



1.16 Vibrodiagnostics

Amended: 2019-04-30

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Technical conditions for machinery vibrodiagnostics. This Standard applies to all Škoda Auto plants.

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Therefore, all parties are strongly recommended to check the ITS regularly. These documents enter into force on the date of their latest update. The ITS wording relevant in terms of contracts and agreements already concluded is that in force at the time of issuing the purchase/service order concerned.

Note: In the event of any discrepancies among the Czech, English and German versions of this ITS, the Czech version shall prevail. The Czech version is available on <http://cts.skoda-auto.com/>.

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1. Key terms - definitions

Technical diagnostics – science dealing with disassembly-free and non-destructive methods of assessing the technical condition of machinery.

Vibrodiagnostics – method of diagnosing the technical condition of machinery in which vibrations are used as the source of input information for subsequent analysis.

Vibrations – dynamic phenomenon in which primary elements or solid bodies make back-and-forth motion around a position of equilibrium.

Diagnosis – the outcome of analysing the current technical condition of machinery, i.e. assessing the operability of such machinery under the given operating conditions. The key tasks of the diagnosis process include:

- Detection – detecting the existence of a starting defect;
- Localisation – identifying the location of the defective part or the “node” of the starting defect;
- Specification – identifying the root cause of the starting defect by assessing the diagnostics signal;
- Prediction – forecasting (estimating) the residual lifespan (the time until necessary repair) for the sake of strategic planning and management of the maintenance process.

Vibration measurement parameters:

- Displacement – unit: mm or μm , in cases where it is possible to use a relative vibration sensor, a displacement diagram, orbits, etc.
- Speed – unit: mm/s; effective value of vibrations under ČSN ISO 10816, ČSN ISO 20816, and ČSN 122011 (standards), spectrums, time record, etc.
- Acceleration – unit: g or mm/s^2 ; effective value, top value, time record, spectrum, etc.

Diagnostics tools – technological equipment and methods that make it possible to analyse and assess the condition of the machinery to be diagnosed.

2. Vibrodiagnostics options and methods

- The basic measurement takes the form of identifying the overall machinery-generated vibrations. Primarily, the purpose is to identify mechanical conditions such as disbalance, misalignment, mechanical loosening, bent shaft, resonance, problems with belt transmissions, etc. This type of measurement is defined in standards that deal with vibration levels admissible for the machinery concerned. The limit values of vibrations are specified in individual standards for the machine equipment (ČSN ISO 10816, ČSN ISO 20816 – general standards for most types of machinery, ČSN 122011 – fans, ČSN 20 0065 for metal machine tools, etc.). The objective of the measurement is to identify the speed of vibration in mm/sec over a range of 10 – 1000 Hz in RMS detection (all of the aforesaid standards apply to this measurement method). An exception is the assessment of vibration levels on machine tools, where stricter criteria are required and where long-term monitoring has led to identifying recommended vibration levels, or machine equipment whose rotation frequency is outside the range of 10 – 1,000 Hz.
- Measurement of vibration accelerations over suitably selected ranges is successfully applied in checking the status of damage to bearings, the lubrication status of slide and roller bearings, detecting electrical problems on electric motors and checking the gearing and lubrication status in transmissions.



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Depending on the method applied, vibrodiagnostics can be divided into the following types:

- One-off machinery status measurement – identifying the current status; predicting further development of the detected conditions/statuses is difficult, though;
- Periodic-round diagnostics – manual measurement done in regular intervals (monthly to quarterly); effective system of predicting further development of the detected conditions/statuses.
- Continuous ONLINE measurement – uninterrupted monitoring of the condition of machinery; usually involves protection mechanisms, i.e. the machinery concerned is shut down upon exceeding pre-set alarm levels.

3. Vibrodiagnostics system – generally proposed process/design

Process of designing a technological diagnostics system (vibrodiagnostics system) in a project solution:

Defining the machinery to be diagnosed

- Assessing operating reliability;
- Ensuring necessary technical parameters and providing necessary technical documentation;
- Assessing the possibilities and benefits of using vibrodiagnostics methods.

