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New Standards ISO 24497 on the Metal Magnetic Memory Method. The Program of Personnel Training and Certification.

Anatoly DUBOV, Sergey KOLOKOLNIKOV

Energodiagnostika Co. Ltd.

Office 12, Yubileiny prospect 8, Reutov, Moscow region 143965, Russia

Tel:+7-495-723-83-22 Fax: +7-498-661-61-35

E-mail: mail@energodiagnostika.ru Web:http://www.energodiagnostika.com

Abstract

A specific features of the metal magnetic memory method (MMM method) are considered.

Information about new ISO 24497 standard on MMM method is given.

The totals of implementation in Russia and other countries are considered.

The Program of NDT personnel training in the MMM method is presented.

Keywords: certification, non-destructive testing, metal magnetic memory, standardization, stress-strained state.

Introduction

Three parts of the new ISO Standard on the metal magnetic memory method are published:

ISO 24497-1:2007 (E) Non-Destructive testing – Metal magnetic memory – Part 1: Vocabulary;

ISO 24497-2:2007 (E) Non-Destructive testing – Metal magnetic memory – Part 2: General Requirements;

ISO 24497-3:2007 (E) Non-Destructive testing – Metal magnetic memory – Part 3: Inspection of welded joints.

According to ISO 24497-1:2007 (E) **the magnetic memory of metal** – is and after-effect which occurs in the form of metal residual magnetization in components and welded joints formed in the course of their fabrication and cooling in the weak magnetic field or in the form of irreversible change of components' magnetization in zones of stress concentration and damages under working loads.

The method of metal magnetic memory (MMM method) – is a non-destructive testing method based on the analysis of self-magnetic leakage field (SMLF) distribution on components' surfaces for determination of stress concentration zones (SCZs), imperfections and heterogeneity of metal structures and welded joints.

SMLF – is a self-magnetic leakage field occurring on the component's surface in the zones of stable slip lines of dislocations under operational or residual stresses or in the zones of maximal heterogeneity of metal structure. More detailed description of the physical bases and practical capabilities of the MMM method can be found in [1, 2, 3].

A specific feature, which distinguishing the MMM method from other NDT methods, is that it detects concentration of stresses on defects, i.e. evaluates the extent of their danger for damaging development and assesses the stress-strained state of metal and welded joints.

By means of reading of SMLF, reflecting the naturally formed residual magnetization, for example, during welding, there occurs a unique opportunity to carry out integral assessment of the weld's actual state taking into account structural inhomogeneity, distribution of residual stresses and welding defects.

The MMM method development started since 1977, when the phenomenon of boiler tubes self-magnetization was first revealed in locations of their damaging.Upon carrying out long-term fundamental investigations, starting from 1990 a widespread industrial implementation of the method began first in power engineering and then in other industries. First guiding documents (GD) and inspection techniques, agreed with Russian engineering supervision (Rostechnadzor) appeared at that time.

Starting from 1994, professor A.A. Dubov has been participating in the work of the International Institute of Welding (IIW). More than 39 IIW documents on the metal magnetic memory method were presented for discussion and approved within the period of 1994-2007. Since 2000 the IIW Commission V "Control and Quality Assurance of Welded Joints" carried out the work on preparation of international standards on the metal magnetic memory method. National Standards of Russia and the Standard of the Russian Welding Society (RWS) were published in 2003:

- GOST R 52005-2003. Non-destructive testing. Metal magnetic memory method. General requirements.
- GOST R 52081-2003. Non-destructive testing. Metal magnetic memory method. Terms and definitions.
- STO RWS 004-03 "Non-destructive testing. Welded joints of the equipment and constructions. Method of metal magnetic memory (MMM-inspection)".

Three parts of the ISO 24497 were developed and prepared for publication based on the Russian Standards.

The MMM method and corresponding inspection instruments are used at more than **1000** Russian enterprises in various industries.

Besides Russia, the method is introduces and tested at individual enterprises in **25** countries of the world: Angola, Argentina, Australia, Bulgaria, Byelorussia, Canada, China, Finland, Germany, Israel, India, Iraq, Iran, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Mongolia, Montenegro, Poland, Serbia, South Korea, Ukraine, USA.

