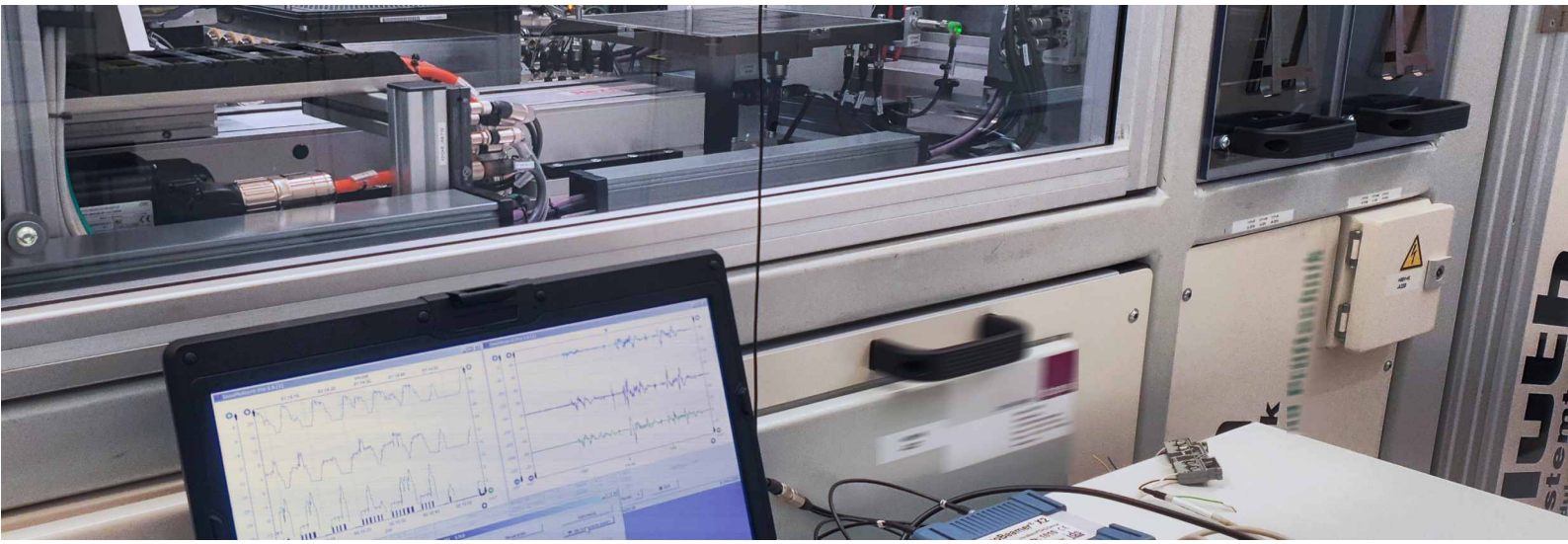
ids innomic® Schwingungsmesstechnik GmbH

Services catalogue

vibration measurement



Single- and two-plane balancing

Measurement, improvement and documentation of the balance condition of machines (rotors, fans, motors, tool spindles)

Overall vibration behavior acc. to DIN 20816

Measurement and documentation of the overall vibration behavior of machines, foundation damping, natural frequencies

Machine diagnostics

Measurement and documentation of roller bearing damage, analysis in the time and frequency domain, transfer function

Vibration measurement acc. to VDI 2038

Measurement and documentation of the usability of buildings - compliance with limit values (VC lines)

Vibration measurement acc. to DIN 4150-2/3

Measurement and documentation of vibration effects on people in buildings and effects on buildings

Human vibration measurement acc. to DIN 5349 and DIN 2631

Measurement and documentation of hand-held machine tools and whole-body vibration measurement

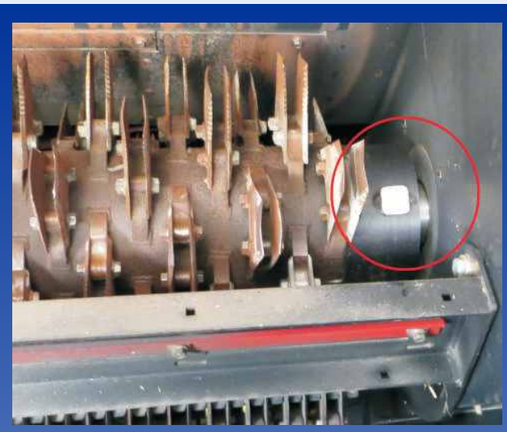
Pic. 1) Field balancing with the VibroMatrix System - InnoBalancer Pro

