4 times, and you will see that the display will increment as shown below:
LOC : 001,, LOC:002., LOC:003., LOC:004., LOC:005
To increment to location 025, press the MAX HOLD key twice, and note that the display will increment as follows: LOC:15., LOC:25.
The displayed value will be the same unit and the same value as when recorded.
3.6.2 To exit from READ MODE, press the RECORD/READ button until the display no longer indicate “READ MODE”.

3.7 DELETING RECORDED DATA
3.7.1 Old data is deleted by saving into the already used location.

3.8 MAX HOLD PUSHBUTTON
Press MAX HOLD once and display will freeze, and will display HOLD (as in fig. 3.4). Press MAX HOLD again, and display will freeze at the maximum value (fig. 3.5), and will only increase if a higher value is measured. Press MAX HOLD again and meter will display the maximum value measured since the meter had been turned on (fig.3.6). Press again and meter will go back to normal. The MAX HOLD button is also used in conjunction with the UNITS button to change the machine class from class I, class II, class III or class IV.

fig. 3.4 - HOLD

fig. 3.5 - MAX HOLD

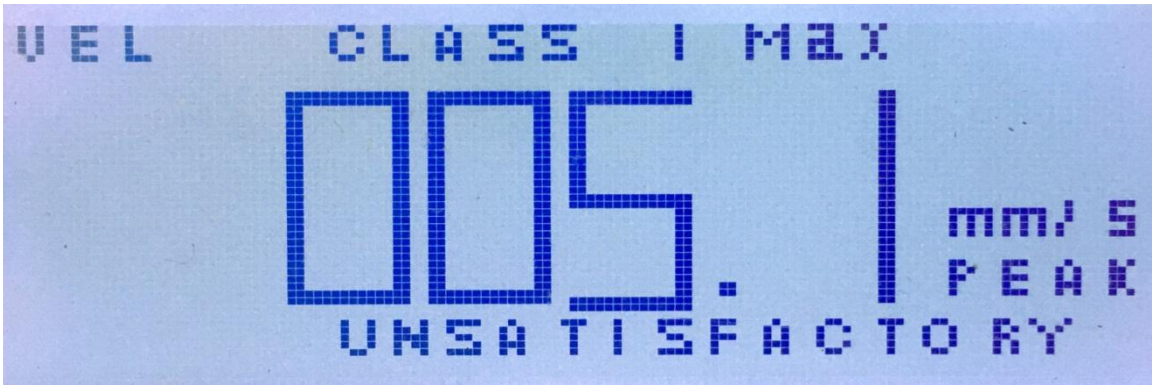


fig. 3.6 - MAX

3.9 ISO10816-1 Alarm Setup

3.9.1 Place the parameter switch located on the right side of the meter to VELOCITY, and the PEAK/RMS switch to RMS. The display will be as shown in fig. 3.7 below. At the top is shown the machine class – which you need to set to either class I,II,III or IV. Then at the bottom is the resulting machine condition which the vibration meter measures. The meter will compute and display the severity level based on the rms value measured (similar to the chart at the bottom front panel of the meter).

fig. 3.7

3.9.2 To set the machine class, press the HOLD button and do not release, then press and release the UNIT button, for each press and release of the UNIT button the machine class will change from I to II to III to IV then back to I. Release the HOLD button after you have chosen your desired machine class. Machine class is dependent on the motor size,
eg. Class I : 0 – 15 kW,
Class II: 15 – 75 kW,
Class III : 75 kw and up and rigid foundation,
Class IV: 75 kW and up and soft foundation.

3.9.3 Now the meter is ready for making the measurement, and will show you the severity level of the machine automatically.

3.9.4 Place the sensor at the point of measurement and observe the readings and also observe at the bottom of the readings the meter will show you the severity level. There are four severity levels – GOOD, SATISFACTORY, UNSATISFACTORY and UNACCEPTABLE.

