OPERATOR-INSPECTOR GUIDANCE CHARTS

FOR INSPECTION

WITH MAGNAFLUX

WET HORIZONTAL UNITS
AND
PORTABLE DRY UNITS

MAGNAFLUX CORPORATION
7300 WEST LAWRENCE AVENUE, CHICAGO, ILLINOIS 60656
(708) 867-8000
MAGNAFLUX UNIT

FOR MAGNETIC PARTICLE TESTING
TO FIND DEFECTS IN MAGNETIC PARTS

This Magnaflux unit has been developed and installed here for Non-Destructive Testing by the magnetic particle method: To test ferrous (magnetic) steel and iron parts for discontinuities such as cracks and seams. If undetected, certain discontinuities can cause early failure of mechanical parts in service.

The use of this method results in finding defects which are not otherwise visible to the eye. With these units you are able to locate such inherent and processing defects as: inclusions, seams, laminations, shrinks, cracks, hot tears, laps, flakes, welding defects, heat treat and grinding cracks, machining tears, quenching and straightening cracks and also fatigue or service cracks on parts from service.

This inspection is important to the quality of the finished product, and in finding defects as early as possible in manufacture, to avoid wasting machining and processing time on defective material.

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For full information, refer to "Principles of Magnetic Particle Testing"

PREPARED BY:
MAGNAFLUX CORPORATION
7300 W. Lawrence Avenue, Chicago, IL 60656
HOW MAGNETIC PARTICLE INSPECTION WORKS: CIRCULAR

Chart No. 1 . . . CIRCULAR MAGNETIZATION

1.
An open magnet has two poles: North and South. The magnetic field between the two poles will attract and hold a nail.

2.
Bend the ends of the open magnet until they almost touch and the magnetic field between the poles will hold iron powder.

3.
Bend the magnet until it is completely closed and fuse the ends. Now the magnet will not attract or hold iron powder because there is no polarity and the magnetic field is in a circle inside the ring. THIS IS CIRCULAR MAGNETIZATION.

4.
A crack part way through the magnet will cause polarity and a magnetic field at the crack, which will hold iron powder and build up an indication of the crack. THIS IS THE PRINCIPLE OF PRODUCING INDICATIONS BY MEANS OF CIRCULAR MAGNETIZATION.
MAGNETIZATION

Chart No. 2 . . . How Magnaflux Uses ELECTRICITY to Provide CIRCULAR MAGNETIZATION for locating lengthwise cracks

1. Electric current passing through a wire creates a magnetic field around the wire. Direction of the field is at 90° to the direction of the current.

2. Electric current passing through a magnetic part creates a magnetic field within the part. THIS IS CIRCULAR MAGNETIZATION — used to detect lengthwise cracks.


IN MAGNETIC PARTICLE INSPECTION, CIRCULAR MAGNETIZATION IS USED TO DETECT LENGTHWISE CRACKS.

Part to be inspected is “set up” in the Magnaflux Unit and electric current is passed through the part or through an electrical conductor within the part. The Circular Magnetic field cutting across the crack attracts and holds iron powder, to indicate the invisible defects.

Electricity is passed thru the part parallel to the defects to be found.

For full information, refer to Chapters 6 and 7, “Principles of Magnetic Particle Testing.”
HOW MAGNETIC PARTICLE INSPECTION WORKS:

LONGITUDINAL

Chart No. 3 . . . LONGITUDINAL MAGNETIZATION

1. 

Bar Magnet

Straighten an open horseshoe magnet and it then becomes a bar magnet. Note the North and South poles.

2. 

Slit in Bar Magnet

A slit (discontinuity) in the bar magnet makes magnetic poles (N. & S.) at the slit that will hold iron powder.

3. 

Crack in a Steel Bar

Here is a magnetic particle indication produced by means of longitudinal magnetization. The crack makes a magnetic field outside the part, to hold iron powder and build up an indication of the crack.
MAGNETIZATION

Chart No. 4 . . . How Magnaflux Uses ELECTRICITY to Provide LONGITUDINAL MAGNETIZATION for locating transverse cracks

1. Electric current passing through a wire wound into a coil creates a magnetic field lengthwise inside the coil.

2. When a part is placed in a Magnaflux Unit inside a coil carrying electric current, a magnetic field running lengthwise of the part is created. This is LONGITUDINAL MAGNETIZATION.