Area of application field balancing

- On-site balancing
- Rotor remains installed
- Single- and two plane balancing dynamic

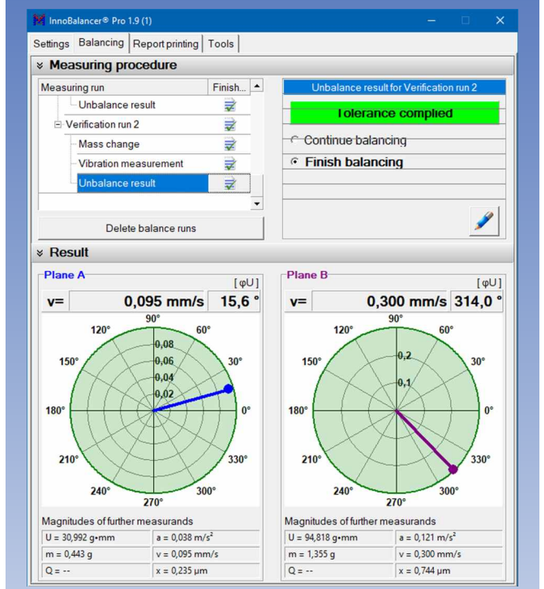
Services from IDS

- Single- and two plane balancing on-site
- Documentation of the balancing result
- Evaluation & consulting

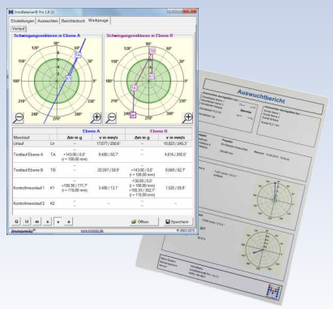


Pic. 2) Set the calculated balancing weights

For balancing, the vibrations on the bearing housing are measured with an accelerometer. The speed and angular position is detected by a light barrier with the help of a reflective mark on the impeller.



Pic. 3) Field balancing can be carried out quickly and effectively with the IDS Innomic software InnoBalancer Pro.



Documentation of the balancing result in a complete balancing report.

Two-plane balancing

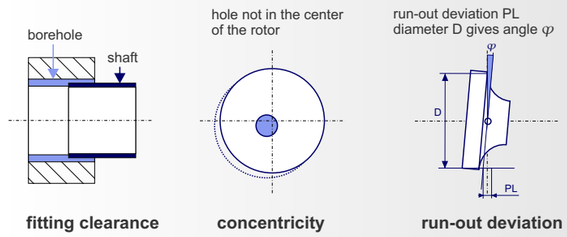
Masses that rotate and whose center of gravity is not on the axis of rotation generate centrifugal forces that rotate with the rotation frequency. As a result of unbalanced centrifugal forces, oscillating forces or oscillating movements occur, which are transmitted to the bearings and by definition (DIN ISO 21925) we are dealing with an imbalance.

In practice, a rotor usually changes due to wear and tear on the tool, dust and process material that has caked up, or material loss after a collision with foreign objects. The rotor does not necessarily have to be removed to change the tool (knives on a milling shaft). However, due to fitting and assembly inaccuracies, the mass distribution changes and thus a possibly increased imbalance.

Field balancing now makes it possible to balance the rotor in the installed (operational) state. However, the masses required to compensate for the imbalance result from the centrifugal forces on the rotor and cannot be measured directly. This would require force sensors installed directly in the bearings.

Instead, the vibrations are measured synchronously with the speed (1st order). The balancing masses can now be calculated from the so-called initial run and a test run with a known test mass at a known position on the rotor. Through the test run in each compensation level, all influences from the bearing stiffness are eliminated at the same time.

The rotor can therefore be balanced when installed at operating speed. There are no additional costs for assembly and transport to a service provider who usually cannot carry out the balancing at full operating speed.



