Instruction Manual

Universal Vibration Meter

VM15

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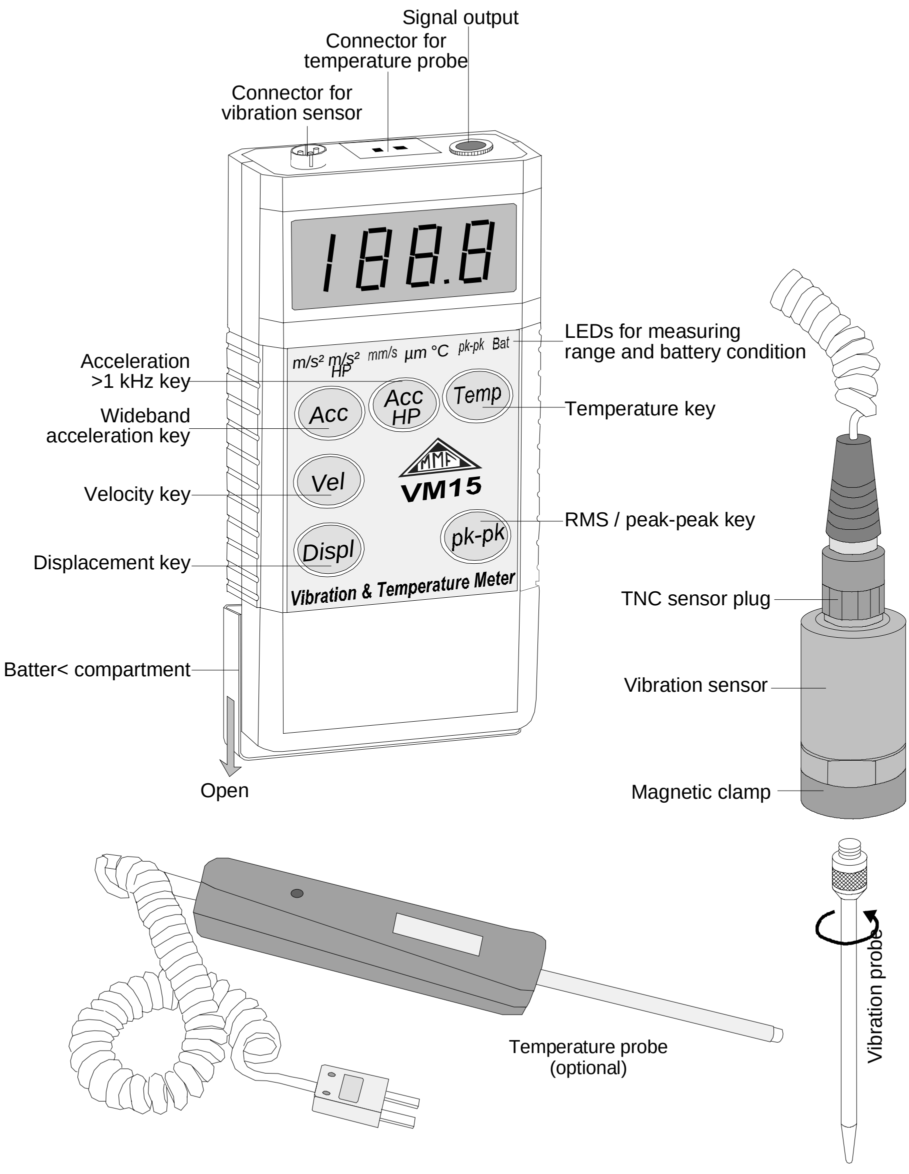
Declaration of CE Conformity


Signal output
Connector for temperature probe
Connector for vibration sensor
188.8
m/s² m/s² HP mm/s µm °C pk-pk Bat
Acc
Acc HP
Temp
Vel
Displ
pk-pk
VM15
Vibration & Temperature Meter
LEDs for measuring range and battery condition
Acceleration >1 kHz key
Wideband acceleration key
Temperature key
Velocity key
RMS / peak-peak key
Displacement key
TNC sensor plug
Batter< compartment
Vibration sensor
Open
Magnetic clamp
Temperature probe (optional)
Vibration probe

Dear customer,

thank you for choosing an MMF Vibration Meter. We wish you convenient operation and successful work with your Vibration Meter VM15!

