1.10.13. AUTOMATED AND MECHANIZED DIAGNOSTIC SYSTEMS FOR RAILROAD RAILS

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Construction principles for equipment and systems recording and processing data on defects and acoustic contact quality in automated and mechanized systems for ultrasonic testing of rails are discussed.

Requirements to improve trustworthiness of flaw detection in rails laid into a route have required the creation of multi-channel systems implementing various testing methods. Thus, in hardware-software complexes installed in railcars and removable flaw detectors (trucks), the number of independent testing channels amounts up to 14 per rail line. In this case, both echo-pulse and mirror-shadow methods of ultrasonic testing are implemented, while flaw-detecting railcars contain also the channel of magnetic testing. All this allows flaw detection with high probability across the whole rail section (except side parts of foot).

These complexes are controlled by special programs providing digital processing of signals in all channels, permitting setting and maintenance of required testing parameters and equipment characteristics, implementation of the established methods of flaw detection and evaluation of the acoustic contact quality, data processing and recording, comparison of data with previous records, as well as printing out of testing document. Analog-to-digital conversion of signals (and its reverse recovery) makes it possible to increase the accuracy of measurement of defect parameters, as well as resolution, operational speed and other characteristics of equipment.

In the equipment of ultrasonic flaw-detecting railcars RDM-15K and removable multi-purpose flaw detectors RDM-22 and RDM-23, high detectability of flaws in the rail head is ensured by application of high-sensitive piezoelectric probes (PEP) with 55° and 70° entry angles of ultrasonic oscillations connected under "tandem" scheme and oriented differently with regard to the rail longitudinal axes. Defects in rail web and in the middle portion of rail foot, as well as in bolt holes are detected efficiently by wide-range PEP's with 42° entry angle and dual-transducer PEP's with 60 mm focal length, which provide dead zone of not more than 3 mm. DT PEP's implements also mirror-shadow method of testing to reveal vertical cracks oriented along the rail axis.

It should be noted particularly that all modern complexes for ultrasonic flaw detection of rails (not only rails, but also pipes of main gas pipelines and nuclear power stations) include systems evaluating the quality of acoustic contact. In this case, measurement of signals of reverberation noises presenting in limited volume articles and detected by special circuit in every channel beyond the testing zone is used. When amplitude of these signals decreases below the threshold level, system records deterioration of acoustic contact and warns of it operator, who undertakes certain corrective actions (for example, repeats the test varying sensitivity or flow of coupling liquid).

In the most advanced flaw detectors of RDM series, multi-parametric processing of acoustic noises (several threshold levels, number of signal dropouts on certain section, etc.) and adjustment for optimal level of testing sensitivity in respective zone of signal selection are performed. It increases significantly both trustworthiness of acoustic contact evaluation and probability of flaw detection.

Automation of flaw detection process presupposes also the possibility of software decoding of testing results; complexes of the last generation include obligatory the system for automatic decoding of defectograms.