Pic. 4) In practice, additional, unavoidable errors occur during assembly due to fitting clearance. In addition, there are errors due to concentricity and axial runout deviations.

With IDS Innomic you can jointly carry out field balancing at your site. As a rule, we carry out the measurements, calculate the counter-weights and specify the exact position on the rotor. With the on-site maintenance staff, the changes can then be carried out professionally by welding, drilling, riveting, screwing. We would also be happy to show you solutions that can be used to create reusable balancing devices on the rotor. (use of slot nuts)

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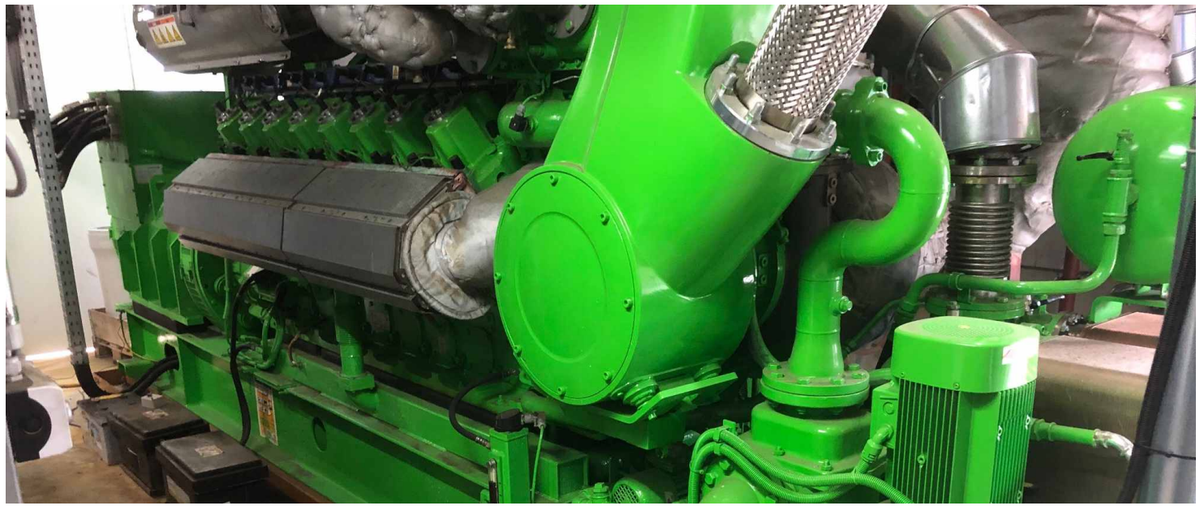


Pic. 1) Vibration measurement according to ISO 8528-5 on a combined heat and power plant engine +

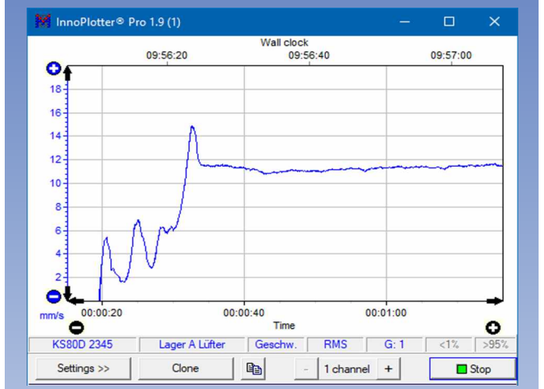
Scope DIN ISO 20816

- Acceptance measurements between manufacturer and operator
- Ensuring machine safety
- Predictive Maintenance

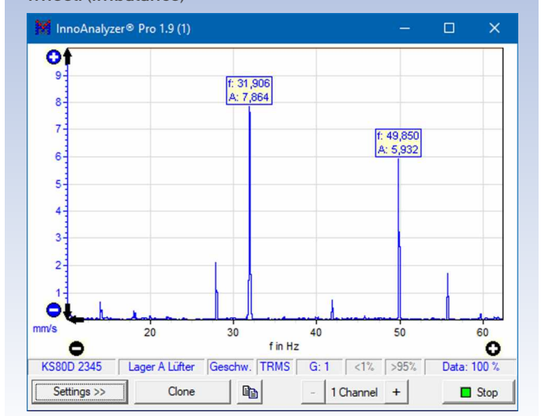
Services from IDS

- Planning and execution of acceptance measurements
- Documentation of all measuring points and results
- Evaluation and consulting, control measurements