3.10 HEADPHONES OUT.

This is located at the left side of the meter (fig. 1), and is used to provide an audio signal to the headphones that are supplied with this meter. To use the headphones, simply insert the headphone jack into the left side jack, and then use the volume controls on the left and right of the headphones for adjusting to a comfortable listening level. The sound output is mono, and it does not matter what setting the mono/stereo switch is adjusted to. To discontinue using the headphones, simply pull out the headphone plug from the meter and store headphone in the carrying case.

fig 3.8 charging batteries

fig 3.9 fully charged battery

3.11 RECHARGING BATTERIES

The charger input jack is located at the left side of the meter and is a USB-B connector. To use the charger, first turn the meter off, then insert the mini-USB-B jack into the vibration meter, then plug the USB-A jack into the charger, and then plug the charger into an available wall socket that is 220 V. AC. Observe on the left side of the meter (fig. 3.8), there will be a red charging light that will illuminate, and will remain on for a period of approximately two and a half hour. The color of the LED will change from Red to ORANGE then to GREEN when fully charged. During charging, the meter will be warm, this is

normal. When the batteries are 100% charged the meter will automatically stop charge, and the green full charge light at the left bottom side of the meter will illuminate as in fig. 9. Any standard USB port on your PC computer may be used to charge the meter.

3.12 CONNECTING THE ACCELEROMETER.

3.12.1 The meter is supplied with an industry standard 100 mV/G IEPE accelerometer with a male BNC connector, connect this to the female BNC connector at the top right side of the meter. If the meter is on but no sensor connected, the meter will indicate "NO SENSOR" at the top of the display as in fig. 3.10.

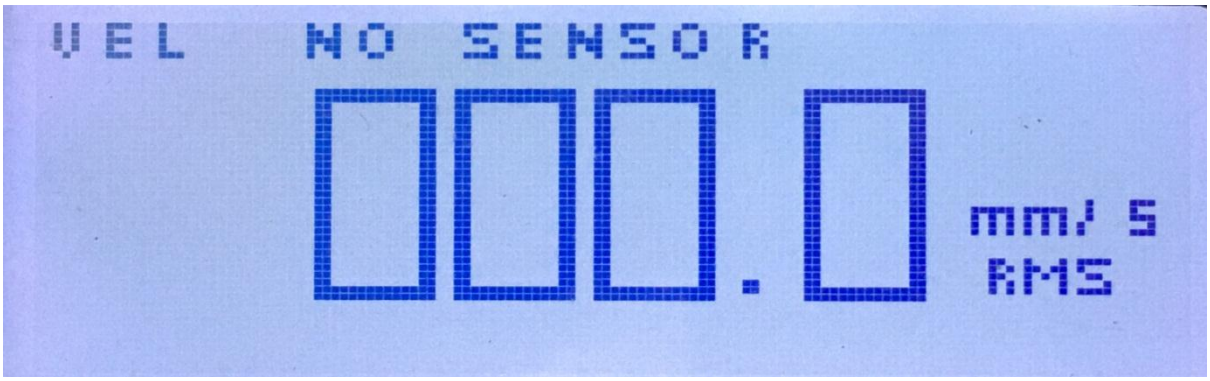


fig. 3.10

3.12.2. The accelerometer is connected to the cable via a MIL connector and is fitted with shrink tubing over it to prevent tampering. Warning.! If shrink tubing is ever removed, DO **NOT** ROTATE THE CONNECTOR OR WIRE WILL BREAK.!!
(See fig. 3.11)

fig. 3.11

3.12.3 If the cable is broken the meter will detect this condition and will display NO SENSOR as in fig. 3.10. If the cable is shorted the meter will display SENSOR ERROR as in fig. 3.12.