1. Properties

The extremely compact Vibration Meter VM15 offers a variety of different measurement and indication possibilities:

- Wideband vibration acceleration, 3 Hz … 10 kHz
- Vibration acceleration, 1 kHz … 10 kHz
- Vibration velocity, 3 Hz … 1000 Hz
- Vibration displacement, 3 Hz … 200 Hz

All measured quantities can be indicated as true rms or true peak-to-peak values. A piezoelectric accelerometer is used as vibration sensor.

Besides vibration the VM15 measures temperature, too. For this purpose a temperature sensor is optionally available.

The instrument is easy to operate and you will become familiar with its operation within shortest time.

2. Application

The Vibration Meter VM15 is designed for offline vibration monitoring of all kind of machinery to assess their running condition. A typical application is cyclic monitoring of machine vibration as part of a maintenance plan. A maintenance interval may be one day or some days up to weeks, depending on type and importance of the machine.

Machine condition monitoring at an early stage helps to prevent unexpected breakdowns. Thus expensive secondary damage and manufacturing loss can be avoided.

3. Function

Figure 1 shows the signal path of the VM15.

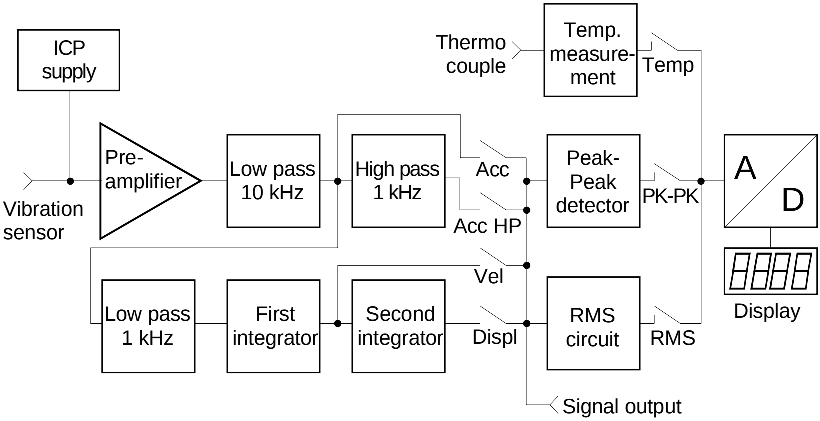


Figure 1: Signal path of the VM15

Vibration Sensor The Vibration Meter VM15 is supplied with a piezo ceramic planar shear accelerometer. This rugged type of accelerometer features highest precision and resolution. The accelerometer is equipped with an integrated ICP® compatible impedance converter.

Input The accelerometer input is connected to an ICP® compatible constant current source, which supplies the integrated electronic circuit of the sensor. The accelerometer signal passes a preamplifier and the following 10 kHz low pass filter. This way the resonant rise of the accelerometer is suppressed. The further signal path depends on the selected measuring range.

Rectifier In the range “Acc” for wideband acceleration measurement the signal directly passes to the rectifier. You can select between rms (RMS) or peak-to-peak (PK-PK) rectifying. The electronic circuit of the VM15 provides the true peak-to-peak value independent of the signal form. For this purpose the positive and negative peak value is stored with a time constant of 1 s and the amounts are added.

Display The rectifier is followed by the analog-to-digital converter and the display. The display indicates 3½ digits that means, the highest indication is 1999. The indication is updated three times a second. The decimal point is shifted in dependence on the measuring range.

Filtering and Integration

In the range “Acc HP” for high frequency acceleration measurement the signal passes a two-pole high pass filter of 1 kHz additionally.

In the range “Vel” the acceleration signal passes after the input stage a two-pole low pass filter and an integrator, which forms the velocity.

In the range “Displ” the signal passes a second integrator additionally. By reason of the double integration displacement is indicated.

☞ Due to their frequency response the integrators provide only small output voltages at higher frequencies. Therefore, at some hundred Hz the dynamic range considerably decreases, especially at measurement of displacement (see Figure 2). At 160 Hz, for example, the dynamic range reaches 10 % only, i.e. 200 µm. Therefore, velocity measurement and particularly displacement measurement are limited to low frequencies.

