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E

Early fault detection

A system for E. indicates machine errors already at an early stage, whereby a further operation of the machine is still possible, usually during a foreseeable future time period, without hesitation.

Eccentricity, mechanical

E. is the deviation of the outside diameter of a shaft related to the geometric center and is also called elongation or mechanical run-out.

Eddy current principle

The eddy current measurement principle relies on the fact that the electromagnetic field in a coil through which alternating current is flowing induces eddy currents in electrically conducting objects (metals). These eddy currents react on the coil across the magnetic field and reduce its electrical power. The power conversion is greater, the closer the metal object is to the coil and the more powerfully it is influenced by its magnetic field. The power withdrawal is evident in the transducer (converter) through a reduction in the voltage. This effect is transformed in the converter after rectification and filtering into a signal proportional to the measured value (e.g. $8\ mV/\mu m$). The transducer can be integrated into the sensor or it can also be external.

Effects of coupling errors

See Coupling errors, effect of

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Efficiency

In a system for power transmission, the relationship of the transmitted effective power P_N in the load to the total power P in the source or to the sum of the effective power P_N and the lost power P_V, i.e.

$$\eta = \frac{P_N}{P} = \frac{P_N}{P_N + P_V}$$

Electrical circuit

Arrangement of construction units or media, by which electric current can flow. The path of the current from a power source over conductive areas back to the same power source.

Electrical machines

- for shaft vibrations [90; 108]
- for bearing vibrations [113; 114], without indication of limit values [100; 101; 103; 105; 113]

Electroacoustic transducer

Transducers that take in an input signal and deliver an acoustic output signal or vice versa.

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Electrode

Electrical pole, in place of a fixed electrical conductor, at which electrical charge amplifiers enter or exit. The positive E. is called the anode, the negative E. is the cathode.

Electrodynamics

The science of the features with which variable electrical and magnetic fields are linked with one another.

Electrodynamic principle

In a coil which moves within the magnetic field of a permanent magnet, a voltage is induced which is proportional to the vibration velocity.

Electromagnetic environment

Totality of the electromagnetic phenomena at a given location.

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Electromagnetic endurance; electromagnetic compatibility

Abbreviation: EMV
The ability of a device or system to function satisfactorily in its electromagnetic surroundings without introducing unacceptable electromagnetic disturbances for other devices in these surroundings.

Concept for a branch of electrical engineering that concerns itself with the investigation of the electromagnetic interference of electronic apparatus and equipment by free space and wireless coupling and proposes such corrective measures as changes in design, shielding, filters, etc. Basically, electronic devices and systems are only permitted to give off a limited amount of interference to their surroundings. However, on the other hand, these devices must be able to absorb a certain amount of interference without having it affect their functionality and reliability.

Electromechanical transducer; electromechanical converter

Transducers that take in an electrical input signal and deliver a mechanical output signal or vice versa.

Note: Electromechanical transducers – as part of vibration sensors – transform mechanical paths, velocities and accelerations into electrical signals proportional to the voltage.

Elongation

With vibrations, the momentary distance of the vibrating magnitude from the rest position (deviation of the magnitude from the temporal mean value). The greatest possible E. is called amplitude, with harmonic vibrations amplitude.

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EMC

Abbr. for **e**lectro**m**agnetic **c**ompatibility.

Encoding

Same thing as coding

Energy, kinetic

The kinetic energy W_{kin} of a body. For a mass point with mass m and velocity v, the following is valid:

$$W_{kin} = \frac{mv^2}{2}$$

Environmental influences

Vibration sensors; environmental effects

Equivalent n^{th} modal unbalance

The smallest individual unbalance that corresponds to the effect of the “unbalance in the n^{th} normal mode” on the bending of the nth normal mode. An equivalent unbalance in n^{th} normal mode affects all other normal modes. A set of unbalances in a suitable number of equalisation planes and configured in such a way that the observed normal mode is affected can be called an “equivalent set and unbalances of the n^{th} normal mode”.

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Erasable programmable ROM

Abbr.: EPROM
This type of the read-only memory is found less in computers and employed more in industrial controls, since it can occur here more frequently that a program sequence changes due to technical alterations and a change in the process is therefore necessary. Normal PROMs or ROMs would have to be discarded and replaced by a new program. With EPROMs this is not necessary. Old contents of the EPROM are deleted and replaced by the new contents.

Error

Difference between observed or computed conditions, procedures, or data on the one hand, and true, fixed or theoretically correct conditions, procedures and/or data on the other hand.

Note 1: One differentiates an E. from its cause or from the occurrence of the event, but also from the behaviour of the error. In other environments, e.g. during quality assurance, one speaks only then of an error if given demands are not fulfilled because of the difference.