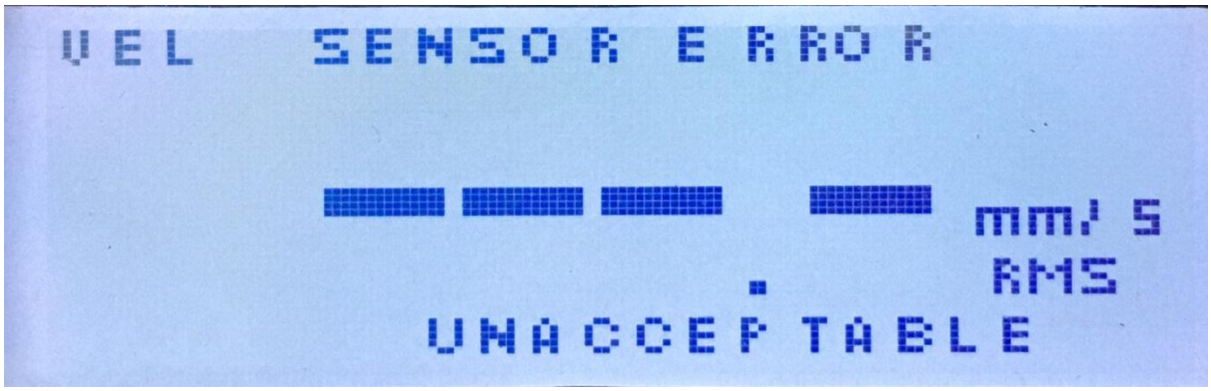


fig. 3.12

3.13 LO BAT

When there is less than 15 minutes of operating time, LO BAT will be displayed. Accurate measurements can still be made all the way until meter shuts itself down.

4.0 HOW TO GET THE MOST OUT OF YOUR VIBRATION METER -

Basics of Vibration.

Use the magnetic base with accelerometer whenever possible. Use stinger probe only for listening to roller bearings and not for making measurements as it may introduce errors. When making vibration measurements, *record the size or rating in kW of the motor* under test, and the type of mounting as this determines the class of the motor which is necessary when analyzing results.

Units of Vibration

This vibration meter will measure the following units: Velocity, Acceleration, crest factor and Displacement A description of each unit is as follows:

Velocity

For general machinery vibration Velocity is the recommended choice for making measurements. (800 rpm and up to 10,000 rpm.). The values obtained can be compared directly with the ISO 10816-1 chart located on the front of the meter.

Acceleration.

Acceleration is favored if the machinery operates at higher speeds., eg. Above 10,000 rpm. the chart located on the front of the meter cannot be used. Instead, refer to the graph on the inside back page “Vibration Severity Judgement” chart. To read Acceleration, you need to lean your head at a 45 degree angle to the right.

Displacement.

Measurement of Displacement is favored for very low frequency measurement., eg for less than 800 rpm. Use graph on the inside back page "Vibration Severity Judgement" chart for guideline. To read, you need to lean your head at a 45 degree angle to the left.

Crest Factor.

In the initial phase of damage occouring in roller bearings the inner race, outer race and retainer or cage generates spikes which causes an increase in the crest factor readings. Making periodic measurements is the best way to obtain the most benefit from this feature, because as damage increases beyond a certain point then the crest factor will decrease.

FINDING LOOSENESS

By measuring on both side of a bolt connection it is possible to find looseness. A machine which is properly connected by a bolt should have the same vibration level on both sides. If the vibration measurements are different, then the bolt is loose. Similarly if a bolt is used to secure the machine on the foundation, then the vibration at the bolt should be the same as at the foundation, if its different then the bolt is loose.

FINDING RESONANCE

Resonance in a machine is the speed at which the highest vibration occur. To easily find the resonance speed of a machine, measure the vibration when its just starting up, or when its shutting down, and observe what speed produces the greatest vibration.

OVERLOAD

If an overload condition should occur, the meter will display OVER. This is a temporary condition that happens if the accelerometer is subjected to excessive shock or vibration, and the display will eventually, in a few seconds, return to normal.

5.0 Measurements.

5.1 Making Measurements.

Measurements are taken by using the supplied accelerometer sensor which is fitted with a ¼-28 stud and a magnetic base as well as a stinger probe. To get the best accuracy, the sensor must have a sound mechanical contact with the point being measured and the ideal way is if possible, tap and thread a hole to connect the sensor to the point being measured. This may not be practical in all cases so the next alternate is to use the magnetic base to firmly attach the sensor to the test point, and if not possible then the last resort is to take the measurement by hand and if a difficult to reach spot, use the stinger probe. Using a threaded connection yields the highest frequency response and the most accurate, using the magnetic base without holding it is the next best frequency response, with hand held measurements yielding the lowest (worst) frequency response.

5,2 Choosing Measurement Points.

