KLASIFIKÁCIA TECHNICKEJ DIAGNOSTIKY

CLASSIFICATION OF TECHNICAL DIAGNOSTICS

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Abstract
The suitable technical diagnostics with following measures resulting from real state is one from the decisive implements for increase of plants service ability. The technical diagnostics is defined as the process at that the topical technical state of objects is detected on the basic of objective evaluating symptoms determined with measuring technique means. Exerting diagnostics is possible with regard on a phase of machine or device life.

Key words
Object, technical diagnostics, safety increase, technical diagnostics performing.

Úvod

At machines diagnostics solution it is necessary to clear certain questions. For sensible application of diagnostics methods in technical practice it is suitable to know the answers on the following questions:

1. Which object (product, manufacturing system, machine, ...) requires technical diagnostics for reliability or safety increase?
2. How can a relevant failure arise?
3. By what methods and means of technical diagnostics do we know to reveal in time the development of a failure state and to avoid to the relevant failure?
4. How do we prove to defend economically the need of this diagnostics?

The answers on these questions create a born structure of the object „Elements of machines diagnostics". In general it is possible to define the diagnostics as the determination, the control of the object technical state from the standpoint of a failure occurrence.

According to the Slovak technical standard STN 01 0105 we define the technical diagnostics as a branch busying with methods and means of ascertaining objects technical state. At the same time we understand the technical diagnostics as the diagnostics realized with non-destructive methods and without dismounting. The same standard states that the technical state of the object is the object state determining, its ability to exert demanded functions at stated conditions of its application. On completion it is suitable to introduce that a purpose of technical diagnostics is prohibiting a relevant failure rise and to lower possible damages on a minimum. The diagnostics is at the same time an inseparable part of machines maintenance.

In the maintenance function there is a small area only that does not exploit the diagnostics of machinery state directly. They are the prescribed maintenance works that are exerted irrespective of actual state of machinery e.g. the interchange of automobile motor oil after running certain number of kilometres or the interchange of hydraulic power unit in the airplane after flying certain number of flied hours. All these methods of the maintenance go out from the certain theoretical and statistical data of machine parts wearing out. Of course also at this type of maintenance the state diagnostics can be exerted and on the results basis to decide about the maintenance interference. The reason why it is not exerted rests in absence

of available diagnostics technique that would be hereby reliable and advantageous with price for working this object.

The aim of the diagnostics is not a measurement but disclosing machine failures in the state without dismounting. We can prevent so to failures and to realize repairs and to lower costs on the maintenance. At complicated technical machineries it need not go about degrading factors only devaluing a material structure and deteriorating operation of the machinery.

According to the degree of diagnostic system automation

a) semi-automatic diagnostics,
b) automatic diagnostics.

Every diagnostic system is a regulation system in essence. The aim of the regulation system is to reach minimum a deviation regulated parameter from the ideal course.

Adaptive systems of management also coincide here. The principle difference from current regulation systems rests in it that the diagnostics device does not emit correction orders into management system for reaching optimum conditions of work but let correction measures only. This measure rests in emitting warning report for service (alarm) or in blocking work of some object system parts so that it does not go to growth of damages. Then the aim of the technical diagnostics is to prevent the relevant crossing critical state of the parameter. In some cases the boundary between regulation and diagnostics is very narrow, e.g. at classifying wasters during automatic gauging on manufacturing line.

In this case the undesirable deviation is also the failure simultaneously therefore we coordinate such a system to the technical diagnostics and we mark as systems of checking in general.

There are also systems where a correction measure is a change of working conditions but not a blocking of system. It is possible to say that the machine has begun to work on forced regime. After finishing work of course it is necessary to remove the cause of the failure. They are the cases where blocking of system presents higher costs than work in forced regime.

If in the system of the technical diagnostics is in feedback chain a man, e.g. for data collection from single devices then the system is only partly automated or semi-automated in opposite case system is fully automated.

In this regard the technical diagnostics is overlapped with the maintenance because the data collection and evaluation of diagnostics object state precedes maintenance works in most cases.

In practice these diagnostics measures are coordinated to maintenance works.

