

CATEGORY: ROLL INSPECTION

TYPE: MAGNETIC PARTICLE INSPECTION

Magnetic particle inspection (MPI) is a non-destructive method that can be used for the detection of surface and near surface flaws in rolls. The process uses an externally applied magnetic field or electric current and the principle that the magnetic flux will leave the part at the area of the flaw. The presence of a surface or near surface flaw (crack or void) in the material causes distortion in the magnetic flux through it, which in turn causes leakage of the magnetic fields at the flaw. This deformation of the magnetic field is not limited to the immediate locality of the defect but extends for a considerable distance; even through the surface of the roll and into the air if the magnetism is intense enough. Thus the size of the distortion is made visible at the surface of the part by means of the tiny particles that are attracted to the leakage fields.

The most common method of magnetic particle inspection for rolls uses finely divided iron or magnetic iron oxide particles held in suspension in a suitable liquid (often kerosene) called magnetic ink. The particles are often colored (typically black for roll inspection) or may be coated with fluorescent dyes that are made visible with a hand-held ultraviolet (UV-A) light. The area under test is first magnetized either with a permanent or electromagnet to create the necessary magnetic field. The magnetic ink is then sprayed or painted over the magnetized area of the specimen. The magnetic particles within the ink are then attracted to the surface field leakage in the area of the flaw and held at the edges of the defect to reveal its size and shape.



Figure 1

Cracks at the surface of a work roll identified using magnetic particle inspection

Below are the main steps of the magnetic particle inspection process used in the roll shop using a permanent bar magnet:

- ❖ Pre-cleaning: The roll surface should be cleaned to remove all oil, grease and oxide scale. For the best result a freshly ground surface is preferred.
- ❖ Magnetizing the roll surface: The bar magnet is applied to the roll surface and 'wiped' over the area under test. When testing for cracks in the axial plane the magnet is 'wiped' around the barrel circumference. For testing in the radial plane the magnet is wiped along the roll barrel.
- ❖ Application of the magnetic ink: The ink should be shaken to uniformly disperse the particles within the carrier fluid. The ink should then be sprayed over the area under test in uniform strokes until full coverage of the area is achieved. As the carrier liquid runs off the surface the magnetic particles are attracted to and retained by the flux leakage from any flaws present.

Advantages

- Low cost
- Will detect flaws at or below the surface
- Will detect flaws after grinding of a roll
- Minimal operator training required

Disadvantages

- Rolls require de-gaussing after testing and prior to eddy current testing
- Not as effective on less magnetic roll materials (such as HSS)