Measurements must be taken at the loaded end of the motor (eg. The end that has a pump or a pulley attached to it), and the sensor must be placed as close as safely possible to the bearings. Do not take measurements on the cowling or covers of the motor, use only solid surfaces. Ideally measurements should be taken at all three axes as shown in diagram, but if not possible at least measurement in horizontal axis should be taken. Keep in mind that the

accelerometer's maximum operating temperature is 60 deg. C, so choose locations that do not exceed this temperature.

5.2.1. The probe can be connected to the machinery under test in three ways.:
1. Via the magnetic base, (preferred option), 2. via a pre installed stud 1/4-28 stud already connected to measurement point on the machine under test, and 3. via the stinger probe (not recommended).

5.2.2 Fig. 5.1 below shows some typical measurement points. For attaching magnetic base, first tilt the magnet by 45 degrees, then attach to the point under test and then release it. To avoid errors due to hand shake, do not hold sensor during measurements. DO NOT ATTACH ACCELEROMETER TO HOT SURFACES greater than 60 deg. C..!

5.2.3 Allow the readings to stabilize, which usually takes about 15 to 30 seconds, you can use the MAX HOLD button to help hold the value,

5.2.4 For removing the magnet, tilt it by 45 degrees, then remove. Always use this method when either connecting or removing the accelerometer. Use of the stinger probe is suggested only in cases where it is impractical or impossible to use the magnetic base. The intended use of the stinger probe is for listening to the sound of roller bearings or gear noises.

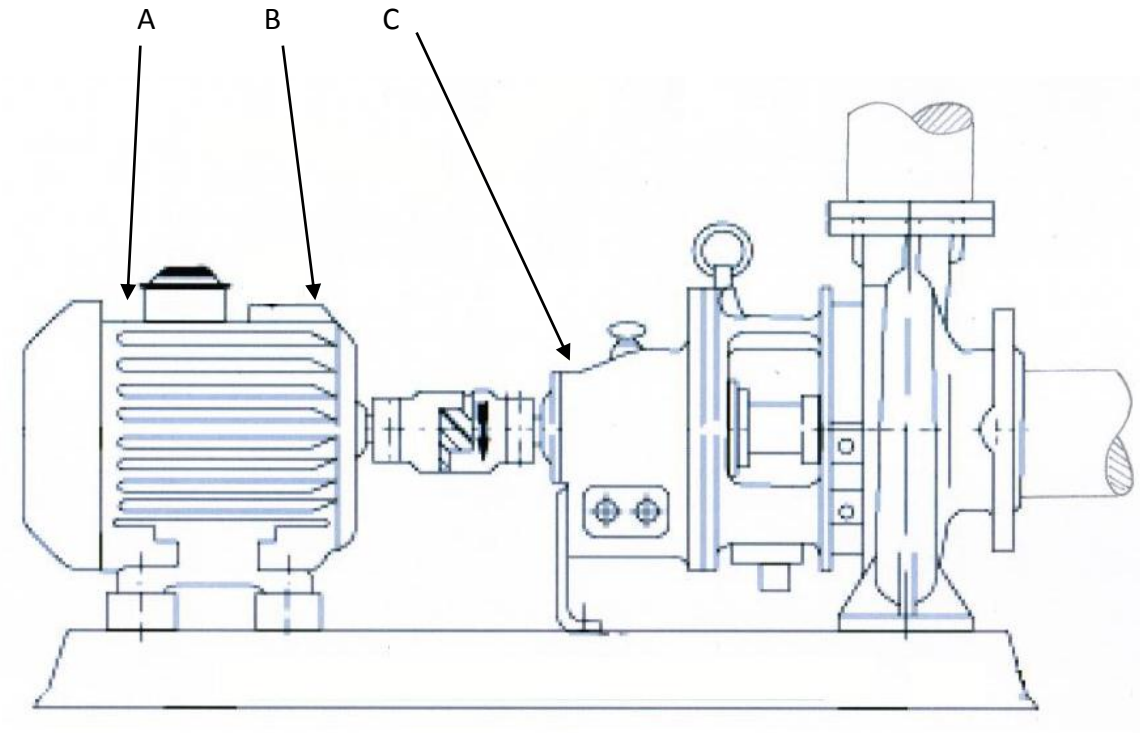


Fig. 5.1

5.2.5 Measurement axes.

There are three axes that can be measured. (as shown in fig. 5.2), Horizontal, Vertical, and axial.