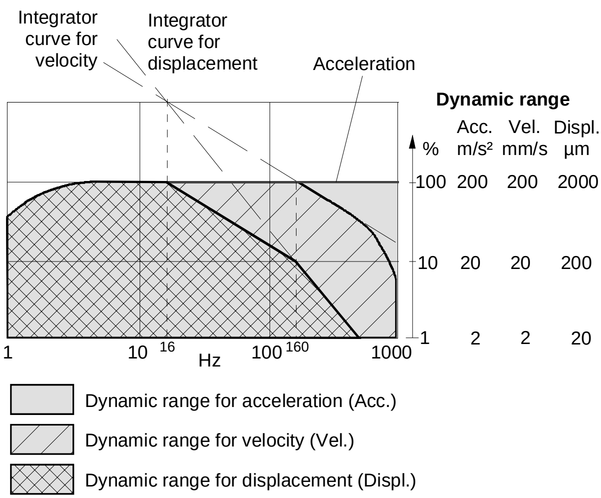


Figure 2: Dynamic range in dependence on the frequency

Temperature Measurement

Temperature measurement is performed using a thermocouple probe.

Signal Output

The output voltage at the signal output is proportional to the unrectified signal of the selected range.

4. Operation

The Vibration Meter VM15 is very easy to operate:

- Mount the accelerometer
- Select the measuring range
  (Acc / Acc HP / Vel / Displ)
- Select the indication (RMS/PK-PK)
- Read the measuring value

4.1. Selection of Measuring Points

General

Before using the Vibration Meter VM15 suitable measuring points at the machine need to be selected. For this purpose it is recommended to turn to specialists with experiences in the field of vibration monitoring on machinery.

In general it is advisable to measure vibration near to its source to minimize distortion of the signal to be measured by transmitting mechanical components. Suitable measuring points are rigid components, for instance the housing of bearings or gearboxes. Especially at vibration monitoring of roller bearings the distance from the pickup to the bearing is to minimize, with only a small number of junctions. This way you can avoid distortion of the frequency characteristics of the measuring signal.

☞ Unsuitable for these measurements are fixing points at lightweight, flexible and soft components.

Recommendations to ISO 10816-1

The standard ISO 10816-1 recommends for vibration measurements on machines the housing of bearings or nearby measuring points.

For routine monitoring it is sufficient in many cases to measure vibration only in vertical or in horizontal direction. Rigid mounted machines with horizontal shafts have their highest vibration levels mostly in horizontal direction. Flexible mounted machines may have high vertical components of vibration, too.

For inspections vibration should be measured in all three directions (vertical, horizontal and axial) at all bearings.

The following illustrations show some examples for suitable measuring points.

You will also find recommendations for measuring points at different types of machines in ISO 13373-1.