IN INSPECTION LONGITUDINAL MAGNETIZATION IS USED TO DETECT TRANSVERSE (CROSSWISE) CRACKS.

Part to be inspected is “set up” in the Magnaflux Unit and electric current is passed through a coil around the part. Small parts should not be centered within the coil, but held close to it where field strength is strongest. The longitudinal magnetic field cutting across the crack attracts and holds iron powder to indicate the crack.

Electricity is passed around the part, parallel to the defects to be found.

For more information, See Chapter 6 and 7, “Principles of Magnetic Particle Testing.”
HOW MAGNETIC PARTICLE INSPECTION WORKS:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>COLOR UNDER WHITE LIGHT</th>
<th>COLOR UNDER BLACK LIGHT</th>
<th>SAE SENSITIVITY</th>
<th>MEAN PARTICLE SIZE (MICRONS)</th>
<th>FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL PURPOSE WET METHOD PARTICLES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14A</td>
<td>Brown</td>
<td>Yellow-Green</td>
<td>8-9</td>
<td>6µ</td>
<td>Powder</td>
</tr>
<tr>
<td>14AM</td>
<td>Prepared bath of 14A and Carrier II (a high flash point petroleum vehicle). Ready to use without measuring and mixing.</td>
<td></td>
<td></td>
<td></td>
<td>Aerosol and Premixed</td>
</tr>
<tr>
<td>14A Redi-Bath</td>
<td>Preblended concentration of 14A magnetic particles, water, wetting agent, and corrosion inhibitor.</td>
<td></td>
<td></td>
<td></td>
<td>Premixed Bath</td>
</tr>
<tr>
<td>20B</td>
<td>Preblended dry mix of 14A and WA-2B water conditioner.</td>
<td></td>
<td></td>
<td></td>
<td>Powder 1.5 oz./gal. 11.25 g/µl</td>
</tr>
<tr>
<td>MG-410</td>
<td>Green</td>
<td>Bright Green</td>
<td>7</td>
<td>10µ</td>
<td>Powder</td>
</tr>
<tr>
<td>410 Redi-Bath</td>
<td>Preblended concentration of MG-410 magnetic particles, water, wetting agent, and corrosion inhibitor.</td>
<td></td>
<td></td>
<td></td>
<td>Premixed Bath 2.7 oz./gal. 21 ml/µl</td>
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<tr>
<td>7C Black</td>
<td>Black Non-fluorescent</td>
<td>6</td>
<td>5-20µ</td>
<td></td>
<td>Powder</td>
</tr>
<tr>
<td>7HF Black</td>
<td>Black Non-fluorescent</td>
<td>6</td>
<td>5-20µ</td>
<td></td>
<td>Aerosol Premixed</td>
</tr>
<tr>
<td>9C Red</td>
<td>Red-Brown Non-fluorescent</td>
<td>6</td>
<td>5-20µ</td>
<td></td>
<td>Powder</td>
</tr>
<tr>
<td>9CM Red</td>
<td>Red-Brown Non-fluorescent</td>
<td>6</td>
<td>5-20µ</td>
<td></td>
<td>Aerosol Same as 9C Premixed</td>
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<tr>
<td>OIL VEHICLE</td>
<td>Carrier II Clear Clear</td>
<td>NA</td>
<td>N/A</td>
<td></td>
<td>Suspension Vehicle N/A</td>
</tr>
</tbody>
</table>

**Figure 1 — Concentrations**

Chart No. 5 . . . PREPARING the Magnaflux Unit

1. Remove the agitator pipe.
   Thoroughly clean out this pipe, the tank, the pump and other pipes in the unit. CLEAN THE STRAINER.

2. Replace the agitator pipe and strainer.

TWO TYPES OF AGITATORS
Chart No. 6. PREPARING THE BATH WITH CONCENTRATES.
Applicable To: Magnaglo,
   Magnaflux

ELECTRIC CURRENT + BATH + DEFECT = MAGNETIC PARTICLE INDICATION

1. Clean unit as outlined in chart No. 5.

2. Pour selected light oil distillate or water (see chart-figure 1) into the tank until it is 1/3 to 1/2 full. Note the number of gallons.