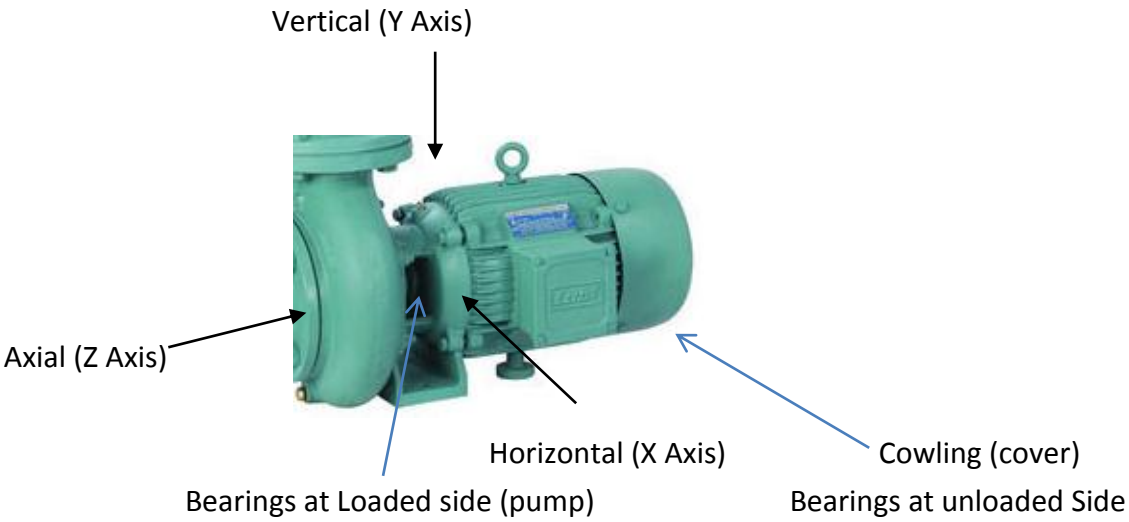
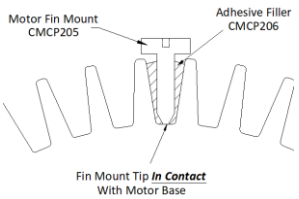


fig. 5.2

Also for motors, there are two sides to be measured. i.e. the side that carries the load; this is the side that has the output shaft and usually will have a gear or pulley attached to it (eg. Point B of fig. 5.1)., and the unloaded side of the motor (eg. point A of fig. 5.1), which would usually have an internal fan (which you cannot see) attached to its shaft, with a cowling covering this fan. The part that carries the load will indicate the higher values of vibration, and usually is likely to experience damage to the roller bearings (if any). More attention should be given to this end (point B of fig. 5.1), and ought to be included in your data collection.

The unloaded side of the motor is (point A of fig. 5.1) difficult to measure, since usually the cowling and the cooling fan will hinder your ability to attach the accelerometer, however you can attach the accelerometer onto the cooling fins (cooling fin adapters are available for this purpose), and as close to the edge as possible. Note that attaching to the cowling will not really enable you to obtain a true measurement of the motor vibration. It is very important to make your measurements at the same spot every time, so it is advisable to mark the spot with paint or permanent marker. Below are examples of ways to measure the unloaded end of a motor.



Types of motor fin mount probe pads (sti, ctc)

5.3 ANALYZING MEASURED DATA

First determine which class and size relates to the machine being analyzed, and after doing so observe if the measured values are within the suggested safe operating levels.
The EN-212 makes it easy to analyze the readings. Prior to making the measurement, set the meter to match the machine class and then the EN-212 will analyze the readings and display the severity level for you – its that simple. Measured values which falls within the green zone will display GOOD, and up to the yellow will display SATISFACTORY these are acceptable levels, however if the values are in the orange zone (UNSATISFACTORY displayed) then it will be necessary to determine the cause and effect a remedy for the excessive vibrations. If measured values are in the red zone (UNACCEPTABLE displayed) then you definitely have a problem and need to desist from using the machine and find a cause for the problem as soon as possible since continued operation may be dangerous and may lead to other problems.