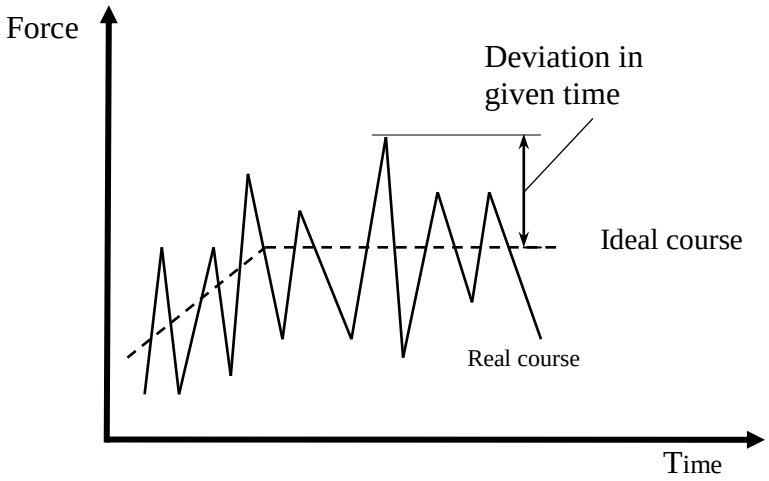

Fig. 1 Example of process regulation

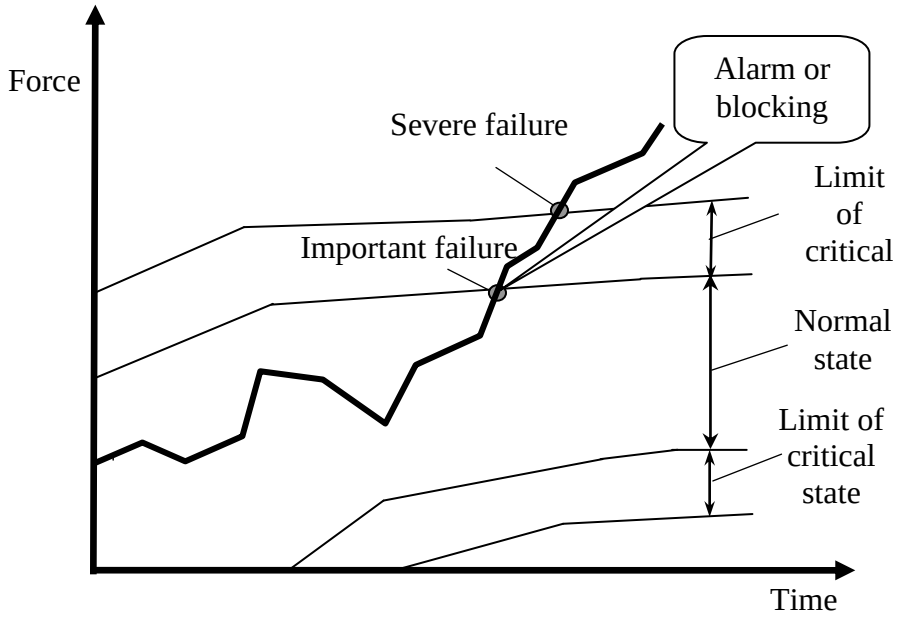

Fig. 2 Example of processional technical diagnostics

According to the time of technical diagnostics performing

a) processional diagnostics,
b) out of process diagnostics.

The process diagnostics is performed during diagnostics object work. Out of process diagnostics is performed then when the diagnostics object is beside operation. Thus, it is performed before beginning function or after termination of object function. If it is system working diagnostics then such a system is marked as on-line.

In case that the system was stopped from operation for failure then test diagnostics performed on such system is called off-line. The diagnostics if the state of device is evaluated on portable diagnostics device also is marked off-line. In electrical repair practice the diagnostics on-line is the diagnostics of elements that are not dismounted or disconnected from the whole of device. The device however can be beside operation. The diagnostics off-line is then the diagnostics of disconnected parts.

Both entrances of diagnostics have advantages and disadvantages. The diagnostics on-line is advantageous from the little laborious and fast determination state point of view. It is inconvenient from high claims on diagnostics intelligence and a percentage of diagnostics covering. The diagnostics covering expresses a measure of detecting and failure locality. On the other hand the off-line diagnostics is advantageous from regard of low claims on diagnostics means. It is sufficient the low intelligence of diagnostics. The disadvantage rests in necessity of uncoupling function parts from the whole. Assembly and dismounting of elements puts high claims on time also means. Diagnostics covering is 100 % however.

According to the method of information obtaining about a technical state of object

a) non-testing methods (physical methods),

b) testing methods (functional methods).

