

STANDARDIZATION EXPERIENCE OF THE TC-132 COMMITTEE IN THE FIELD OF TECHNICAL DIAGNOSTICS, STRESS CONTROL AND LIFETIME ASSESSMENT

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At present all leading diagnostic centers of the world are occupied with the problem of stress and strain measurement in working structures with the purpose of their state assessment. However it is known that the effectiveness of the inspection methods remains low when they are used in practice. Improvement of the effectiveness of the stress-strain state (SSS) control of technical objects during their lifetime assessment takes on special significance.

The following should be noted among the main organizational-technical problems of the SSS control:

- the lack of the metrological basis for certification and calibration of devices for measurement of products' SSS characteristics (till date there are no unified standards, specimens and techniques both in Russia and other countries);
- the lack of standards specifying the general requirements to the methods and devices for NDT of stresses and strains in real structures.

For the first time such standard was developed in Russia by the experts of Energodiagnostika Co. Ltd in cooperation with TC-132 of the Russian Technical Regulation Body and it was published in 2005 under the number GOST R 52330-2005 "Non-destructive testing. Stress-strained state tests on industrial objects and transport. General requirements".

It is known that stress concentration zones (SCZs), occurring due to manufacturing process defects, working loads or their combinations, are main sources of metal components damaging. Presence of SCZs both on new and used products sufficiently reduces their life. Therefore inspection of products' stress-strained state and SCZs detection using the non-destructive testing devices are presented in the standard as the most important task during the SSS control.

In 2005 the experts of Energodiagnostika Co. Ltd. developed the draft of the National Standard "Lifetime assessment of potentially dangerous objects based on the quick methods. General requirements". This standard was officially published in 2008 under the number GOST R 53006-2008.

Fig.1 presents the block diagram of the residual lifetime assessment of potentially dangerous objects being under control of the Russian Technical Supervision Body (Rostekhnadzor).

Quick methods refer to passive NDT methods, which use the internal energy of the structures' metal:

- the method of acoustic emission (AE);
- the metal magnetic memory (MMM) method;
- thermal inspection.

At present these methods are most widespread in practice for the purposes of early diagnostics of damages in metal components and structures.

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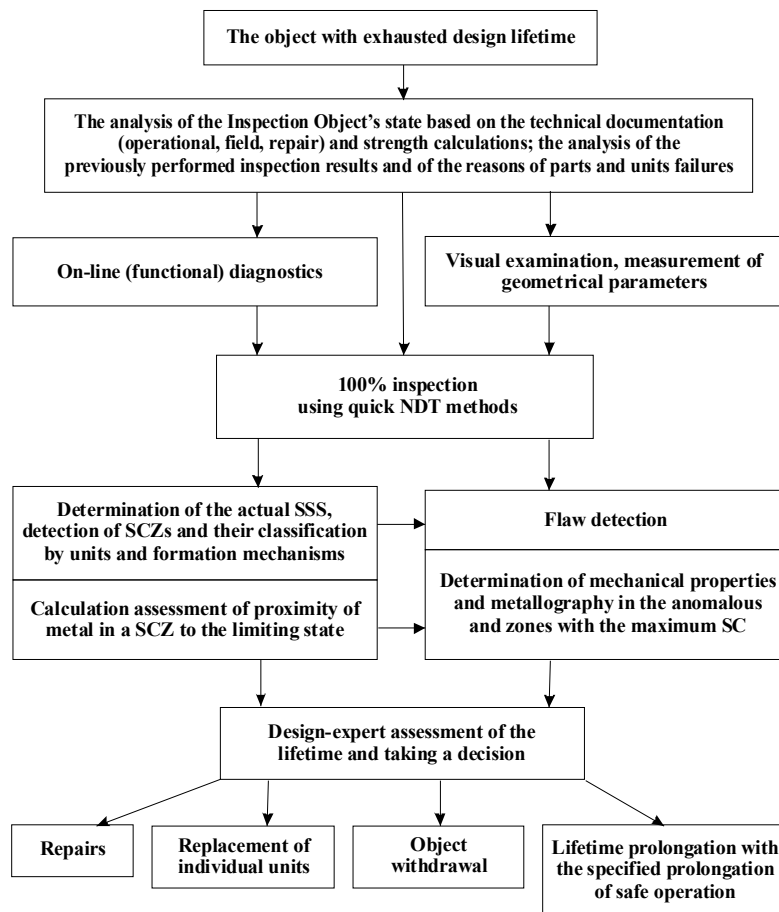


Fig.1. Block diagram of the residual lifetime assessment of potentially dangerous objects being under control of the Russian Technical Supervision Body (Rostekhnadzor).