Developing methods for measuring the machinery to be diagnosed

- Drafting a user manual for the vibrodiagnostics system
 - Diagrams of the machinery to be diagnosed, including exact specification of measurement locations;
 - Specifying the type of vibration sensors;
 - Specifying the sensor-fitting method and the measurement directions;
 - Specifying the measurement device and the parameters to be measured;
 - Specifying the monitoring method/time cycle.

4. Vibration sensors and their locations

When measuring vibrations, the output signal should reflect the process of mechanical vibration as accurately as possible. We require sensors whose output can be processed to provide any parameter (vibration displacement, speed, acceleration). The sensors are fitted to the stationary (non-rotary) part of the machine according to the methodology described in ČSN ISO 13 373-1. If and as necessary, the measurement will include the use of both relative and absolute vibration sensors.

- Sensor fitting methods
 - Fixed screw joint
 - Solid glue
 - Fixation by a magnet
- Key rules for selecting the measurement location
 - The sensors are placed as near the shaft mount as possible;
 - The sensors are placed to non-rotary parts of the structure, most often on the bearing house/bearing base;
 - The sensor directions and marking has to be clear to make it possible to perform the measurement repeatedly;
 - The measurement has to be done under identical operating conditions.



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5. Vibration measurement

It is done and is required in order to check compliance with vibration speed limits v_{ef} - mm/s to detect defects of running wheel imbalances, axial misalignment, belt and other transmissions, structural rigidity etc.

It is done and is required a measurement of high frequency acceleration parameters in g or mm/s² to detect defects and residual lifetime of bearings, wear of gears in transmission units, electric problems in electric motors etc.

6. Result interpretation

The results of analyses are required to provide clear information about the current condition of the machinery concerned and, when measuring excessive vibrations in order to identify their root cause, also to provide recommendations for improving the current status. The result interpretation will vary depending on the proposed measurement method.

One-off and periodic measurement to identify the root causes of excessive vibrations

The output of this type of measurement is a report to contain:

- Name of the person who performed the measurement and write down the report
- Type of analyser and type of sensor applied and their serial numbers;
- Measurement locations illustration (diagram);
- Technical data on the measured machinery to ensure its repeatability (speed, load etc.)
- Measurement conditions under which vibrations were measured to ensure its repeatability (speed, load etc.)
- Analyses performed, frequency ranges, units;
- Measurement evaluation and the name of the standard and a table of limit values for the machinery
- Measurement results
- Recommendations to improve the existing situation.

Online diagnostics

The continuous vibration measurement will also include the familiarisation with the visualisation programme for the current condition of the measured machinery and the determination of threshold limits, which will be reported to the operator when exceeded. The system will be used as a tool for planning preventative maintenance and for timely replacement of worn-out components.

If the on-line system includes parametrisation software, it shall be made available to allow setting and changing the limit vibration values and the processing signal.

In the area of electrical installations the supplier shall abide by ITS 1.11 Electrical equipment as amended, in the area of IT by ITS 1.05 Information systems and technologies as amended.

Measurement points for installing vibration sensors shall be selected according to the methodology described in ČSN ISO 13 373-1 and the sensors shall be fastened according to the recommendations in ČSN ISO 5348.

An acceptance report shall form an integral parts of the installed on-line vibration measurement system and it shall contain the technical documentation to the hardware used, on-line system wiring diagram, description and schematic drawing of measuring points, description of measured parameters, the set limit values, the set signal processing and a list of vibration values measured from the on-line system, which will be used to validate the on-line system. The delivered SW will also include a backup of the diagnostic evaluation unit settings which will be used for re-loading of parameters.



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7. Roles and responsibilities

The vibrodiagnostics coordinator, supervisor, methodologist and approver of its technical solution is the Company's Vibrodiagnostics Engineer, a PSZ/1 staff member. The technicians responsible for the maintenance of the vibrodiagnostics system are the respective machinery maintenance units or contractors responsible for the maintenance of vibrodiagnostics system components in cooperation with the Vibrodiagnostics Engineer.

8. List of approved manufacturers

The list of manufacturers of complete vibrodiagnostics systems applies to deliveries of new machinery. If, for technical reasons, it is necessary to select a manufacturer that is not on the list of suppliers, such a decision will be subject to written consent from ŠKODA AUTO a.s., the Vibrodiagnostics Coordinator.

- SKF
- Adash
- IFM
- DIF
- FAG
- Prüftechnik
- B&R