Pic. 2) Vibration measurement according to ISO 14694 on a fan



Pic. 3) Measurement of the effective value of the vibration speed in the frequency range 10..1000 Hz on a fan with inadmissibly high amplitudes, caused by dirt on the fan wheel. (imbalance)



Pic. 4) Frequency spectrum of the vibration speed at 1,920 rpm. The vibrations caused by imbalance can be clearly seen at 31.952 Hz.

Overall vibration behavior of Machines according to DIN ISO 20816

During operation, machines are often the cause of vibrations that occur or are themselves subject to additional forces from other vibration generators. Overall, this results in a vibration behavior which, in the best case, can be reduced to a minimum without posing a risk to people or the environment and the quality of the product remains guaranteed.

The DIN ISO 20816 series of standards defines limit values for vibrations in various machine types, above which safe operation is no longer possible.

In order to avoid damage from the outset, vibration values can be measured during installation and commissioning, which are then checked and, if necessary, automatically monitored. If no special specifications have been made between the manufacturer and the operator of the machines and no special standards apply for a machine type, the limit values of this series of standards can serve as a starting point.

With its employees, who are certified as vibration analysts according to ISO 18436-2, IDS Innomic has the necessary expertise and high-quality measurement technology to carry out these measurements in accordance with the standard.

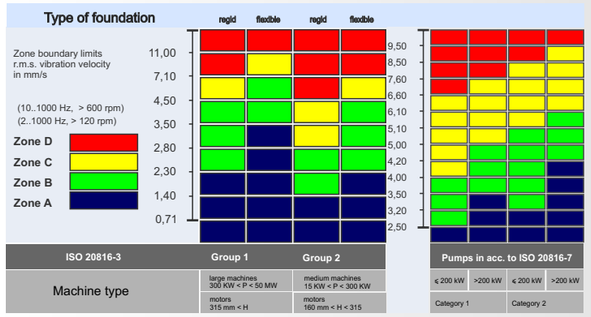


Bild 5) Limits of the total vibration parameters according to DIN ISO 20816

The installation of the machines is decisive for compliance with the limit values. Additional influences from natural frequencies of the machine frame, individual machine parts and components, and the foundation can be measured and documented. If problems arise, changes to the operating parameters or design improvements are made in a targeted manner.

Vibration dampers are regularly used to decouple the machines from the foundation. Depending on the design, however, the vibration damping effect usually decreases over time. Since the design of the damping is frequency-dependent, negative effects can occur here, especially when excited by speed-synchronous machine components. However, the quality of the damping can be measured using a transfer function and, if necessary, restored by replacing it.

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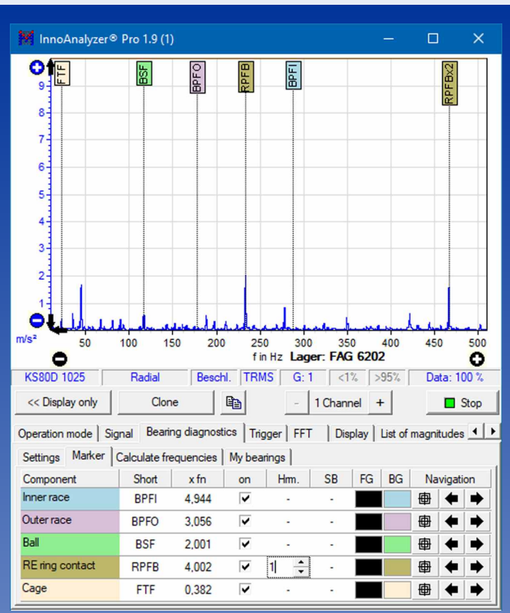
Pic. 1) Vibration measurement on a bearing block for roller bearing diagnosis using envelope analysis

