Portable Magnetizing Equipment for Magnetic Particle Inspection

To properly inspect a part for cracks or other defects, it is important to become familiar with the different types of magnetic fields and the equipment used to generate them. As discussed previously, one of the primary requirements for detecting a defect in a ferromagnetic material is that the magnetic field induced in the part must intercept the defect at a 45 to 90 degree angle. Flaws that are normal (90 degrees) to the magnetic field will produce the strongest indications because they disrupt more of the magnet flux.

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Introduction to Magnetic Particle Inspection

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Therefore, for proper inspection of a component, it is important to be able to establish a magnetic field in at least two directions. A variety of equipment exists to establish the magnetic field for MPI. One way to classify equipment is based on its portability. Some equipment is designed to be portable so that inspections can be made in the field and some is designed to be stationary for ease of inspection in the laboratory or manufacturing facility. Portable equipment will be discussed first.

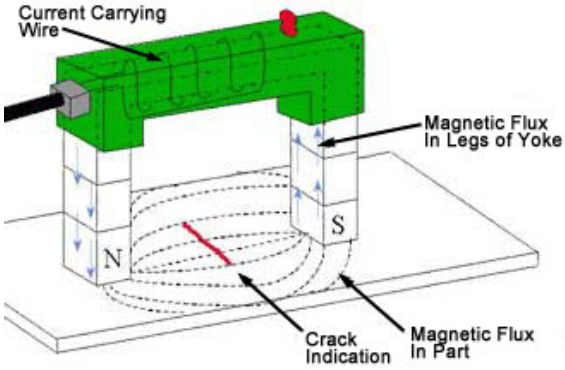
Permanent magnets

Permanent magnets are sometimes used for magnetic particle inspection as the source of magnetism. The two primary types of permanent magnets are bar magnets and horseshoe (yoke) magnets. These industrial magnets are usually very strong and may require significant strength to remove them from a piece of metal. Some permanent magnets require over 50 pounds of force to remove them from the surface. Because it is difficult to remove the magnets from the component being inspected, and sometimes difficult and dangerous to place the magnets, their use is not particularly popular. However, permanent magnets are sometimes used by

Image Courtesy of Parker Research Corp.

divers for inspection in underwater environments or other areas, such as explosive environments, where electromagnets cannot be used. Permanent magnets can also be made small enough to fit into tight areas where electromagnets might not fit.

Electromagnets



Today, most of the equipment used to create the magnetic field used in MPI is based on electromagnetism. That is, using an electrical current to produce the magnetic field. An electromagnetic yoke is a very common piece of equipment that is used to establish a magnetic field. It is basically made by wrapping an electrical coil around a piece of soft ferromagnetic steel. A switch is included in the electrical circuit so that the current and, therefore, the magnetic field can be turned on and off. They can be powered with alternating current from a wall socket or by direct current from a battery pack. This type of magnet generates a very strong magnetic field in a local area where the poles of the magnet touch the part being inspected. Some yokes can lift weights in excess of 40 pounds.

Portable yoke with battery pack

Portable magnetic particle kit

View a short movie on portable magnetic yokes. (716 KB mov)

Prods

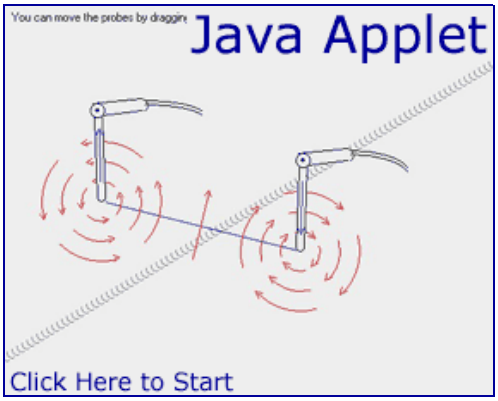
Portable Prod Unit

Prods are handheld electrodes that are pressed against the surface of the component being inspected to make contact for passing electrical current through the metal. The current passing between the prods creates a circular magnetic field around the prods that can be used in magnetic particle inspection. Prods are typically made from copper and have an insulated handle to help protect the operator. One of the prods has a

trigger switch so that the current can be quickly and easily turned on and off. Sometimes the two prods are connected by any insulator (as shown in the image) to facilitate one hand operation. This is referred to as a dual prod and is commonly used for weld inspections.

If proper contact is not maintained between the prods and the component surface, electrical arcing can occur and cause damage to the component. For this reason, the use of prods are not allowed when inspecting aerospace and other critical components. To help prevent arcing, the prod tips should be inspected frequently to ensure that they are not oxidized, covered with scale or other contaminant, or damaged.

The following applet shows two prods used to create a current through a conducting part. The resultant magnetic field roughly depicts the patterns expected from an magnetic particle inspection of an unflawed surface. The user is encouraged to manipulate the prods to orient the magnetic field to "cut across" suspected defects.



Portable Coils and Conductive Cables

Coils and conductive cables are used to establish a longitudinal magnetic field within a component. When a preformed coil is used, the component is placed against the inside surface on the coil. Coils typically have three or five turns of a copper cable within the molded frame. A foot switch is often used to energize the coil. Conductive cables are wrapped around the component. The cable used is typically 00 extra flexible or 0000 extra flexible. The number of wraps is determined by the magnetizing force needed and of course, the length of the cable. Normally, the wraps are kept as close together as possible. When using a coil or cable wrapped into a coil, amperage is usually expressed in ampere-turns. Ampere-turns is the amperage shown on the amp meter times the number of turns in the coil.


Portable Coil


Conductive Cable

Watch these short movies showing a cable being used to establish magnetic fields in parts. Cable wrapped around part (690 KB mov). Cable wrapped through the part (425 KB mov).

Portable Power Supplies

Portable power supplies are used to provide the necessary electricity to the prods, coils or cables. Power supplies are commercially available in a variety of sizes. Small power supplies generally provide up to 1,500A of half-wave direct current or alternating current when used with a 4.5 meter 0000 cable. They are small and light enough to be carried and operate on either 120V or 240V electrical service. When more power is necessary, mobile power supplies can be used. These units come with wheels so that they can be rolled where needed. These units also operate on 120V or 240V electrical service and can provide up to 6,000A of AC or half-wave DC when 9 meters or less of 0000 cable is used.

The features of a portable power supply are explained in this short movie (800KB mov).

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