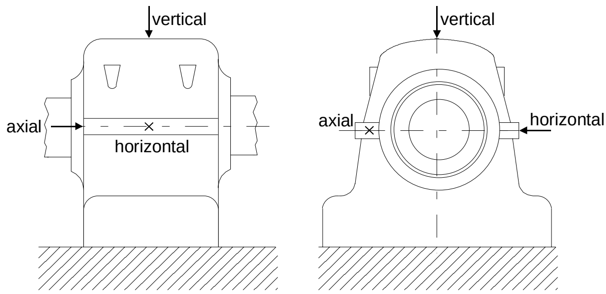


Figure 3: Measuring points on pillow block bearings

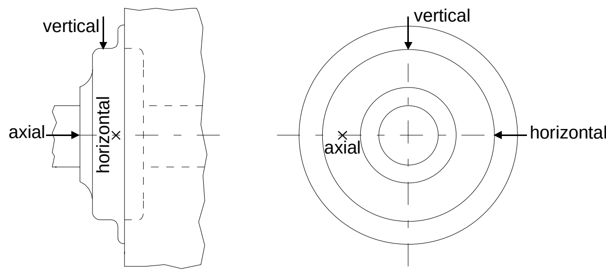


Figure 4: Measuring points on end shield bearings

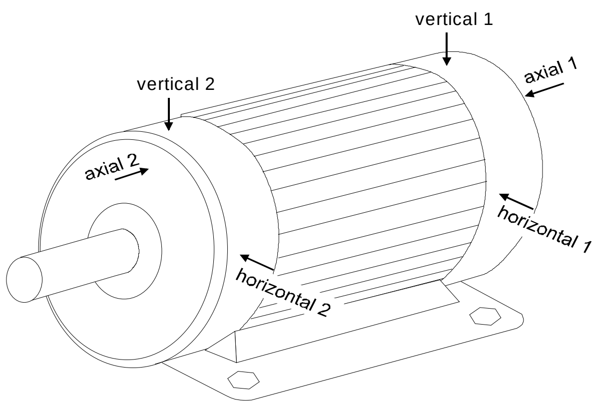


Figure 5: Measuring points on electric motors

4.2. Mounting of the Accelerometer

Magnetic Clamp

The easiest way to attach the accelerometer to the measuring point is the use of a magnetic clamp (delivered together with the accelerometer). It is screwed into the M5 threaded hole in the bottom of the accelerometer. A thin film of grease, for instance silicone oil, between accelerometer and magnetic clamp and on the measuring point improves the quality of mechanical coupling.

☞ **Caution:** The magnetic clamp has a very strong pulling force and is, therefore, suitable for transmission of high frequencies and vibration levels. Please note, however, that careless dropping of the magnetic clamp to the measuring point may generate very high g levels which can overload the accelerometer. Therefore, put on the sensor with the magnetic clamp to the measuring point like shown in Figure 6 by gently rolling it over the edges.

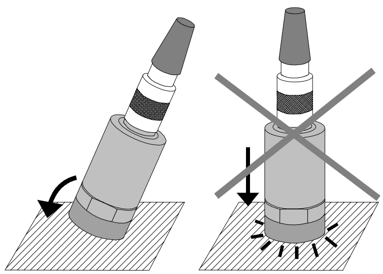


Figure 6: Attaching the magnetic clamp

Coupling Surface

For defined coupling conditions to the measuring object, it is recommended to use a coupling plate of steel with a flat coupling surface. It should have at least the diameter of the accelerometer bottom. Suitable for this purpose is, for instance, a steel plate according to Figure 7. It can be epoxy glued or welded to the measuring point.

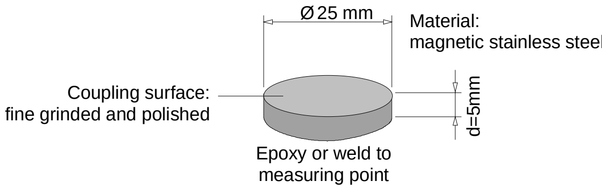


Figure 7: Preparing the coupling point

☞ **Important:** A good quality of the surface between the accelerometer and the test object is necessary for an exact transmission of vibration. Rough and scratched or too small coupling surfaces may cause considerable measuring errors, particularly in the range above 1 kHz. Cast or varnish surfaces are unsuited.

Accelerometer Probe The probe is an useful accessory for rough estimating measurements of vibration severity at measuring points which are difficult to access. It is screwed into the M5 threaded hole in the bottom of the accelerometer. However, some experience is required to get reproducible results.

The probe is unsuitable in the frequency range above 1 kHz. Due to coupling resonance at higher frequencies significant measuring errors may occur.

Accelerometer Cable Make sure that the cable connector at the accelerometer is tightly screwed. The connection of the cable to the measuring instrument is removed by pulling it out. Please don’t try to turn it!

4.3. Measurement

Switching on and Measuring Range By pressing one of the measuring range keys “Acc”, “Acc HP”, “Vel”, “Displ” or “Temp” the Vibration Meter is switched on. The selected measuring range is indicated by one of the LEDs below the display. The measuring range can be changed by pressing another key.

RMS and Peak-Peak Value of Vibration Within the vibration measuring ranges you can select between true rms or true peak-to-peak indication. After switching on the instrument, it indicates at first in any case rms values. By pressing the “pk-pk” key the instrument switches to the indication of peak-to-peak values. The LED „pk-pk“ indicates this.

☞ **Notice for measuring displacement:**
Please consider that the accuracy which can be achieved in the displacement range is limited due to double integration. This applies particularly to peak-to-peak displacement. A variation of the displayed value of ± 10 µm is normal.

The VM15 and the transducer cable must not be moved during measurement of displacement. Even slight motion can introduce force into the sensor and thereby generate unwanted displacement.

Overload

If the input signal is too high, the display shows at the first digit from the left side the figure “1”. The three other digits remain off.

This may occur at very high vibration levels or at shock load of the accelerometer.

In the temperature measuring range overload is indicated in case the temperature sensor is not connected.