3. Weigh or measure Magnaglo or Magnaflux concentrates as recommended in figure 1.

4. (a) Turn on pump motor of Magnaflux unit. Pour the concentrate directly into the tank of unit (near the pump intake).

   (b) Run agitator pump for a few minutes. Then test for proper bath strength and adjust as necessary. (see chart 6B)

CONCENTRATE + OIL OR WATER = SUSPENSION (BATH)
1. Clean unit as outlined in chart No. 5.

2. Pour required amount of water into tank.

3. a. Weigh or measure the WA-2B wetting agent into a container.
   b. Usable range is 1 to 1 1/4 ounces per gallon of bath.
   c. Turn on motor of Magnaflux unit. Pour the wetting agent into the water directly over the sump.

4. a. Weigh or measure Magnaflux or Magnaglo concentrate into a separate container.
   b. Use amount specified in figure 1.

5. a. Concentrate may be poured directly into bath. Better dispersion results if poured over the sump.
   b. Continue to run pump motor for a few minutes.
   c. Test for proper bath strength and adjust as necessary. (see chart 6B)

NOTE: The WA-2B water conditioner must be in the water before adding the concentrate particles.

KEEP DIRT OUT OF MAGNETIC PARTICLE BATH!
Chart No. 6B ... CHECKING BATH STRENGTH

DO THIS ON NEWLY MIXED BATH AND DAILY THEREAFTER!

1. Let pump motor run for several minutes to agitate a normal mixture of particles and liquid.

2. Flow the bath mixture through hose and nozzle for a few moments to clear hose.

3. Fill the Centrifuge Tube to the 100 C.C. line.

4. Place Centrifuge Tube and Stand in location free from vibration.

5. LET TUBE STAND FOR 30 MINUTES FOR WATER BATHS; 60 MINUTES FOR OIL BATHS.

6. Refer to fig. 1 for correct settled particle reading.

If reading is higher, add proper liquid. If lower, add concentrate.

NOTE:

- Do not include dirt particles in your Centrifuge Tube readings.

- It’s a good idea to check bath strength once a day or, at least, once every two days.

    Change the bath regularly—about once a week—or up to once a month if bath is not contaminated or if inspection volume is low.

For more information, refer to "Principles of Magnetic Particle Testing."
**HOW MAGNETIC PARTICLE INSPECTION WORKS**

**Chart No. 7 . . . APPLYING THE BATH**

**ELECTRIC CURRENT + BATH + DEFECT = MAGNETIC PARTICLE INDICATIONS**

There are two methods for applying the bath:

A. **CONTINUOUS METHOD** — Current and bath applied together; that is the indicating particles are on the part while magnetizing current is being applied.
   1. Flow bath through nozzle over the part.
   2. Stop the flow by releasing the nozzle.
   3. Close the current switch to apply current at the same instant you release the nozzle.
   4. Current passes immediately through the part while bath particles are still draining heavily over the surface.

Be sure the current strength is high enough to show expected defects, but not so high that particles build up along flow lines or at any change of section.

B. **RESIDUAL METHOD** — Bath is applied after current has been shut off; that is the indicating particles are on the part when residual (remaining) magnetic field is present.
   1. Pass current through part or through coil to magnetize the part.
   2. Shut off current.
      This will leave a residual magnetic field in parts of hard (retentive) steel.
   3. Apply the bath by the hose, or by dipping the part in a separate tank of agitated bath.

**NOTE:** The RESIDUAL METHOD can only be used on hard steels—which "hold" a magnetic field—usually high carbon or alloy steels, especially in the hard state.

For full information, See Chapter 14, "Principles of Magnetic Particle Testing."
AFTER INSPECTION, PARTS ARE USUALLY DEMAGNETIZED.

Alternating Current Coil is Usually Used
ON A.C. units use coil on the unit.
ON D.C. units use either an external
demagnetizer (type S or SB) separate
from the unit or the A.C. or D.C.
demagnetizer built into some units.