Application area machine diagnostics

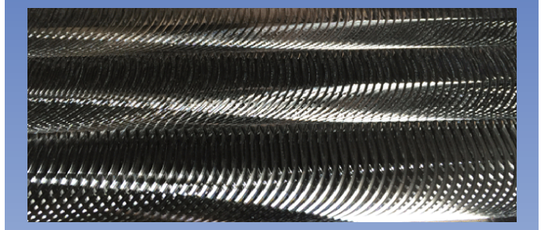
- Roller bearing diagnosis
- Construction & development
- Process optimization

Services from IDS

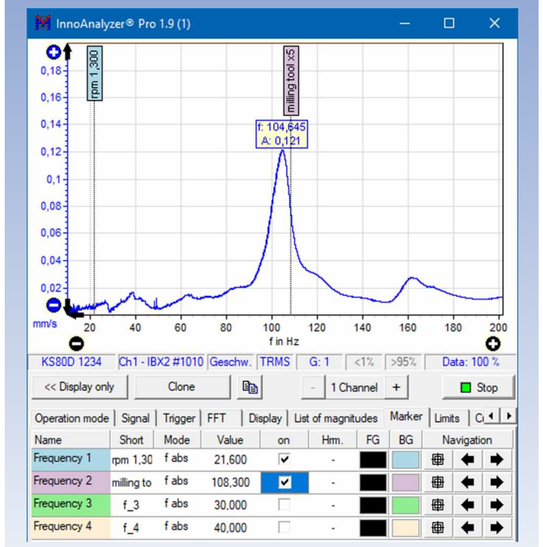
- Planning and execution of vibration measurements and diagnostics
- Documentation of all measuring points and results
- Evaluation and consulting, control measurements



Pic. 2) Rolling element damage (BSF) + rolling element ring contact (RPFB) visible as clearly defined spectral lines in the envelope spectrum.



Pic 3) Chatter vibrations visible as machining marks.



Pic. 4) Natural frequency at 104.6 Hz, excited by the tool engagement with a frequency of 108.3 Hz, which results from the operating speed (1,300 rpm / 60x5).

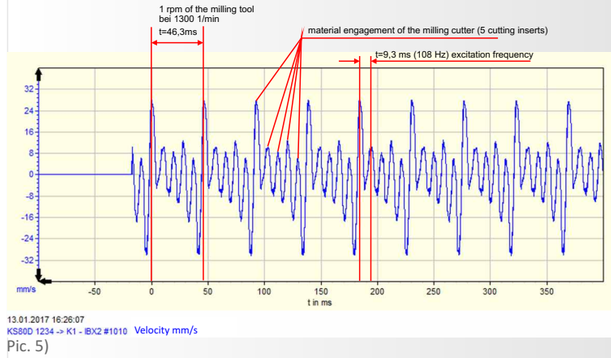
Machine diagnostics

In the case of machine processing, the product quality depends on the perfect functioning of the machine while adhering to the specified tolerances. Wearing parts of a machine cause the mechanical properties to change. In detail, this also changes the vibration behavior in detail.

With the help of a vibration diagnosis, the cause of the malfunctioning of a machine can then be determined in many cases relatively inexpensively and with justifiable effort.

With the help of the envelope curve analysis, the vibration measurement on a rolling bearing provides precise information about which components (inner ring, rolling element, outer ring, cage) are damaged. As a rule, conclusions can also be drawn from this as to the cause. For example, the constant start-stop events of a rotor without a speed ramp can put excessive strain on the cages due to the forces that occur (acceleration x mass of the rolling element set).

The determination of the natural frequencies of the machine structure also provides precise information as to whether the speeds used or external influences are suitable for causing resonances or at least loss of stability through the excitation of these frequencies. Chatter vibrations are a typical example. Here, the excitation occurs through the material engagement of the tool (milling cutter), which occurs at a frequency that corresponds to the number of indexable inserts x operating speed / 60.



Pic. 5)

In addition to the high positioning accuracy of the individual axes of a traverse path for tool spindles, the load rigidity of the feed system (linear guide) also plays a decisive role in quality. The constructive design with the highest possible 1. natural frequency can also be nullified again by inadequate or uneven attachment of the linear guide to the machine bed. If the resulting natural frequencies are close to the excitation frequency (depending on the tool and speed), resonance phenomena occur with uncontrolled tool engagement, which can be found on the workpiece as so-called chatter marks.