☞ Please note, when using the integrators (measuring ranges “Vel” and “Displ”) that the overload indication is derived from the signal after the integrators. So it may occur in extreme cases, for instance, at vibration signals with high frequencies and very high levels that the input stage of the instrument is already overloaded, while the display shows “normal” measuring values.

The reason for this fact is the attenuation of higher frequencies by the integrators, as shown in Figure 2. Just to make sure that the input stages are not overloaded, switch to the range “Acc” and activate the indication “pk-pk”. Now the signal before the integrators is indicated. If there is no overload indication, you can measure velocity or displacement unreservedly.

Temperature Measurement

If you have connected the temperature probe to the instrument you can switch to the temperature range by pressing the “Temp” key. The VM15 can measure temperatures between 2°C and 200 °C.

The temperature probe can be ordered optionally (ordering no. **VM15-T**). It is characterized by a very fast measurement, even on rough or painted surfaces.

☞ **Important:** Please remove the accelerometer from the test object before using the temperature probe, in case both measuring points are electrically connected. If the tip of the temperature probe and the accelerometer case are connected, the VM15 will not measure properly.

☞ **Important:** The temperature probe is equipped with an unprotected, spring shaped thermocouple for shortest response time. It has a long lifetime at gentle manipulation. Soft pressure to the measuring point is sufficient for good temperature transmission. The tip of the sensor must be free of contamination and should be cleaned, if required, by cleaning benzine. After use put on the protection cap.

Shut-off Timer About 1 to 2 minutes after pressing one of the measuring range keys, the instrument switches off automatically. This way an unintentional discharge of the battery is avoided. The automatic shut-off function is deactivated if a plug is inserted in the signal output.

4.4. Signal Output

The signal output is located at the upper end of the instrument. This output is intended for connection of an external instrument via a 3.5 mm phone jack (mono). This can be useful, for instance, to store the measured signal by means of a data logger or to analyze the signal spectrum by an FFT-analyzer.

The signal output offers the signal of the measured value before passing the rectifier. This may be, for instance, the broadband acceleration in the range “Acc” or the once integrated and filtered signal in the range “Vel”.

The maximum output voltage is ± 3 V. The output voltage is scaled proportional to the indication on the display. At an indication of “200.0” the output voltage is 2 V, for example. This applies to rms and peak-to-peak values. The output impedance is about 100 Ω via a capacitance of 1 µF.

The signal is connected to the outer ring of the jack socket. The central contact is connected to the ground. The wiring of the jack is shown in Figure 8.

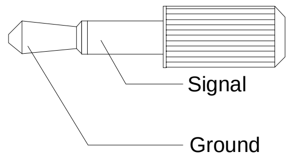


Figure 8: Wiring of the signal output

Deactivating the Shut-off Timer If a plug is connected to the output, the auto switch off function will be deactivated. The instrument measures continuously without any activation of a key.

Signal Cable A 1.5 m measuring cable with 3.5 mm jack at one end and BNC connector at the other end is optionally available (ordering no. **VM15-S**).

☞ To avoid unnecessary battery discharge by continuous operation, please disconnect the signal cable when the instrument is not in use.

4.5. Replacing the Battery

The Vibration Meter VM15 is powered by a 9 V battery type IEC 6F22 (PP3 or equivalent). The battery compartment is located at the rear of the instrument. The battery compartment is opened by pressing on the grooved part of the cover and sliding it downwards (see figure page 3).

The power consumption amounts to about 12 mA. It is recommended to use alkaline batteries. With alkaline batteries a battery life of about 20 h can be reached. The use of accumulators is possible as well. A fully charged accumulator works about 5 h.

When the VM15 is switched off its stand-by current is only 4 µA which is in the range of the self-discharge current of typical batteries.

Battery Indicator The right LED (“BAT”) indicates if the battery voltage drops below 7.5 V. Down to 7 V the instrument works properly.

☞ Please take flat batteries out of the compartment immediately, to avoid leakage. It is advisable to do the same, if the instrument will not be used for longer time.

5. Measuring Methods for Machine Vibration

The assessment of machine vibrations as part of predictive maintenance requires a high degree of experience. At this point, therefore, this problem can be only touched on with the help of some proven methods.

5.1. Vibration Severity Measurement for Unbalance

A common procedure for monitoring the Unbalance of rotating machines is to measurement of vibration velocity, or so-called vibration severity. Vibration severity is a measure of the energy of the emitted vibration. Reasons for Unbalance, for instance, may be loose screws, bent components, worn out bearings with too much clearance or dirt on blower fans. Often several of these effects can influence one another.