A. Coil Demagnetization

1. Put part in coil.
2. Turn on current.
   (Use high tap is using A.C. unit.)
3. Draw part out and well away from
coil while current is on. For greater
effect (if needed) rotate part end-
for-end while withdrawing.
4. Check for residual magnetism with
   a Magnaflux field indicator. Needle
deflection should be slight.

B. Theory: Demagnetization is accomplished by a reversing polarity field in the
part. This field is progressively reduced from high to low strength in small
steps.

Drawing the part out of the high strength A.C. field in the coil above results
in less and less field with each current cycle (at 60 cy. per sec.) until very
little field remains in the part.

FOR MORE INFORMATION SEE CHAPTER 17, "PRINCIPLES OF MAGNETIC PARTICLE TESTING" OR "DEMAGNETIZATION" BULLETIN OF MAGNAFLUX CORPORATION.
HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS

Chart No. 1...SOLID CYLINDRICAL PARTS

SHOT No. 1—HEAD SHOT

- Circular magnetization finds lengthwise cracks.
- Current passed through part magnetizes it circularly to find lengthwise cracks when bath is applied.
- INSPECT for particle indications showing longitudinal defects—mark defects.

<table>
<thead>
<tr>
<th>No. 1—SOLID CYLINDRICAL PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXAMPLE</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1&quot; Dia. part.</td>
</tr>
<tr>
<td>3&quot; Dia. part.</td>
</tr>
<tr>
<td>Bolt-1½&quot; D.</td>
</tr>
<tr>
<td>Tappet-Push rod</td>
</tr>
</tbody>
</table>

CONTROL YOUR AMPERAGE BY RESULTS, OR ACCORDING TO APPLICABLE SPECIFICATIONS.

SHOT No. 2—COIL SHOT

- Longitudinal magnetization finds transverse (crosswise) cracks.
- Current passed through coil magnetizes part lengthwise to find transverse defects when bath is applied.
- INSPECT for particle indications showing transverse defects—mark defects.

NOTE:
Effective length magnetized by one coil shot is one half coil diameter on either side of coil. On long parts, use repeated shots and baths down the length of the part. Put small parts close to coil body.

FOR CYLINDRICAL PARTS WITH DIAMETER CHANGE:
Head and coil shots must be done twice!
1. One shot with amperage for large diameter.
2. One shot with amperage for small diameter.

WATCH FOR:
A corner or change of section is a likely place for cracks. Be careful not to interpret a corner-accumulation as a crack indication.

For more information, refer to “Principles of Magnetic Particle Testing.”
IN TYPICAL PARTS

Chart No. 2... HOLLOW CYLINDRICAL PARTS

No. 2 — HOLLOW CYLINDRICAL PARTS

<table>
<thead>
<tr>
<th>EXAMPLE</th>
<th>APPROXIMATE CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. 1 SHOT</td>
</tr>
<tr>
<td>1&quot; O.D. Tube</td>
<td>500-1000</td>
</tr>
<tr>
<td>3&quot; O.D. Tube</td>
<td>1500-3000</td>
</tr>
<tr>
<td>Wrist Pin (1½&quot;D.)</td>
<td>800-1500</td>
</tr>
<tr>
<td>Cylinder Sleeve 6&quot;</td>
<td>2500-max.</td>
</tr>
<tr>
<td>Bearing Race 3&quot; D</td>
<td>1500-3000</td>
</tr>
</tbody>
</table>

CONTROL YOUR AMPERAGE BY RESULTS, OR ACCORDING TO APPLICABLE SPECIFICATIONS.

NOTE: Central conductor gives the BEST MAGNETIC FIELD, and BEST INDICATIONS, on inner surfaces of any hollow cylinder shape.

SHOT No. 1 — HEAD SHOT
(With Central Conductor)

• Central conductor is used for circular magnetization to find lengthwise cracks.
• Apply bath, both inside and outside.
• INSPECT for particle indications showing longitudinal defects—inside and out—mark defects.

SHOT No. 2 — COIL SHOT

• Longitudinal magnetization finds transverse (crosswise) cracks.
• Current passed through coil magnetizes part lengthwise to find transverse defects.
• Apply bath, both inside and outside.