In expert literature it is preferential division of technical diagnostics methods on physical and functional. We can coordinate the functional methods to the testing methods and the physical methods to the non-testing methods. The definitions referring the physical and functional methods are meanwhile ambiguous. So that in many practical cases is hard to decide what method it is. At the non-testing (physical) method from the given diagnostics object only the choice dynamics output quantities (signals) are watched mostly during its function (operation process diagnostics). At the non-testing method we always suppose that this object has not in the beginning operation the failure and that we disclose in time arise of the important failure by the used method.

Following operation temperature of bearing can be an example of the non-testing method. In the simplest case of evaluation the limits of upper operation temperature are stated. After crossing this limit we can judge on arise of the important failure that it is necessary to be solved by the diagnostics or maintenance interference. In more complicated case we subject the watched quantities to the mathematical analysis. The diagnostics parameter (diagnostic index) is its result. In general case the diagnostics parameter on difference from the diagnostics quantity need not be drawn on time dependence. It is possible also to border with certain limits its change that always runs in time.

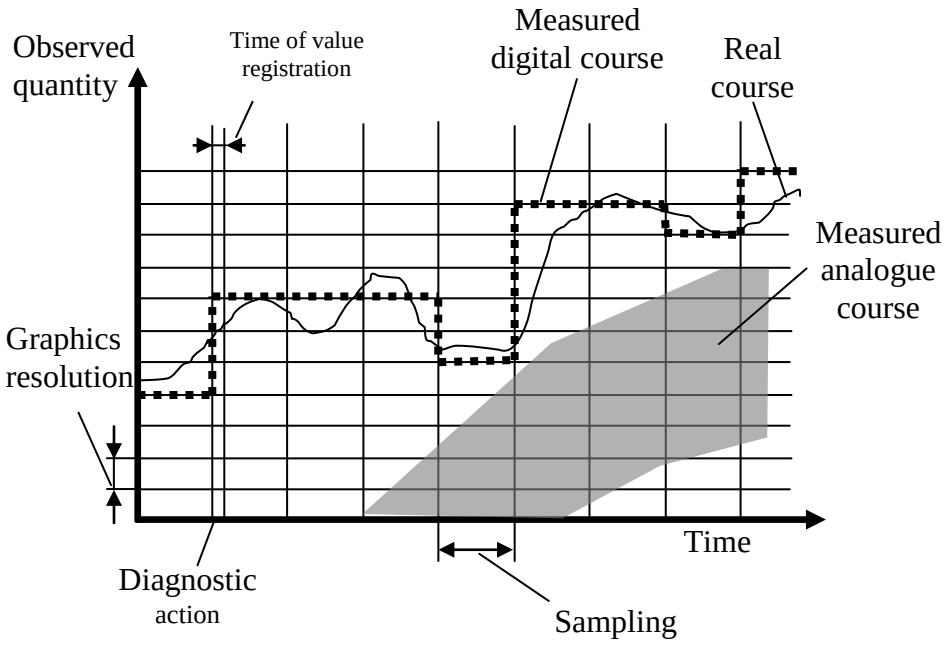

Fig. 3 Technical state of object

E.g. the occurrence of the certain spectral line in frequency spectrum of the monitored signal can be a diagnostics parameter. At the right non-testing method the time between single diagnostics functions (time of measurement) together with time on evaluation and the diagnostics interference must be shorter than the assumed time between the last registered deviation of quantity and its development into the relevant failure. Distinguishing ability of measurement corresponds to every digital measurement.

It has to be adequate to changes of a measured quantity without escape of information about a technical state of object (Fig.). At analogous technique the distinguishing is given by measuring chain exactness.

Sampling or sampling frequency determines a density of diagnostics functions. In general a level division of diagnostics functions intervals need not be equal. The high sampling frequency secures more information simultaneously but costs on measurement are higher. The highest possible sampling frequency is limited by the necessary time of value registration. It is the time necessary for performing and record of standard value coincidence with the measured value. The distinguishing states the minimum difference between the measured values.

The higher is distinguishing the more precise is the value determination. Of course with distinguishing increase also costs grow. At the testing (functional) method the given diagnostics object is submitted to the exactly stated tests. The response of object is measured at it. The diagnostics system supplies on entrances of the diagnostics object beforehand-defined testing signals.