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Pic. 1) Vibration measurements and preliminary investigations during the planning and construction phase

Scope VDI 2038

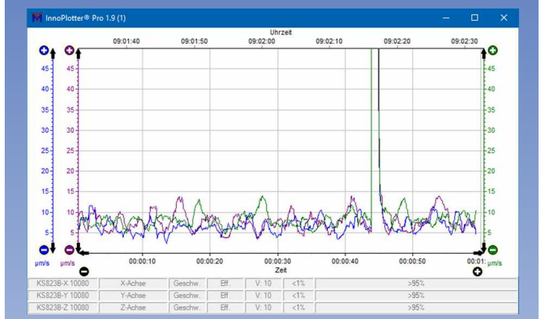
- Semiconductor industry
- Measuring device manufacturer
- Data centers
- Measurement and testing laboratories

Services from IDS

- Planning and execution of the vibration measurement
- Documentation of all measuring points and results
- Evaluation & consulting

Pic. 2) VC-C line, suitable for microscopes up to 1000x magnification

Bild 3) The sensors are coupled on the foundation or on the installation floor using a measuring plate in accordance with DIN 45669-1. The measuring plate can simultaneously have 3 individual sensors for each spatial direction (X-Y-Z). The measuring plate is leveled beforehand with appropriate adjusting screws.



Pic. 4) The overall vibration characteristics are measured and documented over a period of up to 24 hours. In this way, special vibration events can be assigned and assessed during the construction phase and later in the production phases.

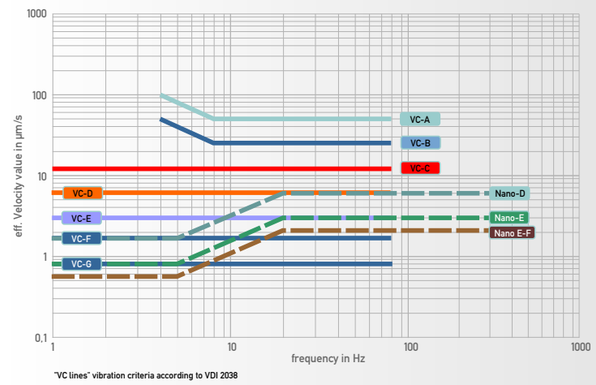
Pic. 5) With the InnoAnalyzer Octave Pro, the measurement is carried out in accordance with VDI 2038. The measured third-octave band spectra of the vibration velocity are displayed together with the limit values (VC lines according to VDI 2038) in a real-time graphic. Not only can the conditions at the new location be determined, but they can also be easily compared with the measurements at a reference location, e.g. the old location.

Vibration measurement according to VDI 2038

The question of serviceability arises, among other things, when dynamic loads are applied, the effects of which have an impact on the vibration behavior of the building in parts or as a whole. For new industrial buildings, conservative load assumptions are often made very optimistically in favor of economic aspects in construction and execution.

On the other hand, manufacturers of precision measuring systems are making ever higher demands in terms of vibrations and shocks at the respective installation site. With the help of so-called VC lines, VDI 2038 defines max. permissible vibration levels based on which compliance with limit values means that trouble-free operation can be expected. Sheet 2 of the guideline describes the metrological determination of vibrations and shocks, as well as the requirements for the individual components of the measuring device according to DIN 45669-1.

VC lines - limit curves of third-octave vibration velocity spectra



"VC lines" vibration criteria according to VDI 2038

Pic 6)

Classic application - new factory hall

The production capacities at the old location are limited and the move to a larger production hall is pending. But will the precision machines and systems also work precisely at the new location? The vibration behavior at the old location can be measured as early as the planning phase and used as a benchmark for the construction of the new building. The knowledge of the previous conditions, which arises from such a measurement and evaluation, creates trust and security with regard to the vibration and shock requirements.

But also independently of empirical values from other production sites, IDS Innomic documents the vibrations and shocks by taking measurements at the new investment location in comparison to the specifications based on VC lines according to VDI 2038.

As early as the construction phase, regular measurements can be used to assess compliance with the specifications, e.g. on the foundation.

