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Quick Break

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Quick break is also known as fast break or controlled break and is the sudden ending or stopping (quick break) of magnetizing current. This breaking of the current results in a transient (eddy) current induced into the part. The functionality of the quick break process can be defined as the measurement of how fast the magnetic field collapses in an induced (coil) shot.

Quick break was discovered in the late 1950s when it was found that, when a direct current is shut off, the field around the conductor falls rapidly to zero. This rapid change of energy generates a voltage and a current that is in the opposite direction of that in the circuit. This sudden breaking of the direct current at the end of magnetization resulted in a transient current being induced into the part. This resulting current was greatly increased when using quick break on ferromagnetic material. This increase in the residual magnetic field inside of the part resulted in a better field for inspection. For more information, refer to outside work (Falk, 2011).

The original magnetic particle units that had the quick break feature did this by opening the direct current coil circuit and drawing an arc across the contact. This ensured that the current decayed rapidly enough to zero to induce the transient current. However, this technique caused significant wear and tear on the contacts.

In later models (Figure 1), researchers incorporated silicon-controlled rectifiers (SCRs), making quick break much easier to achieve. Using the turnoff time of the SCR at the zero current crossing, along with a secondary high voltage transformer and an open circuit voltage, researchers developed controlled break. Controlled break is the main technique used in producing quick break in the magnetic particle units used today.

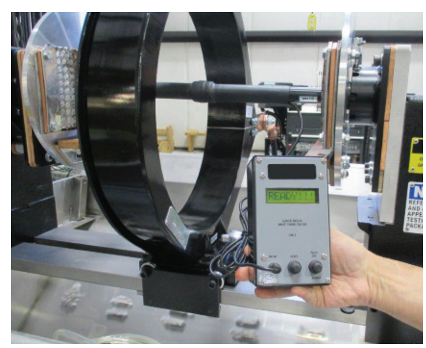

Figure 1. Quick break tester in use at a plant.

In magnetic particle testing (MT), the quick break technique is used to generate a transient current within a part for finding transverse discontinuities in the ends of longitudinally magnetized bars. These types of discontinuities are often concealed by the strong polarity at the bar ends. With the use of the quick break technique, the resultant transient current makes certain that the field stays true to the end of the bar, enabling the inspection of transverse discontinuities.

Figure 2 shows a bar that is magnetized longitudinally (Betz, 1967). Notice in Figure 2a, which shows the bar without quick break, the two ends become poles and the lines of flux enter and leave near the bar at 90° to the surface. Therefore, the very ends of the bar are not truly longitudinally magnetized and any transverse indications in this area may not be reliably detected.

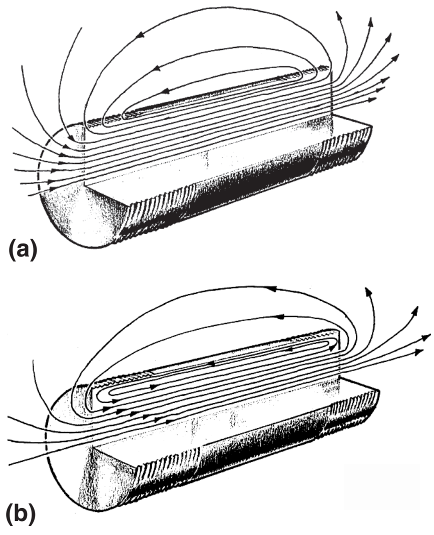

Figure 2. Residual field inside a bar generated by: (a) slow break; (b) quick break transient current.

In Figure 2b, it can be noted that when the same part is longitudinally magnetized and the current is closed rapidly via a quick break process a transient current is generated, which flows inside the bar resulting in a near surface field, allowing the part to be truly longitudinally magnetized to the very ends of the bar. This allows transverse indications to be found at the very end of the bar.

As with most techniques used in MT or any other form of nondestructive testing, there are standards or specifications that must be followed. The first standards were military specifications and have since been incorporated into ASTM International specifications. The quick break technique is no different. *ASTM E 1444* and *ASTM E 709* call for a quick break check to be conducted on a magnetic particle unit with the quick break feature every six months (ASTM, 2008; ASTM, 2012). The ASTM standard only requires the headshot to be checked if the technician is attaching cables and wrapping them into a coil.