Note 2: See also DIN-55350-11.

Error, bias (of a measuring instrument)

Estimated contribution of a measuring instrument to systematic measurement deviation.

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Error limit; limit of permissible error; maximum permissible error

1) General: The limit of the agreed upon or guaranteed, certified extreme deviation upward or downward from the target display or from a prescribed value of the measured variable. E. are conceptually to be strictly differentiated by the error and the measurement uncertainty. It is usually characterized by indication of the range within which its measured value may lie (proportionally related to the full-scale value or absolutely). The accuracy class is determined by the E.

2) Measuring instruments: Magnitude of measurement deviation limit for a measuring instrument.

Error (of indication) of a measuring instrument

That contribution toward measurement deviation caused by a measuring instrument.

Evaluation of vibrations

Recommendations for the values for the ALARM and SHUTDOWN (limit values for operation, ALARM-limit and SHUTDOWN-limit) as well as for the assessment of measurement results are contained in the following guidelines.

- Centrifugal pumps
  - for bearing vibrations [113]

- Centrifuges
  The assessment of vibrations in centrifuges can be done acording to [113; 115].

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In general the machines in the machine group T and [115] resp. in the group <flexible supports> are arranged in the group of [113]. Because of the special conditions of operation the classification of the centrifuges from group B presents difficulties.
During continuous monitoring the centrifuge must be automatically switched off upon reaching a limit value. Data for this are in the prescription for the prevention of accidents for centrifuges [104]. [113] also gives advice about the limit values for alarm and shutdown.

- Compressor plant
- for shaft vibrations [90; 108]
- for bearing vibrations [113; 114], without limit values [103; 105; 115]

- Electrical machines
- for shaft vibrations [90; 108]
- for bearing vibrations [113; 114], without indication of limit values [100; 101; 103; 105; 113]

- Hydro-electric plant
- for shaft vibrations [92; 110]
- for bearing vibrations there is at this time no guideline

- Industrial turbo-sets
- for shaft vibrations [90; 91; 108; 109]
- for bearing vibrations [113; 114], without limit values [103; 105; 115]

- Planetary gearboxes
  The rms value of vibration velocity from 10 Hz up to at least tooth-mesh frequency should be measured. As a rule the use of acceleration sensors is required for this application. If the vibration acceleration is monitored, the low frequencies (e.g. planet passage frequencies) will be suppressed. If there are no limit values for the assessment available from the manufacturer or from own experience, an assignment to Group G [115] is possible.

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- Power station turbo-sets
- for shaft vibrations [89; 94; 107; 116)
    - for bearing vibrations [112], without limit values [103; 105; 115]

- Printing machines
  The assessment of vibrations in printing machines can be done according to [113; 115].

- Spur gears
  It is recommended to monitor the shaft vibrations at the drive-end and driven-end bearings using relative shaft vibration sensors. An extended monitoring (axial thrust and bearing temperature) should be carried out according to [102].
  For monitoring the bearing housing vibrations the same basic rules as for planetary gearboxes are valid.

- Ventilators
  The assessment of vibrations in ventilators can be done according to [113; 115]. In [113] an indication of limit values for alarm and shutdown is also given.

Expert system

An E. is a computer system which possesses the authority of human experts on a special field of knowledge and is used as a consulting and problem/solution system. The system must be in the position to refine inquiries and reformulate them into complete problem definitions, generate understandable answers and carry out assistance with the application of the solution. Here it is essential that the reliability of the offered solution can be checked. Since it concerns extremely special systems, which, despite restrictions, deal with large and usually diffuse fields of knowledge (an essential problem with E. is the

acquisition of knowledge) and should have the goal of exceeding, on a long-term basis, the authority of individual experts, the development of E is very lengthy and expensive.

External triggering

With external triggering, the measurement procedure is initiated by a signal (usually, an impulse) introduced from without. Internal triggering criteria (positive or negative level with increasing or decreasing signal trend) are also used for external triggering.

For the analysis of machine vibrations, the external impulse is derived from the machine shaft (e.g. by a reflecting marker). The impulse thereby achieves a phase shift of the rotational angle position of the shaft. At constant machine rpm, the sampling of vibrational values can follow in equidistant time intervals Δt after the start of data capture through an external impulse. If, by comparison, the rpm during measurement is not constant, very large errors can result during messaging processes; the errors will increase as the number of messages increases. In this case, the rotation-synchronous (in brief: synchronisation) sampling of the vibration signals is necessary. That is, they are sampled in equal rotational angle increments.

External triggering is especially important for the time domain notification.