ISO 10816-1 If no reference values of vibration severity are available on the relevant machine, you may refer to the recommendations of ISO 10816-1 (see table below). Here you will find permissible values of the vibration severity of different machine types. The basis of the assessment is the maximum value of all measured points on the machine.

Machine Type	Power Rating or Shaft Height	Speed min^{-1}	Foun-dation	Max. Continu-ous value mm/s
Steam Turbines	300 kW – 50 MW		rigid	7.1
	300 kW – 50 MW		flexible	11
	> 50 MW	< 1500	rigid	7.1
	> 50 MW	< 1500	flexible	11
	> 50 MW	1500 – 1800		8.5
	> 50 MW	3000 – 3600		11.8
	> 50 MW	> 3600	rigid	7.1
	> 50 MW	>3600	flexible	11
Electrical Engines	< 160 mm		rigid	2.8
	< 160 mm		flexible	4.5
	160 – 315 mm		rigid	4.5
	160 – 315 mm		flexible	7.1
	> 315 mm	120 – 15000	rigid	7.1
	> 315 mm	120 – 15000	flexible	11
Gas Turbines	< 3 MW		rigid	7.1
	< 3 MW		flexible	11
	> 3 MW	3000 – 20000		14.7
Generators	> 50 MW	1500 – 1800		8.5
	> 50 MW	3000 – 3600		11.8
Blowers, Compressors	< 15 kW		rigid	2.8
	< 15 kW		flexible	4.5
	15 – 300 kW		rigid	4.5
	15 – 300 kW		flexible	7.1
	> 300 kW		rigid	7.1
	> 300 kW		flexible	11
Pumps with separate drive	< 15 kW		rigid	4.5
	< 15 kW		flexible	7.1
	> 15 kW		rigid	7.1
	> 15 kW		flexible	11
Pumps with integrated drive	< 15 kW		rigid	2.8
	< 15 kW		flexible	4.5
	> 15 kW		rigid	4.5
	> 15 kW		flexible	7.1

Measurement with the VM15

Vibration severity is measured in the measuring range “Vel”. The instrument should be switched to the rms mode (LED “pk-pk” is dark).

5.2. Vibration Measurement on Reciprocating Engines

ISO 10816-6

Reciprocating engines, like combustion engines and compressors, are characterized by forward and backward going masses. The vibration generated by this motion, is higher than the vibration of rotating machinery. Standard ISO 10816-6 contains recommendations for the assessment of vibrations of reciprocating machines. The measured quantities are the rms values of acceleration, velocity and displacement. They are picked up at the machine block in all three axes of the room. The recommended frequency range reaches from 2 Hz up to 1000 Hz. That means that the Vibration Meter VM15 is well suited for vibration measurement according to ISO 10816-6.

By means of the measured values of the three vibration quantities, the reciprocating engine may be classified as belonging to a particular class of assessment. The following table allows this classification. At first read the relevant vibration severity level for all three measured vibration quantities. The highest of these three determined severity classes is the decisive class. In the right part of the table you will find the degree of machine condition in dependence on the machine class (depending on size, construction, assembly and speed of the machine).

<table>
<tr><th rowspan="2">Vibration Severity Level</th><th colspan="3">Maximum Vibration</th><th colspan="7">Machine Class</th></tr>
<tr><th>Vibration Displacem. µm rms</th><th>Vibration Velocity mm/s rms</th><th>Vibration Accelerat. m/s² rms</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td>1.1</td><td>< 17.8</td><td>< 1.12</td><td><1.76</td><td rowspan="4">A/B</td><td rowspan="5">A/B</td><td rowspan="6">A/B</td><td rowspan="7">A/B</td><td rowspan="8">A/B</td><td rowspan="9">A/B</td><td rowspan="10">A/B</td></tr>
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<tr><td>180</td><td>> 1784</td><td>> 112</td><td>> 176</td><td>D</td></tr>
</table>

The assessment classes have the following meanings:

A New machines

B Continuous running without restriction possible

C Not suitable for continuous running, reduced operability until the next scheduled maintenance

D Too high vibration, damages to the machine cannot be excluded

5.3. Measuring Bearing Condition

General The two methods mentioned above according to ISO 10816 are concerned with vibration caused by unbalanced masses. This section deals with vibration generated by roller bearings.

