Modern Comparators – Quick, Automated Testing of Critical Metal Parts for Hardness, Alloy & Dimensions

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A wide variety of features and accessories greatly enhance and optimize comparator capabilities.

Rapid inspection of fasteners and metal parts for properties such as heat treatment, hardness and alloy, is a key requirement in meeting today's stringent specifications in the automotive, aerospace, nuclear and similar demanding industries. Improperly heat treated parts can result in costly machining issues, rework, lost production time and product failure. A roller used in a car starter motor, a pin used to attach the rocker arm to the valve train or a bolt in a connecting rod assembly can fail if it is not properly heat treated and hardened, resulting in serious safety issues.

It is not difficult to take samples of these parts and subject them to definitive tests for hardness such as Rockwell and Brinell tests. However, these and other laboratory tests are time consuming and they are destructive tests that measure a metal's hardness by determining the metal's resistance to the penetration of a nondeformable ball or cone. The tests determine the depth to which such a ball or cone will sink into the metal, under a given load, within a specific period of time. But for producers handling thousands of parts an hour, an inexpensive and more practical method is called for (see **Figure 1**).

Fortunately, there is an economic, reliable technology that meets this need—eddy current and electromagnetic comparators. Today's improved comparators offer a reliable, quick way to test and sort large quantities of metal parts for hardness, alloy, dimensions and some other physical characteristics. Modern day comparators can include many features that optimize the ability to differentiate between signals from wanted and unwanted conditions. Broad frequency ranges enhance selectivity. Screen displays can have rectangular, elliptical and other shaped target region thresholds, allowing the customer to capture the clustered peak signals for a batch of parts, and set the boundaries to correspond to each group. Threshold levels within target regions can be set to select signals based on amplitude, phase or a combination of both. Test speeds can reach thousands of parts per hour, outputs can alert operators when a specified number of parts have been tested and reports can categorize the number of pieces that signaled within each target region (see **Figure 2**, **Figure 3** and **Figure 4**).

Fig. 1 — Typical fastener parts that can be inspected for hardness, alloy, various dimensions and other physical characteristics using eddy current or electromagnetic comparators.

How Eddy Current & Electromagnetic Technology Works

Eddy current comparators operate on the principle that when a metal part is placed inside or close to a test coil, which is excited by an alternating current, it causes an impedance change in the coil that is directly related to the permeability, conductivity and physical dimensions of the part. Variations in conditions such as hardness or heat treatment in a part cause a change in permeability, and changes in alloy will affect the conductivity.

Likewise, a significant change in the dimensions of the part will also affect the conductivity and permeability and create an impedance change that can be detected by the instrument. Nonmagnetic (nonferrous) material has differences in electrical conductivity. Magnetic (ferrous) materials

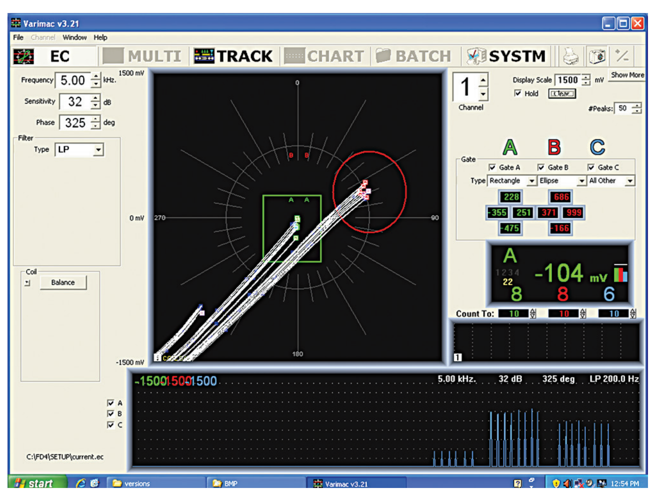

Fig. 2 — Test signals from 0.75", 1" and 1.25" long steel pins. The Varimac® VI eddy current comparator separated the pins using three target areas—the green box, red circle and the outside area. The screen displays the number of pieces in each of the target areas—eight in green target A, eight in red target B and six in outside area. A strip chart display at the bottom of the screen also shows signals for each pin. A counter keeps track of the total number of pins separated into each receiving bin and alarms when a preset level is reached.