

SKF Vibration Pen^{plus}



CMVP 40, english system (in/s; equivalent Peak)/
CMVP 50, metric system (mm/s; RMS)

Overall vibration and enveloped acceleration

Overview

A multi-parameter approach to condition monitoring provides two different methods for monitoring machinery condition. This allows for early detection of specific machinery problems and provides more ways to measure changes in machinery condition.

The SKF Vibration Pen^{plus} is a multi-parameter vibration monitoring tool capable of measuring vibration (caused by rotational and structural problems like imbalance, misalignment, looseness, etc.), and capable of measuring vibration in higher frequencies (caused by rolling element bearing or gear mesh problems).

Multi-parameter monitoring is the most thorough and effective method for monitoring bearing and machinery condition. The Vibration Pen^{plus} tool's multi-parameter approach provides accurate and reliable data upon which to base maintenance decisions and promotes early detection, confirmation, and accurate trending of bearing and machinery problems.

Functional description

When performing measurements, the Vibration Pen^{plus} tool's sensor input signal is processed to produce two different measurements for each machinery POINT, Overall Vibration and enveloped acceleration.

The Vibration Pen^{plus} tool's LCD simultaneously displays both measurement values. Depending on the type and location of the machinery component being measured, either or both readings may be of interest.

Overall vibration

(ISO* 10816, Part 1-6) Low frequency vibration (10 Hz to 1 kHz)

- ➡ Overall velocity vibration occurring in the 10 Hz to 1 kHz frequency band is considered the best operating parameter for judging rotational and structural problems like imbalance, resonance, misalignment, looseness, and stress applied to components.



Many machinery problems may cause excessive overall vibration. Mechanical looseness, imbalance, soft foundation, misalignment, rotor bow, resonance, eccentricity, bad belts, or lost rotor vanes can all be measured with overall ISO* vibration measurements.

Measuring the overall vibration of a machine or component, or the structure of a machine, and comparing the measured value to the machine's normal value (or to ISO 10816 standards) indicates machinery health and condition changes.

Note: Overall vibration is not an indicator of bearing or gear mesh problems that typically occur in higher frequency ranges.

Enveloped acceleration

Bearing/gear mesh frequency vibration (10 kHz to 30 kHz)

- ➡ Enveloped acceleration measurements measure the high frequency repetitive vibration signals typically caused by bearing and gear mesh problems.

Envelope detection is very useful in rolling element bearing and gear mesh analysis where a low amplitude, repetitive vibration signal may be hidden by the machine's rotational and structural vibration noise.

* ISO (International Organization for Standardization)

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For example, suppose a rolling element bearing has a defect on its outer raceway. Each rolling element strikes the defect as it passes the defect, causing a small, repetitive vibration signal. This vibration signal is of such low amplitude that, under normal ISO vibration monitoring, it is lost in the machine's other rotational and structural noise.

Envelope detection filters out low frequency rotational signals, then enhances the high frequency defect signals to focus on repetitive events in the 10 kHz to 30 kHz frequency range, and provides an averaged peak value for early detection of bearing and gear mesh problems.

Note: Enveloped acceleration measurements do not detect rotational or structural vibration caused by imbalance, misalignment, looseness, etc.

Easy operation

Vibration Pen^{plus} readings are easily performed, simply:

- Turn the Vibration Pen^{plus} on.
- Press the Vibration Pen^{plus} tool's sensor tip against your machinery measurement POINT.
- Wait for the readings to stabilize, and record the measurement values.

Easy evaluation

The Vibration Pen^{plus} tool's front-panel LCD simultaneously shows overall velocity vibration readings in mm/s RMS (CMVP 50) or in in/s equivalent Peak (CMVP 40), and acceleration enveloping readings in g^E ("E" indicating enveloped acceleration).

The SKF Vibration Pen^{plus} severity card provides quick reference for ISO Standard 10816 overall velocity vibration comparisons.

General severity level guidelines

When considering severity levels, one should always be aware that even standards can only provide general guidelines to determine initial alarm settings. At no time should such guidelines substitute for experience and good judgement. The most reliable method of determining alarm settings is to trend vibration readings over time, establish baseline values and alarm settings above baseline values.

Vibration measured In velocity

For velocity vibration, ISO standards like ISO 10816, First Edition 1995 or VDI 2056 guidelines are generally accepted. ISO 10816 with the title 'Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts' consists of six parts. Part 1 (10816-1) determines general guidelines and are superseded by the following, more explicit parts of ISO 10816, like part 2 (10816-2) for Land-based steam turbines and generators in excess of 50 MW with normal operating speeds of 1500 r/min, 1800 r/min, 3000 r/min and 3600 r/min.

The severity chart shown in Table 1, is in accordance with the ISO 10816-2 guidelines. For exceptions to this guideline and for more details, please refer to the ISO 10816-2 document itself.