Typical reasons for damage to roller bearings are fatigue, corrosion, cage damage, insufficient lubrication or fatigue caused by excess strain. The results are damages of the ball race (creation of pittings), rising temperature, increasing noise, rising bearing clearance, flutter up to the breakage of the cage and the total breakdown of the machine.

The movement of the rolling elements along such damages, such as pittings, generates mechanical pulses which initiate vibrations of the whole system. These vibrations can be measured, for instance, at the housing of the bearing.

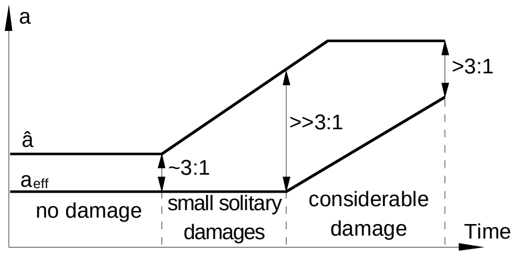
As a rule, the vibrations of roller bearings have frequencies above 1 kHz. Usually acceleration is measured.

Damages of roller bearings may be diagnosed by means of frequency analysis or on the basis of rms and peak value measurements over time.

The diagnosis of the frequency spectrum provides the most detailed information about a bearing, but requires a high degree of experience.

Vibration measurement in time domain (measurement of rms and peak value of acceleration) is much easier to perform but yields less specific results. In many cases, however, it is sufficient to evaluate the condition of a roller bearing.

Crest Factor An established method in time domain is the measurement of the crest factor. The crest factor is the quotient of the peak value and the rms of acceleration ($\hat{a}/a_{rms}$). This method is based on the experience that in the early pre-damage stage of the bearing the rms of acceleration shows only small changes, whereas the peak value increases significantly (see Figure 9).



The following table shows the crest factor and, alternatively, the product of peak and rms values in dependence on the degree of the bearing damage.

Condition	a_{eff}	â	$\hat{a}/a_{eff}$	$\hat{a} \bullet a_{eff}$
no damage	small	small	~ 3	small
small individual damage	small	increased	>3	slightly increased
several individual damages	increased	increased	>3	medium increased
severe individual damage	increased	high	>>3	increased
many severe individual damages	high	high	>3	high

Diagnostic Coefficient

Another method of monitoring roller bearings in time domain is the diagnostic coefficient $D_K(t)$ according to Sturm. This coefficient is calculated from the rms and the peak values of the acceleration at good operating condition of the bearing (initial values with the index 0) and at the present condition (index t):

$$D_K\ (t) = \frac{a_{eff}\,(0) \bullet \hat{a}(0)}{a_{eff}\,(t) \bullet \hat{a}(t)}$$

According to Sturm the following values represent the indicated conditions:

$D_K(t)$	Bearing Condition
> 1	Improvement
1 - 0.5	Good condition
0.5 - 0.2	Accelerating influence to the damaging process
0.2 - 0.02	Progressive damaging process
< 0.02	Damage

Measurement with the VM15

The Vibration Meter VM15 is suitable to evaluate the condition of roller bearings according to the above mentioned methods. The measuring range “Acc HP” is intended for bearing vibration. It eliminates lower frequencies of the signal, which do not originate from the bearing. The rms and the peak value (by pressing the “pk-pk” key) are measured.

☞ Please note that the Vibration Meter VM15 measures the peak-to-peak value. This value is divided by two to obtain the peak value â.

6. Maintenance and Calibration

The VM15 should be protected from dirt and liquids. The case is not water tight.

Please protect the vibration sensor from hard impact on metallic surfaces to maintain its measuring accuracy.

Calibration The accuracy of the Vibration Meter VM15 can be checked easily by means of a vibration exciter, for instance the Vibration Calibrator **VC10** from MMF. This calibrator excites the accelerometer at a frequency of 159.2 Hz with a definite vibration level of

Acceleration	10 m/s²
Velocity	10 mm/s
Displacement	10 µm.

The manufacturer Metra Mess- und Frequenztechnik recommends a yearly check of the VM15 and offers a calibration service. During this check your instrument is adjusted by means of a reference standard certified by the PTB (Physikalisch-Technische Bundesanstalt, the Federal Calibration Authority of Germany). The calibration laboratory provides a calibration certificate for the equipment on demand.