VERY SHORT HOLLOW CYLINDERS

• String short cylinders on central conductor for circular shot and, (sometimes), follow with two head shots across the diameters (see chart 5, note "A").
• INSPECT after each shot—turn part 90° between shots.

Examples

<table>
<thead>
<tr>
<th></th>
<th>Thru Conductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuts-1&quot; O.D.</td>
<td>Approx. Amps.</td>
</tr>
<tr>
<td>Rings-2&quot; O.D.</td>
<td>400-1000</td>
</tr>
<tr>
<td>Shaft Spacers 3&quot; O.D.</td>
<td>1000-2000</td>
</tr>
<tr>
<td></td>
<td>1500-3000</td>
</tr>
</tbody>
</table>
HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS

Chart No. 3 — SPRINGS

SHOT No. 1 — HEAD SHOT

- Current passed through spring from end to end finds lengthwise cracks in the wire that forms spring.
- Apply bath.
- INSPECT for particle indications which show the longitudinal defects — mark defects.

SHOT No. 2 — HEAD SHOT (WITH CENTRAL CONDUCTOR)

- Current passed through a central conductor magnetizes spring and finds transverse cracks in the wire that forms the spring.
- Apply bath.
- INSPECT for particle indications which show transverse defects — mark defects.

NOTE: Springs are usually inspected by continuous method, using Magnaglo.

For more information, refer to "Principles of Magnetic Particle Testing."

### No. 3 — SPRINGS — SHOT NO. 1

<table>
<thead>
<tr>
<th>DIAMETER OF WIRE</th>
<th>APPROXIMATE CURRENT Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼&quot;</td>
<td>100-250</td>
</tr>
<tr>
<td>½&quot;</td>
<td>200-500</td>
</tr>
<tr>
<td>1&quot;</td>
<td>500-1000</td>
</tr>
</tbody>
</table>

CONTROL YOUR AMPERAGE BY RESULTS OR ACCORDING TO APPLICABLE SPECIFICATION

### No. 3 — SPRINGS — SHOT No. 2

<table>
<thead>
<tr>
<th>DIAMETER OF SPRING COIL</th>
<th>APPROXIMATE CURRENT Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>500-1000</td>
</tr>
<tr>
<td>2&quot;</td>
<td>1000-2000</td>
</tr>
<tr>
<td>3&quot;</td>
<td>1500-3000</td>
</tr>
</tbody>
</table>
IN TYPICAL PARTS

Chart No. 4 — SOLID PARTS WITH HOLE THROUGH END

EXAMPLE: CONNECTING RODS

<table>
<thead>
<tr>
<th>Connecting Rods</th>
<th>SHOT No. 1</th>
<th>SHOT No. 2</th>
<th>SHOT No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amperes</td>
<td>Amperes</td>
<td>(Central Conductor) Amperes</td>
</tr>
<tr>
<td>1&quot; Max. Web. O.D.</td>
<td>800-1000</td>
<td>300-700</td>
<td>800-1500</td>
</tr>
<tr>
<td>3&quot; Cross Section</td>
<td>2000-3000</td>
<td>1000-Max.</td>
<td>2500-Max.</td>
</tr>
<tr>
<td>Similar Parts: Rocker Arms</td>
<td>500-2500</td>
<td>300-700</td>
<td>500-2000</td>
</tr>
<tr>
<td>Wind Hinges</td>
<td>2000-Max.</td>
<td>1000-Max.</td>
<td>1500-2500</td>
</tr>
<tr>
<td>Terminal Fittings</td>
<td>200-800</td>
<td>100-500</td>
<td>500-1500</td>
</tr>
</tbody>
</table>

CONTROL YOUR AMPERAGE BY RESULTS OR APPLICABLE SPECIFICATIONS.

SHOT No. 1 — HEAD SHOT

- Circular magnetization finds lengthwise cracks.
- Current passed through part magnetizes it circularly to find lengthwise cracks — apply bath.
- INSPECT for particle indications which show longitudinal defects — mark defects.

SHOT No. 2 — COIL SHOT

- Longitudinal magnetization finds transverse cracks.
- Current passed through coil magnetizes lengthwise to find transverse defects — apply bath.
- INSPECT for particle indications which show transverse defects — mark defects.