Industrial machines with nominal power above 15 kW and nominal speeds between 120 rpm and 15000 rpm when measured in situ are covered by ISO 10816-3.



The machines are separated into four different groups:

Group 1

Large machinery and electrical machines with shaft height greater than 315 mm. These machines are normally equipped with sleeve bearings.

Group 2

Medium-size machines and electrical machines with shaft height in between 160 mm and 315 mm.

These machines are normally equipped with rolling element bearings and operating speeds above 600 rpm.

Group 3

Pumps with multivane impeller and with separate driver with rated power above 15 kW.

Machines of this group may be equipped with sleeve or rolling element bearings.

Group 4

Pumps with multivane impeller and with integrated driver.

Machines of this group mostly have sleeve or rolling element bearings.

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Specifications

Vibration pickup: Piezoelectric acceleration integrated sensor (compression type)

Measurement range: 1 to 55 mm/s (RMS), 0.06 to 3.00 in/s (equivalent, Peak)

Tolerance: ± 10% and 2 digits measured at 80 Hz

Frequency range:

Overall vibration: 10 Hz to 1,000 Hz (*Tolerances measured within the frequency range are in accordance with ISO 3945 and 2 digits.*)

Acceleration enveloping: 10 kHz to 30 kHz

Display: Measurement value 3.5 digit LCD

Display cycle: Approximately one (1) second

Overload indication: OVER

Battery replacement indication: BATT

Hold indication: HOLD

Power: Two (2) CR2032 lithium batteries

Battery lifetime: 170 mA hours current consumption

Measurement mode: 7.5 mA

HOLD mode: 3.0 mA

Auto power off function: Power is turned off approximately two minutes after last ON or HOLD operation

Dimensions: Height: 17.8 mm (0.7")

Width: 30.5 mm (1.2")

Length: 157.5 mm (6.2")

Weight: Approximately 77 g (2.7 oz.) with batteries

Ambient operating conditions: -10 °C to +50 °C (+14 °F to +122 °F)

20% to 90% relative humidity

Ordering information

- **CMVP 40-EN** Vibration Pen^{plus} english system (in/s; equivalent Peak), includes two (2) CR2032 lithium batteries, a leather belt holster, Vibration Severity Card and a English language manual
- **CMVP 50-EN** Vibration Pen^{plus} metric system (mm/s; RMS), includes two (2) CR2032 lithium batteries, a leather belt holster, Vibration Severity Card and a English language manual
- **CMVP 50-DE** Vibration Pen^{plus} metric system (mm/s; RMS), includes two (2) CR2032 lithium batteries, a leather belt holster, Vibration Severity Card and a German language manual
- **CMVP 50-FR** Vibration Pen^{plus} metric system (mm/s; RMS), includes two (2) CR2032 lithium batteries, a leather belt holster, Vibration Severity Card and a French language manual

Optional kits that includes the Vibration Pen^{plus} CMVP 40/CMVP 50

- CMPK 200^{plus} Basic Condition Monitoring Kit (metric system)
- CMPK 210^{plus} Basic Condition Monitoring Kit (english system)
- CMPK 60^{plus} Bearing Analysis Kit (english system)
- CMPK 70^{plus} Bearing Analysis Kit (metric system)

Table 1. Vibration severity chart ISO 10816-2.

ISO 10816-2		Steam Turbines and Generators	
Velocity		Speed (rpm)	
CMVP 40 in/sec eq. Peak	CMVP 50 mm/sec RMS	1500 or 1800	3000 or 3600
0.66	11.8	DAMAGE OCCURS	
0.56	10.0		
0.47	8.5	RESTRICTED OPERATION	
0.42	7.5		
0.29	5.3	UNRESTRICTED OPERATION	
0.21	3.8		
0.16	2.8	NEWLY COMMISSIONED MACHINERY	
0.08	1.4		
0.00	0.0		

Table 2. Vibration severity chart ISO 10816-3.

ISO 10816-3		Machinery Groups 2 and 4	Machinery Groups 1 and 3		
Velocity		Rated power			
CMVP 40 in/sec eq. Peak	CMVP 50 mm/sec RMS	15 kW – 300 kW		Group 1: 300 kW – 50 MW Group 3: Above 15 kW	
0.61	11.0	DAMAGE OCCURS	DAMAGE OCCURS		
0.39	7.1				
0.25	4.5	RESTRICTED OPERATION	RESTRICTED OPERATION		
0.19	3.5				
0.16	2.8	UNRESTRICTED OPERATION	UNRESTRICTED OPERATION		
0.13	2.3				
0.08	1.4	NEWLY COMMISSIONED MACHINERY	NEWLY COMMISSIONED MACHINERY		
0.04	0.7				
0.00	0.0				
Foundation		Rigid	Flexible	Rigid	Flexible