Since 1998 the Russian and International Centre for experts training and certification by the method of metal magnetic memory – an independent body for personnel certification in the field of non-destructive testing Energodiagnostika Co. Ltd. - with issuing of Level I and II Certificates operates in Moscow. The branches of the centre operate in Warsaw and Beijing.

As of April 2008, more than **1300** experts in Russia, more than **200** experts in China, **46** experts in Poland and more than **60** specialists from other countries (Argentina, Byelorussia, Bulgaria, Iran, Israel, Latvia, Lithuania, Kazakhstan, Serbia, Ukraine and others) passed training.

The "Program and Examination handbooks for NDT specialists training and certification for qualification Levels I and II in the metal magnetic memory method" are agreed with Russian engineering supervision (Rostechnadzor) Departments corresponding to the sphere of accreditation.A specialized Training Handbook for MMM-inspection specialists training was developed and published [1].

The training process and inspection techniques development were accompanied by fundamental scientific researches. The book by Vlasov V.T., Dubov A.A., Physical bases of the metal magnetic memory method [2] was published in 2004, and the book by Vlasov V.T., Dubov A.A. Physical theory of the "strain-failure" process [3] was published in 2007.

Development and implementation of the MMM method becomes especially relevant in connection with the following circumstances.

In the latest edition (2005) of the International Standard ISO 9712 "Non-Destructive Testing. Qualification and Certification of Personnel" a new type of inspection – "Strain Testing" was introduced along with conventional methods.

In Russia in 2005 the Russian Society for Non-Destructive Testing and Technical Diagnostics (RSNDTD) approved the "System of voluntary personnel certification in the file of non-destructive testing and diagnostics" where "Strain testing" is included in the list of NDT methods.

Taking into account all the above said as well as the fact that the principal task of the MMM method is SSS assessment, the Program of NDT personnel training in the MMM method (Table 1) was developed so as to cover both the questions of defects detection and the field of strain testing.

Table 1. The Program of Level I and II specialists training in the metal magnetic memory method.

No.	Topic Name	Hours
1.	General questions of non-destructive testing.	4
2.	Physical bases of magnetic inspection methods.	4
3.	Physical bases of the metal magnetic memory method (MMM). GOST R 52005-2003. Non-destructive testing. Metal magnetic memory method. General requirements. GOST R 52081-2003. Non-destructive testing. Metal magnetic memory method. Terms and definitions. STO RWS 004-03 "Non-destructive testing. Welded joints of the equipment and constructions. Method of metal magnetic memory (MMM-inspection)". GOST R 52330-2005. Non-destructive testing. Stress-strained state tests on industrial objects and transport. General requirements.	8
4.	Study of standards on engineering diagnostics GOST 27.004-85 and safety GOST 27.002-89.	4
5.	Basic provisions of fracture mechanics. Energy criteria.	4
6.	Study of the "Provision about the order of technical devices, equipment and constructions safe operation period prolongation at hazardous industrial objects" (GD 03-484-02)	4
7.	Problems of ageing equipment residual life assessment.	2
8.	Study of the "Methodical guideline for residual life determination of potentially dangerous objects under control of Rostechnadzor" (GD 09-102-95). Study of branch GDs on life assessment.	6
9.	MMMM parameters and their registration. Equipment.	4
10.	*Bases of MMMM technology.* Methodical and metrological bases of MMM.	2
11.	Application of MMM. Inspection techniques and objects.	8
12.	The procedure of SSS and metal's mechanical properties inspection methods and flaw detection methods application at life assessment.	8
13.	Instruments and devices used at MMM.	4
14.	Laboratory classes. The MMM method. Carrying out inspection on specimens.	10
15.	Examinations.	8
	TOTAL:	80

References

[1] Dubov A.A., Dubov Al.A., Kolokolnikov S.M. Metal magnetic memory method and inspection instruments. Training Handbook. Moscow: ZAO “TISSO”, 2003, 320 p.

[2] Vlasov V.T., Dubov A.A. Physical bases of the metal magnetic memory method. Moscow: ZAO “TISSO”, 2004, 389 p.

[3] Vlasov V.T., Dubov A.A. Physical theory of the “strain-failure” process, Part I. Physical criteria of metal’s limiting states. Moscow: ZAO “TISSO”, 2007, 517 p.