SHOT No. 3 — HEAD SHOT (WITH CENTRAL CONDUCTOR)

- Used to detect cracks around hole.
- Insert central conductor bar through hole.
- Magnetize with current shot, apply bath inside and out.
- INSPECT for particle indications which show cracks parallel to direction of hole, inside and out. — mark defects.

For more information, refer to "Principles of Magnetic Particle Testing."

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HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS

Chart No. 5 — LARGE DIAMETER DISCS, GEARS, ETC.

SHOT No. 1 — HEAD SHOT (WITH CENTRAL CONDUCTOR)

- Central conductor used for circular magnetization to find cracks across gear.
- INSPECT for particle indications showing defects — mark defects.

SHOT No. 2 — FIRST HEAD SHOT ACROSS GEAR

- Current passing across diameter through gear finds cracks extending around the gear.
- Use copper-braid, neoprene-backed contacts on heads to avoid burning gear teeth at contact points.
- INSPECT for particle indications showing defects — mark defects.

SHOT No. 3 — SECOND HEAD SHOT ACROSS GEAR

- Turn gear 90° and shoot again across diameter.
- INSPECT for particle indications showing defects — mark defects.

NOTE "A" : Large diameter rings with large center hole. Rest on conductor, inspect only near conductor. Repeat around circumference.

NOTE "B" : Shot 2 and 3 above can be replaced by one induced magnetization shot where volume of parts justifies tooling.

CONTROL YOUR AMPERAGE BY RESULTS OR APPLICABLE SPECIFICATIONS.

<table>
<thead>
<tr>
<th>EXAMPLE</th>
<th>APPROXIMATE CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHOT No. 1</td>
<td>SHOT Nos. 2 &amp; 3</td>
</tr>
<tr>
<td>Medium Dia. Gears—4” D.</td>
<td>2000-Max, 1500-Max.</td>
</tr>
<tr>
<td>8” D.</td>
<td></td>
</tr>
<tr>
<td>Reduction Gear—15” D.</td>
<td>2000-Max. (Note “A”)</td>
</tr>
<tr>
<td>Cam Ring &amp; Gear</td>
<td>2000-Max. (Note “A”)</td>
</tr>
</tbody>
</table>

For more information, refer to "Principles of Magnetic Particle Testing."

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IN TYPICAL PARTS

Chart No. 6 – IRREGULARLY SHAPED PARTS
EXAMPLE: CRANKSHAFTS

SHOT No. 1 – HEAD SHOT

- Circular magnetization finds defects.
- Current passed through part magnetizes it circularly to find lengthwise defects when bath is applied.
- INSPECT for particle indications which show the longitudinal defects — mark defects.

SHOT No. 2 – COIL SHOT

- Longitudinal magnetization finds transverse (crosswise) cracks.
- Current passed through coil magnetizes part lengthwise to find transverse defects when bath is applied.
- INSPECT for particle indications which show the longitudinal defects — mark defects.

<table>
<thead>
<tr>
<th>EXAMPLES</th>
<th>APPROXIMATE CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crankshafts 2&quot; Dia.</td>
<td>1000-2000</td>
</tr>
</tbody>
</table>

CONTROL YOUR AMPERAGE BY RESULTS OR APPLICABLE SPECIFICATIONS.

NOTE: For long crankshafts or similar parts shoot twice or more down the length of the part. Each coil shot is effective for only one or two bearing areas.

For more information, refer to “Principles of Magnetic Particle Testing.”
HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS

Chart No. 7 – IRREGULARLY SHAPED PARTS
EXAMPLE: HOUSINGS

SHOT No. 1 – HEAD SHOT (WITH CENTRAL CONDUCTOR)

- Central conductor, inserted through holes in housing, is used for circular magnetization to find cracks in directions shown.
- Conductor kept near body of part (see note “A” chart 5).
- INSPECT for particle indications showing defects.

SHOT No. 2 – FIRST HEAD SHOT ACROSS A DIAMETER

- Magnetizes part circularly as shown.
- Current passing across diameter through part finds cracks in direction shown when bath is applied.
- INSPECT for particle indications showing defects.

SHOT No. 3 – SECOND HEAD SHOT ACROSS A DIAMETER

- Same as shot No. 2, except rotate part 90°: shoot across a second diameter and apply bath, to locate all cracks as shown.