An ISO10816-1 CHART is shown below, and also the same chart is attached to the front of the meter for conveniently checking your measured values vs acceptable limits of operation.
Machines are separated into class depending on the size.
Various classes are as follows:
Class I : 0 – 15 kW.
Class II : 15 – 75 kW.
Class III : 75 kW and above and mounting is a rigid base
Class IV : 75 kW and above and mounted on a soft base.

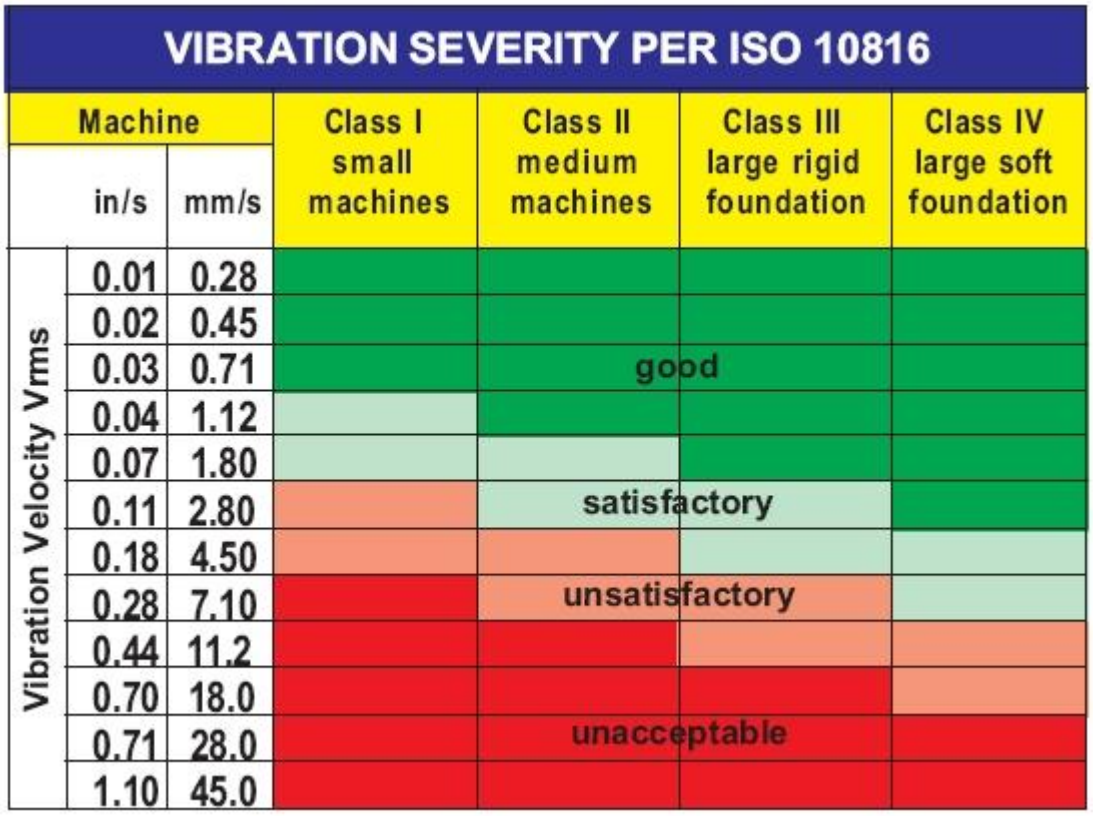


Fig. 5.2 ISO10816-1 severity chart.

For example, if motor under test is rated at 15 kW, and our measured value is 1.5 mm/s (rms)., then using the above chart, this machine would be a Class I, and our measured value Would fall between 1.12 and 1.8 mm/s which would be “satisfactory”

5.4 HEADPHONES

The oldest technique of testing roller bearings is by listening to the sound. This is still effective and reliable, however requires some experience which can be acquired by using your headphones to listen to various machines. Use the stinger probe attached to the accelerometer and place as close as safely possible to the roller bearings. Listen carefully and you can actually hear the bearings rotating. If all is well, it should be a continuous noise. New machines are generally quieter than old ones. When roller bearings are damaged they will create a discontinuous noise, a hammering or scraping noise.