This standard specifies more specifically the role and the tasks of modern methods of technical diagnostics, namely – 100% inspection and detection of stress concentration zones (SCZs), determining reliability and residual lifetime of metal components and structures, classification of SCZs by the degree of their hazard.

It is suggested to carry out calibration strength calculations with residual lifetime assessment for SCZs being in operation, taking into account the actual structural-mechanical properties of the metal, detected during the inspection.

It should be noted that the indicated new Russian National standards have no analogues in the world. The standards are presented at the Annual Assemblies of the International Institute of Welding (IIW) on behalf of the Russian Welding Society (RWS) as draft International standards.

In particular, the standards on the metal magnetic memory method GOST R 52005-2003, GOST R 52081-2003 and STO RWS 004-03 gained international approval at the level of an International standard ISO 24497-1:2007(E), ISO 24497-2:2007(E), ISO 24497-3:2007(E).

The standard GOST R 52330-2005 “Stress-strain state tests on industrial objects and transport. General requirements” was presented as draft International standard (in Osaka, July 11, 2004, and in Prague, July 10-15, 2005) for two times already.

In 2008-2009 Energodiagnostika Co. Ltd. in cooperation with TC-132 carried out the work on adaptation of International standards in Russia:

- Non-destructive testing. Metal magnetic memory method. Part 1. Terms and definitions. Development of GOST R. Direct replacement of GOST R 52081-2003 for MC – IDT ISO/DIS 24497-1.

- Non-destructive testing. Metal magnetic memory method. Part 2. General requirements. Development of GOST R. Direct replacement of GOST R 52005-2003 for MC – IDT ISO/DIS 24497-2.

- Non-destructive testing. Metal magnetic memory method. Part 3. Inspection of welded joints. Development of GOST R. Direct application of MC – IDT ISO/DIS 24497-3.

At present large arsenal of methods and devices for non-destructive testing of residual stresses (RS) in mechanical engineering products and stress-strain state (SSS) of operated industrial objects has been accumulated. Most of mechanical stress control methods are based on specimens calibration during their tension. At that the scale factor and the load recurrence, forming actual stresses (working and residual) on the real equipment, were not considered. Some experts believe that only volume stresses determine reliability and it is necessary to measure and take into account only their values during strength calculation of the equipment and structures. On the contrary, other experts think that only surface and local stresses are determinant. They refer to the fact that damages develop in local stress concentration zones (SCZs) and from the surface layer of the metal.

These conditions prompt the necessity of a standard specifying the classification of non-destructive methods for inspection of stresses and boundary conditions of their application based on modern achievements of science of materials and fracture mechanics, in particular, based on the energy concept of “internal stresses” and considering different levels of stress control locality.

The draft GOST R “Non-destructive testing. Mechanical stress determination. Classification of methods” was developed.

This standard develops the provisions stated in the methodical guidelines and standards, specifies the classification of methods of mechanical stress non-destructive testing. The classification is based on the process of interaction of the physical field used by the method with the object of inspection.

The Vth International Conference “Equipment and structures diagnostics using the metal magnetic memory method” was held in Moscow, Izmailovo, on February 18-20, 2009 jointly with TC-132. The Conference Proceedings were edited and published.

An active works within the Work Group “Stress Control and Lifetime Assessment”, headed by the TC-132 Chairman S.N. Pichkov and the Corresponding Member of the Russian Academy of Sciences (RAS) V.E. Scherbinin was carried out during the work of the XVIIIth All-Russian Scientific-Technical Conference “Non-destructive testing and technical diagnostics”.

The suggestion about the development of methodical documents on estimation of the manufacturing equipment’s residual lifetime within the framework of TC-132 (see the Resolution published in the journal “Control. Diagnostics”, No.1, 2009, p.9) was included into the Conference Resolution on the initiative of A.A. Dubov.

Employees of Energodiagnostika Co. Ltd. took part in the work of the seminar on “The Concept of metrological assurance of mechanical (residual) stress measurement” on behalf of TC-132. The seminar was organized on August 26, 2008, by the Federal State Unitary Enterprise All-Russian Scientific Research Metrology Institute named after Mendeleev (St.-Petersburg).

In 2008 under the decision of the SPU “RISCOM” Coordinating Committee A.A. Dubov was appointed the Head of the Work Group on “Stress Control and Lifetime Assessment”. The aim of this Work Group is the development of normative documents and standards including the standards on the working subject of TSC-132.