

1.10.39. WAYS OF AUTOMATION OF ULTRASONIC TESTING OF RAILS DURING THEIR REWORKING AND WELDING

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For the last several years, scheduled replacement of jointed track by continuous welded railroad track is carried out within the railroad network of Russia. Starting from 2000, continuous welded railroad track mileage is increased annually by 3,000 – 3,200 km. By the year of 2010, number of welded joints of laid-in-track rails will increase more than twice and amount to 5.2 mln. joints.

Currently, laid-in-track rails are subjected to one-hundred percent testing along the whole length by detachable flaw detectors equipped with recorders, as well as by mobile equipment. In addition, welded joints are tested, since they are the most critical portions of rails. Ultrasonic testing of welded joints is performed by portable flaw detectors by means of manual scanning of joint across the whole section.

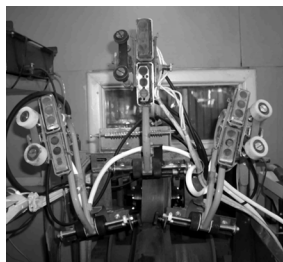
In accordance with policy of the JSC Russian Railways (“RZD”) on multiple use of rail metal, strings welded both of new rails and rails already operated in a track (so called “used” rails) are laid in track. In this connection, the most important task to ensure the safety of trains movement is the nondestructive testing of used rails and welded joints even at the stage of production of long-length strings at rail-welding enterprises.

For pre-welding ultrasonic testing of used rails, installation AVIKON-11RSP is designed in the JSC “Radioavionika” (St.-Petersburg). It represents the stationary post with personal computer, search system with ultrasonic multi-channel units and movement sensor installed on it. Within AVIKON-11RSP, testing signals are displayed on the PC monitor in the form of B-scan in the real-time mode. Installation AVIKON-11RSP/VS is a modification of this testing equipment. Rail testing not only in the area of head and web projection zone, but in the area of foot wings as well is its distinctive feature. Thus, AVIKON-11RSP/VS tests rail across the whole section.

From 2006, two multi-channel flaw detection installations AVIKON-11RSP/VS operate successfully at RSP-8 (Yaroslavl, Northern Railroad) for incoming testing of used rails and outgoing testing following re-profiling. From October 2007, two just the same installations are operated at RSP-31 (Tikhoretsk, North-Caucasian Railroad).



What concerns ultrasonic testing of rail welded joints, from 1960's and until now (almost fifty years!), it is performed by means of scanning of heat-affected zone by manual probe with $\alpha = 50^\circ$ under echo-method only.



Despite of multiple attempts of mechanization and automation of the process of manual ultrasonic testing of rail welded joints, said problem was not resolved until recent time. Application of various supplementary scanning devices facilitating procedures of probe movement in a predetermined path (on the rail rolling surface mainly) does not resolve the problem: firstly, testing remains still subjective; secondly, testing productivity does not increase, which is necessary in conditions of constant growth of the number of welded joints.

Above listed circumstances, as well the fact that up to 30% of rail breakages on the JSC “RZD” railroads occur for the last time due to defects in welded joints made replacement of manual testing by automated one the topical matter.

For solution of indicated problem, we have proposed method of ultrasonic testing based on the successive insonification of welded joint by the group of probes with their stationary positioning on the rail surface.

This idea was practically implemented in the form of flaw detector MIG-UKS developed in the JSC “Radioavionika”. PEP in this flaw detector does not move over rail surfaces. In this case, the whole section of welded joint is subjected to insonification by means of 70 PEP’s installed on surfaces of the rail head and foot wings. In total, 84 channels are formed in MIG-UKS.

Flaw detector provides joint testing for two installations of search system on a rail. Herewith, insonification of joint is performed firstly from one side and then – from another one. Testing technology does not require operator to remove or to turn around flaw detection carriage in the process of testing. For accurate carriage positioning with regard to the center of welded joint, it is equipped with laser pointers. Operator aligns the laser pointer beam with the welded joint center and installs the unit of resonators on the rail head.

Presently, two options of MIG-UKS for operation en-route and in stationary conditions of a rail-welding enterprise (RWE) are implemented.

Both flaw detectors use just the same insonification scheme and operation modes.

Indicated options differ by their design, and namely: MIG-UKS/en-route is controlled by means of special arms, while of MIG-UKS/RWE – by means of pneumatic actuator.

Application of MIG-UKS flaw detector allows solution of following tasks:

- minimization of subjective factor during testing through replacement of manual scanning by electronic one;
- formation of testing protocol for every welded joint with testing results and parameters per every channel represented in it;
- improvement of welded joint testing quality for the account of joint verification under three ultrasonic testing methods: echo-, mirror- and delta-method.

Thus, for the last several years, the JSC “Radioavionika” team has resolved automation tasks for the process of incoming testing of used rails at rail-welding enterprises, as well as testing of rail welded joints both en-route and at RWE’s.

