Mounting products with mission-critical functions (bolts, studs, rods) used in aviation technology are subject to increased strength, hardness, and wear resistance requirements. They are made of medium carbon steels alloyed with chromium, manganese, or silicium (steel 37Cr4, 41Cr4, 46Cr2, 42CrMo4, and others). The balance between the strength and plastic properties of the products is achieved by the choice of the mode of their heat treatment - quenching and subsequent medium or high temperature tempering. Possible deviations in the chemical composition of the material of the products and the modes of their heat treatment from the prescribed ones lead to unacceptable deviations of the properties of the products. This requires monitoring all products.

The physical basis of magnetic structural analysis lies in the fact that mechanical and magnetic properties of steels are sensitive to the structural transformations occurring in them during thermal treatments. It has been proven that the coercive force \( H_c \) and the remanent magnetization \( M_r \) of many steels are related to their structure. When controlling mass batches of products, the best results in reliability and productivity are achieved by magnetization of products when they fall through a coil with direct current and measurement of the remanent magnetic flux \( F_d \) in the product. In this case, \( F_d \) in products is not proportional to \( M_r \), but to \( H_c \) of the material of the products.

A characteristic feature of alloyed steels with a carbon content greater than 0.3%, including steels 37Cr4, 41Cr4, 46Cr2, 42CrMo4 and others, is a non-monotonic change in \( H_c \) with an increase in the tempering temperature \( T_t \) of products. Therefore, magnetic quality control of products from such steels requires a specific process. To test the tempering mode of such products, we have proposed to expose the magnetized products to a graded influence of a demagnetizing field with intensity \( H_p \), before measuring \( F_d \).

The developed method allows us to choose the value of \( H_p \), at which the optimum sensitivity to changes in \( T_t \) is achieved while monitoring products of specific sizes. In this report we show that such testing is based on the sensitivity of \( F_d \) in the product after its reverse magnetization in the field \( H_p \) to the remanent magnetization of the material \( M_r \). We also report the technical means ensuring application of the developed methodology in industrial settings with a control output of up to 2 products per second. Examples of application of the method for controlling the hardness of small bolts made of steel 42CrMo4, intended for use in aircraft construction, are given.

**KEYWORDS**

mounting components | non-destructive testing | mechanical properties | heat treatment | medium carbon steels |