6.0 Service and Maintenance of your Vibration Meter.

6.1 Do not wipe display as it scratches easily, instead use a lens cleaning brush for cleaning. For the body of the meter, use a dry lint free cloth. If grease or oil is on the meter, then use household solvent to clean the meter. Do not immerse the meter in water because its not waterproof and will be damaged.

6.2 Battery cover –*should not be necessary to remove* – but it can be removed by a small coin or fingernail. The meter uses a 8.4 Volt lithium ion battery pack that is fitted with an electronic protection circuit. Replacement of the batteries will become necessary when they no longer hold the charge. The unit is capable of remaining on continuously for 20 hours without need for recharging, but when the batteries gets older, this period gets less and less, and so when the need for recharging gets more often, it's a sign that the batteries ought to be changed. (batteries usually last about two or three years or more).

6.3 Accelerometer care: This is the heart of the vibration meter, it should be handled with care, and should not be dropped or subjected to high temperatures or it will be damaged.

6.4 Accelerometer cable: Poor handling of the accelerometer cable will shorten its life. The accelerometer should not be removed by dragging the cable, and the cable should not be subjected to undue stress or sharp bending. Also the accelerometer should not be lifted by the cable.

OK

Not OK.!
Cable may
break here

6.5 Calibration of the meter is recommended at least once per year to ensure optimum accuracy. For recalibration and service, contact AMET Co., Ltd.

7.0 Specifications – Model EN-212

Display:	132 x 48 Graphic LCD Display with Backlight.
Measurement Ranges/(Resolution):	
Acceleration:	0~20/(0.01) G's., cm/s^2.,mm/s2,ft/s^2
Velocity	0~ 200/(0.1) mm/s, cm/s.,
Displacement:	0~ 200/(0.1) um,in/mm.
Crest Factor:	1.0 ~ 16
Frequency Range:	Acceleration: 5 Hz to 20 kHz.
	Velocity: 5 Hz to 1 kHz.
	Displacement: 20 Hz to 1 kHz.
Accuracy:	
Acceleration	± 1% + 3 least significant digits (LSD).
Velocity	± 1% + 3 (LSD). @ 156 Hz REF.
Displacement	± 1% + 3 (LSD). @ 70.1 Hz REF.
Memory	100 data points in RAM retains even without battery.
Sampling time	1 second.
Low Battery Indication:	Graphic Display on front panel indicates when there is approx. 15 minutes of usable time in the batteries.
Power Supply:	8.4 Volt Lithium Ion Rechargeable batteries. Nominally 20 hours continuous use before recharging.
Auto Power off :	Approximately 15 minutes after turn-on.
Operating Temperature:	Meter: -10°C to 50°C., and less than 80% RH.
	Accelerometer: -10°C to 60°C.
Input Impedance	100KΩ
Accelerometer Sensitivity	100 mV/g
Max Input : 20 G's	
Accelerometer current	3.5 ± 1 mA Headphone Impedance : 8Ω
Headphone Connector	2.5" mini jack. Weight : 0.5 lb. (230 g)

Dimensions 1.25" (30 mm) X 3.25" (83mm) X 6.25" (156mm)

8.0 WARRANTY.

This warranty guarantees that this vibration meter is free from defects in material and workmanship for a period of 60 months, commencing from the date of delivery to customer. The accelerometer and recharger is warranted to be free from defects in material and workmanship for a period of 12 months, commencing from the date of delivery to customer. This warranty excludes rechargeable batteries and cables. The warranty shall not apply to any product which shall have been repaired or altered, or shows sign of neglect, abuse, or use in applications beyond the designed purpose and scope of the instrument. This warranty is in lieu of all other warranties, express or implied, including (but not limited to) any implied warranties or merchantability or fitness for a particular purpose and in no case shall liability exceed the original purchase price of the equipment.

9.0 EC Declaration of Conformity.

We declare on our own responsibility that this product conforms to the following:

Standards: EN50081-1

Standards: EN 50081-2

Calibration and Repair Service.

AMET Co., Ltd. offers complete repair and calibration services for this product. For repair or for periodic calibration, please contact us at the number listed below.

Support Hotline: 02-503-8900
Website: www.amet.net

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