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Pic. 1) Vibrations caused by demolition work in the immediate vicinity of a data center

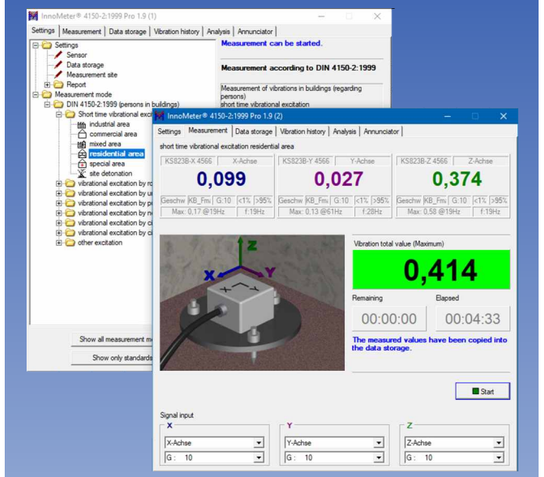
Area of application DIN 4150

- Vibrations in construction
- Effect of vibrations on **buildings**
- Effect of vibrations on **people** in buildings

Services from IDS

- Planning and execution of sample measurements
- Documentation of all measuring points and results
- Evaluation & consultating

Pic. 2) Vibration effects on people in buildings caused by production machines in the same building. Here meeting and office rooms.



Pic. 3) The maximum cycle values of the weighted vibration severity KBFTi for part 2 and the absolute peak values for part 3 of the standard are measured and documented.

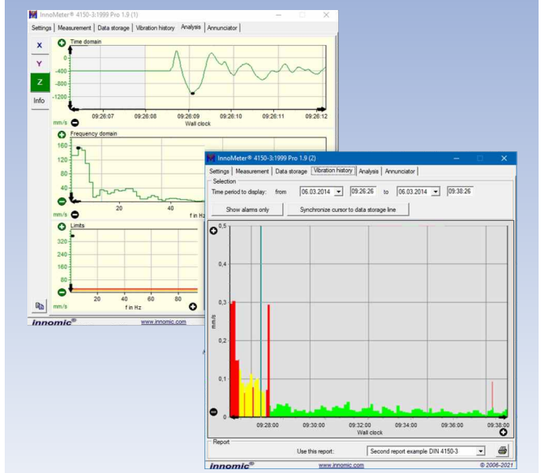


Bild 4) For subsequent documentation, the course of the vibration events and their main frequency component is stored over the entire measurement.

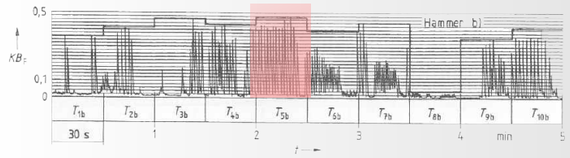
Vibration measurement according to DIN 4150-2/3

Vibrations and oscillations can cause damage to the fabric of a building. As a rule, this is caused by long-term effects from adjacent road traffic or short-term vibrations from construction activity.

With appropriate knowledge of the strength of the vibrations, i.e. measurement and monitoring of compliance with limit values, measures to prevent damage can be discussed in advance together with the "causer" and the party affected.

The DIN 4150 series of standards provides reference values for this purpose, and damage can be expected if these values are exceeded. Part 3 in particular deals with vibrations in the building industry that affect buildings.

But even for people in buildings, vibrations can not only be perceived as unpleasant, but can also lead to long-term damage to health. Depending on the situation, whether residential or commercial, Part 2 of the standard provides the reference values to be observed for different times of day.



i	1	2	3	4	5	6	7	8	9	10
KB_{FTi}	0,36	0,41	0,46	0,43	0,47	0,39	0,44	0,04	0,35	0,41

Pic. 5) Time characteristic of the weighted vibration severity KBF(t) with determination of the cycle maximum values KB_{FTi} for a forging hammer.

For larger construction sites and longer construction activities, it is often advisable to set up continuous vibration monitoring, which, however, is also associated with high costs for personnel, data volume and evaluation.

In many cases, however, a trial measurement is sufficient, during which specific construction activities are then carried out at the designated distance from the affected building. If the values are significantly below the reference values and the construction work is carried out successfully, it can be assumed that the limit values will be complied with during the further course of the construction work.