☞ **Important:** Please note, that calibration is valid only for the instrument together with its accelerometer. You will find the serial number of your VM15 on its rear. The accelerometer has an engraved serial number. Both serial numbers are put down in the chapter “Technical Data” of this instruction manual. By means of these numbers you will find the right set in case of any mix-up.

7. Technical Data

Instrument:

Measuring ranges	Vibration acceleration:	3 Hz - 10 kHz,	199.9 m/s²
	Vibration acceleration:	1 kHz - 10 kHz,	199.9 m/s²
	Vibration velocity:	3 Hz - 1000 Hz,	199.9 mm/s
	Vibration displacement:	3 Hz - 200 Hz,	1999 µm
	Temperature:		2 - 200 °C
Display modes	True rms (only vibration)		
	True peak-to-peak value (only vibration)		
Accuracy	Vibration acceleration:	± 5%, ± 2 digits	
	Vibration velocity:	± 5%, ± 2 digits	
	Vibration displacement:	± 10%, ± 5 digits	
	Temperature:	± 3 K, ± 2 digits	
Vibration input	ICP® compatible		
	Connector:	*Binder* series 719, 3 pins, male	
	Constant current:	1 mA	
	Compliance voltage:	10 V	
Temperature input	Thermocouple type K with compensated connector		
	Socket:	miniature thermocouple connector	
Display	LCD, 3 ½ digits, character height 8.9 mm		
	Refresh rate:	3 Hz	
Signal output	AC signal depending on measuring range		
	Maximum output:	± 3 V (± 2 V at FSO of display)	
	Impedance:	approx. 500 Ω via 1 µF	
	Connector:	3.5 mm phone jack (mono)	
Power supply	9 V battery type IEC 6F22 / PP3		
	Current consumption:	approx. 12 mA	
	Stand-by current:	approx. 4 µA	
	Life time:	approx. 20 hours (Alkaline)	
		approx. 5 hours (NiMH Accu)	
	Battery indicator:	LED at U_{BATT} < 7,5 V	
	Auto shut-off timer:	after 1 - 2 min	
Operating temperature	-20 to 55 °C		
	Rel. humidity 95 %, no condensation		
Dimensions	125 x 60 x 25 mm³ (without connectors)		
Weight	150 grams		

Vibration Sensor:

Type	piezoelectric accelerometer
Sensitivity	approx. 25 mV/g
Output	ICP® compatible
Bias voltage	4 - 5 VDC
Resonant frequency	approx. 28 kHz
Transverse sensitivity	< 5 %
Mounting	M5 thread
Connector	TNC socket
Cable	spiral cable, stretched length approx. 1.5 m plug: TNC / *Binder* series 719, 3 pins, female
Dimensions	height 45 mm, ∅ 21 mm, SW19
Weight	50 grams

Accessories:

Standard	Instrument Vibration sensor Cable for vibration sensor Probe for vibration sensor Magnetic clamp Instruction manual Plastic case		
Optional	Temperature probe	Ordering no.:	VM15-T
	Belt case	Ordering no.:	VM15-G
	Signal output cable	Ordering no.:	VM15-S
	(1.5 m; with phone plug 3.5 mm and BNC plug)		

Serial Numbers:

(To be filled out by the manufacturer)

Instrument ....

Vibration Sensor ....

Limited Warranty

Metra warrants for a period of
24 months
that its products will be free from defects
in material or workmanship
and shall conform to the specifications
current at the time of shipment.

The warranty period starts with the date of invoice.
The customer must provide the dated bill of sale as evidence.
The warranty period ends after 24 months.

Repairs do not extend the warranty period.

This limited warranty covers only defects which arise as a result
of normal use according to the instruction manual.

Metra's responsibility under this warranty does not apply to any
improper or inadequate maintenance or modification
and operation outside the product's specifications.

Shipment to Metra will be paid by the customer.
The repaired or replaced product will be sent back
at Metra's expense.

Declaration of Conformity

Product: Vibration Meter
Model: VM15

It is certified hereby that
the above mentioned product
complies with the demands
pursuant to the following standards:

EN 50081-1
EN 50082-1

Responsible for this declaration is the producer

Metra Mess- und Frequenztechnik
Meißner Str. 58
D-01445 Radebeul

Declared by
Manfred Weber
Radebeul, 4th of January, 2002