For this check to be made, ASTM allows for a unit to be checked using an oscilloscope or other applicable technique as specified by the equipment manufacturer. Prior to 1970, units were checked with an oscilloscope where one actually watched the

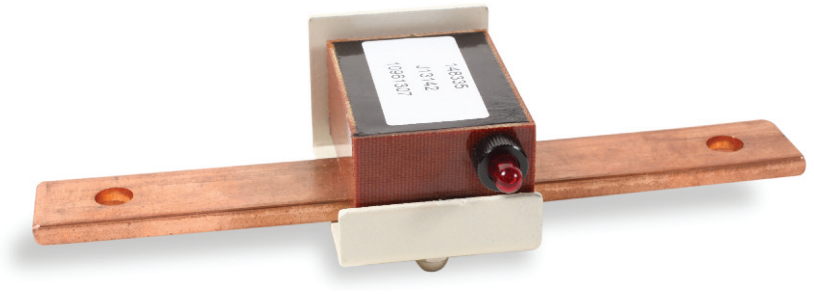

Figure 3. Quick break tester.

sine wave collapse rapidly to zero. However, in the 1970s magnetic particle manufacturers introduced quick break testers. These testers were small, handheld devices that gave a go/no go readout. The tester was composed of a small bulb and inductive coil. The technician would place the tester in the coil, and at the end of the mag shot the bulb would light up if quick break were functioning. These instruments are still very much in use today as they are a simple verification of a machine's quick break function (Figure 3).

There have been new designs of the quick break tester in the last couple of years, resulting in testers that give a digital readout of the quick break value. These testers actually give the value of the voltage induced by quick break. The ability to obtain an actual voltage leads to the ability to provide a quantitative way to detect and track the satisfactory performance or possible degradation of the quick break feature on magnetic particle units. This quantitative ability is a preferred system process check for those technicians that audit MT facilities.

Quick break is used in other applications besides the aforementioned transverse cracking at the end of bars. Quick break serves as a primary function of the induced current technique. The induced current technique is a noncontact MT technique used primarily on ring-shaped parts. However, this is another topic unto itself. The quick break process is not applicable when performing testing using prods or yokes because the test article is part of the magnetic circuit. More information on this topic can be found in other work (ASNT, 2008).

Another application of the quick break magnetization technique is when dealing with articles with structural changes that can create a high internal flux density, resulting in an external polarity that can produce a magnetic indication. Examples of such changes are internal splines, keyways or holes in the article. The problem with these types of non-relevant indications is that they may mask a relevant indication. The quick break process can help minimize, if not eliminate, the indication from the structural change.

Items made with a ferrous metal with high retentivity can benefit from the quick break process. The magnetic field produced in these materials when subjected to the quick break process produces a very strong residual field. This strong residual field is beneficial if the residual technique is to be used to perform the MT. An example of the application of this aspect is the inspection of a bearing race.

A few final things should be remembered. First, quick break is only found on three-phase, full-wave direct current machines. Second, machines are typically only tested on the coil circuit unless cables are connected to the head shot and wrapped to form a coil. Next, quick break is primarily used to enable the capability to find transverse discontinuities at the ends of a part that has been longitudinally magnetized. Finally, quick break is used as a function of the induced current fixture.

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References

ASNT, *Nondestructive Testing Handbook*, third edition: Vol. 8, *Magnetic Testing*, American Society for Nondestructive Testing, Columbus, Ohio, 2008.

ASTM, *ASTM E 1444, Standard Practice for Magnetic Particle Testing*, ASTM International, West Conshohocken, Pennsylvania, 2012.

ASTM, *ASTM E 709, Standard Guide for Magnetic Particle Testing*, ASTM International, West Conshohocken, Pennsylvania, 2008.

Betz, C.E., *Principles of Magnetic Particle Testing*, Magnaflux Corp., Chicago, Illinois, 1967.