Their physical size occurs also in operation conditions and has influence on function of the object. The testing signal is caused by a functional change of the object. The correspond output signals are monitored on outputs. At the testing method we do not know beforehand to say whether this object has or does not have an important failure. If, of course we have this knowledge then the test serves on location of the failure. Testing diagnostics is performed mostly in out of process diagnostics.

The structural diagnostics in certain sense can be the testing or the non-testing method. It goes out from the assumption that every machinery must regularly error-free to work if it consists from error- free parts mutually error-free switched over. At this diagnostics only static quantities are characteristic for structure of part. Structure diagnostics in the first row goes out from the measurement of static quantities as dimensions, shape and surface roughness. Respectively at application of flaw detection devices we evaluate also inside structure of part material. In the end the switchover between object parts is checked.

A peculiarity of structure diagnostics is that a function is not self-checked by a physical quantity that rises at operation but other physical quantity that as a rule has no influence on a function during operation. Most frequently it is a light as a porter of information about technical state of an object. From this point of view we can consider the method that is testing. Then a testing signal is a quantity that does not cause a functional change of the object. On the other hand these quantities can be measured also during work of the device as physical quantities that are changed by the working conditions influence. From this point of view we could consider as a non-testing method.

The technical state of the machine can be judged on the basis of static and dynamic quantities. In general it applies that if all static quantities are in order in all parts of the machine then also dynamic quantities must be in order during operation of the machine. A choice of suitable diagnostics quantities depends on their availability and stated value for the concrete object.

On evaluation of testing signals it is necessary to know an internal structure and function of a testing object.

After analysis and optimisation of testing steps we can test practically by two methods:

1. Right responses on single testing steps are laid in a memory of computer. Output values are compared with the memory (Fig. 4).

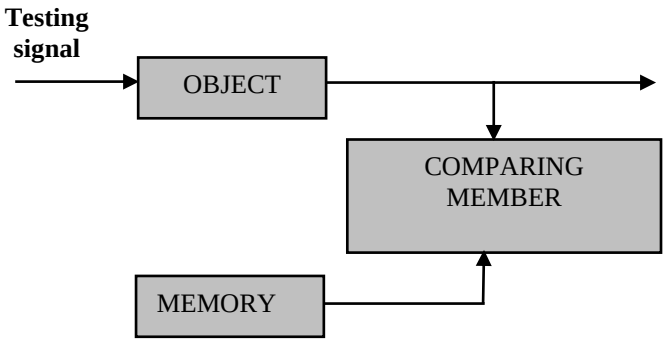

Fig. 4 Testing steps

2. Right responses on testing steps are obtained so that at the same time we load two equal objects but we know about one that it is without failure. Output values are compared with the object without failure. (Fig.)

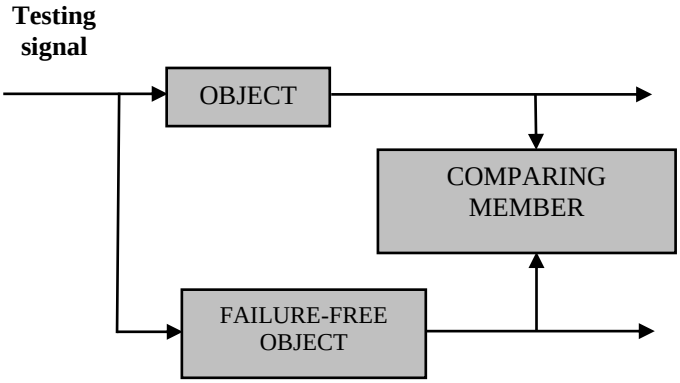

Fig. 5 Testing steps

Súhrn

Distinguishing critical state when the maintenance interference is just suitable prolongs the time of single parts utilization, e.g. it is not necessary to interchange oil if it has still suitable mechanical and chemical properties on the other hand it can be exacting on time and costs to find out reliably an actual oil state also with prediction of time and service life.

The solution is a simple interchange with reliance on statistical course of the failure state development.

Simultaneously due to development of diagnostics methods and electrical engineering the diagnostics is introduced also into the area of planned periodical maintenance with firm intervals marked as HTL (Hard Time Limit) maintenance. The diagnostics becomes a more advantageous economically. Of course the type of maintenance is with it changed on interval type.

Kľúčové slová
Objekt, technické diagnostiky, zvyšovanie bezpečnosti, technické prevedenie diagnostiky.

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