5.3.3. FEATURES OF CALIBRATING MEASURING SYSTEMS OF MAGNETIC PARTICLE FLAW DETECTORS

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Magnetic particle testing provides possibility to detect dangerous defects in the material of most critical parts and assemblies of various mechanisms, machines, equipment and other facilities, and, thus, to prevents accidents and catastrophes. Magnetic particle flaw detectors represent by themselves complex technical devices. In order to ensure efficient magnetic particle testing, flaw detectors are verified thoroughly for compliance with technical specifications and GOST 21105 both at the moment of release from manufacturing plant and periodically in the process of operation.

Magnetic particle flaw detectors are not measuring means. They have neither signs inherent to measuring means, nor measuring destination. Therefore, they are not subjected to metrological checks. However, as a rule, they have the built-in specialized systems for measuring magnetization current. Herewith, amperemeters are linked functionally with other elements of flaw detectors and are included in their unique measuring systems. These measuring means used for the specified purpose must be subjected to primary and periodic metrological verification. Their metrological examination must be carried out without removal from the structure of flaw detectors. Otherwise, it can lead to low accuracy in evaluation of metrological properties of indicated measuring means and, sometimes, to their damaging due errors during performance of assembling and disassembling works.

It is reasonable for system measuring magnetization current of magnetic particle flaw detectors to be subjected to calibration. Confirmation of such system suitability for application must be the result of calibration. If required, corrections to its readings must be determined. Prior to perform calibration of measuring system, it is necessary to analyze technical documentation for flaw detector, to evaluate its appearance, as well as to verify parameters of non-measuring systems of flaw detector. Preliminarily, operable state of magnetization current measuring system should be assured. It is reasonable to calibrate stationary flaw detectors in meteorological conditions established for industrial premises. As a rule, operability of measuring systems of flaw detectors does not change within the recommended optimal temperature range (16 to 25°C). Therefore, there is no need to maintain any defined temperature level during their calibration.

During calibration, relative magnetization current measurement error is determined. To that end, magnetizing device is connected in series with 1,000 A (75 mV) instrument shunt (or with other one depending on technical characteristics of flaw detector) with measuring terminals connected with electronic oscillograph. Oscillograph is set in triggered sweep mode. Magnetization current is passed through a shunt and magnetizing device. By oscillograph, voltage at shunt U_{sh} (in mV). Current rate passed through a shunt is determined using relationship:

$$J_{SH} = (1{,}000 / 75)U_{SH}.$$

This current value is accepted as true. Current readings on digital indicator (amperemeter, kiloamperemeter) of flaw detector is accepted as measured value. Relative error **δ** is calculated for three different values of magnetization current equal to 30, 50 and

70% of maximal value indicated in specifications for flaw detector. In calculations, the following relationship is used

$$\Delta = (|N_R - N_M|) / N_M \cdot 100\ (\%),$$

where N_r – is readings of digital indicator (amperemeter, kiloamperemeter) of flaw detector, A; N_m – value of measured magnetization current accepted as true, A; $|N_r - N_m|$ – absolute positive value of current measurement error, A.

All measurements for three different values of magnetization current are performed not less than twice. For every current value, arithmetic average of counts obtained in the given point is taken as a measurement result. Average relative error of the magnetization current measuring system must not exceed 10%.

Part are magnetized by maximal (amplitude) value of current. Therefore, if amperemeter determining actual (effective) current value or average current value for a half-period is used in the measuring system of flaw detector intended for parts magnetization by alternate or pulse current, indicated instrument must be graduated during calibration by amplitude value of current or corrective table or graph must be elaborated. For sinusoidal current, amplitude value is higher than effective one in 1.41 times, while for average current value, which is understood to be the average arithmetic value for a half-period, it is higher in 1.57 times.

In order to increase the efficiency of magnetic particle testing, it is reasonable to prepare standard requirements to calibration of measuring systems of magnetic particle flaw detectors and to elaborate the standard calibration scheme for metrological support of measuring systems of magnetic particle flaw detectors.