And in the case of subjective impressions of persons in buildings, a test measurement can clarify whether the perception actually correlates with immissions from vibrations or whether the reference values are formally complied with.

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Pic. 1) Determination of the max. permissible period of exposure to vibrations on the wrists

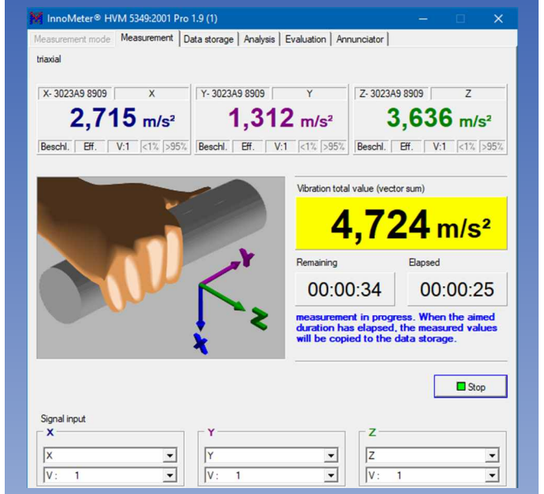
Scope of application DIN ISO 5349 / DIN ISO 2631

- Hand held machine tool manufacturer
- Manufacturer of construction machinery, forestry and garden machinery
- Transportation, floor conveyor technology

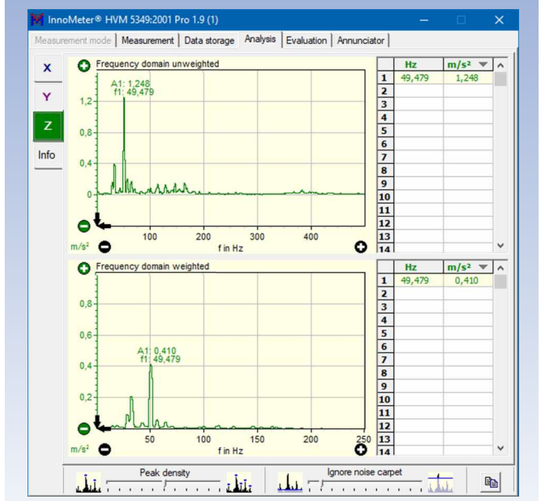
Services from IDS

- Planning and execution of the measurement
- Documentation of all measuring points and results
- Evaluation & consultating

Fig. 2) Triaxial sensor with handle adapter on jackhammer



Pic. 3) The evaluated effective value of the acceleration is measured and documented. Compliance and exceedance are signaled in real time during the measurement by traffic light colors.



Pic. 4) Automatic analysis of the individual frequency components unweighted and weighted.

Human vibration measurement according to DIN ISO 5349 and DIN ISO 2631

Hand-arm vibration DIN ISO 5349

Hand-arm vibration is caused by vibrations transmitted through the palm and fingers into the hands and arms. Workers whose hands are regularly exposed to vibrations can experience damage to hand and arm tissue. With the appropriate measurement solution, it is possible to detect whether activities are hazardous.

Whole-body vibration DIN ISO 2631

Whole-body vibrations are caused by vibrations transmitted from machines and vehicles at the workplace via the seat or feet. These often occur during off-road work, e.g. in agriculture, construction and quarries, but also on the road in trucks or industrial trucks such as forklifts.

Whole-body vibration is not limited to sedentary workers, but can also occur when standing on a concrete crusher, for example.

We offer the following measurements as a service:

Hand-arm vibrations DIN ISO 5349

- Measure the vibrations of hand-guided machines in compliance with ISO 5349, VDI 2057-2 and EU Directive 2002/44/EG
- Measurement with real-time evaluation according to LärmVibArbSchV

Whole body vibration DIN ISO 2631

- Determination of vibration load on the human body
- Objective testing of comfort in vehicles
- Measurements conforming to standards ISO 2631-1, ISO 2631-2, ISO 2631-4, special measurements according to ISO 2631 (SEAT value)
- Measurement with real-time evaluation according to LärmVibArbSchV

Pic. 5) Triaxial sensor integrated in a seat cushion for measuring whole-body vibrations.

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Services catalogue

vibration measurement

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