SHOT No. 4 – COIL SHOT

- Provides longitudinal magnetization for parts with a long dimension.
- This shot is used when shape of housing approaches that of a cylinder.

For more information, refer to “Principles of Magnetic Particle Testing.”
**HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS**

**BLANK CHART – FILL IN FOR YOUR PARTS**

<table>
<thead>
<tr>
<th>DESIGNATED PARTS</th>
<th>APPROX. CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Nos.</td>
<td>Head Shot</td>
</tr>
<tr>
<td></td>
<td>Coil Shot</td>
</tr>
</tbody>
</table>

**SHOT No. 1 – HEAD SHOT**

**SHOT No. 2 – COIL SHOT**
HOW MAGNETIC PARTICLE INSPECTION IS USED TO FIND DEFECTS

BLANK CHART – FILL IN FOR YOUR PARTS

<table>
<thead>
<tr>
<th>DESIGNATED PARTS</th>
<th>APPROX. CURRENT</th>
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<tr>
<td>Part Nos.</td>
<td>Head Shot</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SHOT No. 1 – HEAD SHOT

SHOT No. 2 – COIL SHOT
PORTABLE MAGNAFLUX UNIT USING PROD AND CABLE INSPECTION FOR MAGNETIC PARTICLE TESTING TO FIND DEFECTS IN MAGNETIC PARTS

Portable Magnaflux units are used: To test ferrous (magnetic) steel and iron parts for discontinuities such as cracks and seams. If undetected, certain discontinuities can cause early failure of mechanical parts in service.

Magnetic particle inspection provides the means of finding defects which are not otherwise visible to the eye. With this type of unit an inspector is able to locate such inherent and processing defects as: inclusions, seams, laminations, shrinks, cracks, hot tears, laps, flakes, welding defects, heat treat and grinding cracks, machining tears, quenching and straightening cracks and also fatigue or service cracks on parts from service.

This inspection is important to the quality of the finished product, and in finding defects as early as possible in manufacture, to avoid wasting machining and processing time on defective material.

Inspection with the magnetic particle method consists of three parts:
1. Creation of magnetic field in the test part or area.
2. Application of magnetic particles to the magnetized area.
3. Examination for particle accumulations (indications).

For full information, refer to "Principles of Magnetic Particle Testing."

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HOW MAGNETIC PARTICLE INSPECTION WORKS
CIRCULAR MAGNETIZATION

Chart No. 1. How Magnaflux* uses electricity to create circular magnetic field in the part.

1. High amperage, low voltage current through a wire creates a magnetic field around the wire. Direction of the field is at 90° to the direction of the current.

2. High amperage, low voltage current passing through a part creates a magnetic field within the part between the prods. This is circular magnetization—used by Magnaflux to detect defects parallel to current flow.

3. Magnetic Particle Indication of Crack in Weld or Casting Wall

IN INSPECTION WITH MAGNAFLUX, CIRCULAR MAGNETIZATION IS USED TO DETECT CRACKS IN WELDS OR LOCAL AREAS OF LARGE SURFACES, HEAVY CASTINGS, FORGINGS, ETC.

High amperage, low voltage current is passed through the part or an area of the part between the prods or clamps held firmly to the surface. Any crack which cuts across the magnetic field attracts the magnetic particles to form an indication and indicate defects.

High amperage, low voltage current is passed through the part parallel to the defects to be found.

For full information, refer to "Principles of Magnetic Particle Testing."

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Chart No. 2. How Magnaflux uses electricity to create longitudinal magnetic field in the part.

1. High amperage, low voltage current passing through a wire wound into a coil creates a magnetic field lengthwise inside the coil.

2. When a part is placed in a coil carrying high amperage, low voltage current, a magnetic field running lengthwise of the part is created. This is LONGITUDINAL MAGNETIZATION.

3. IN INSPECTION WITH MAGNETIC PARTICLE LONGITUDINAL MAGNETIZATION IS USED TO DETECT TRANSVERSE (CROSSWISE) CRACKS.

High amperage, low voltage current is passed through a coil or cable wrapped around the part. Coil should be wound to fit the part size closely and turns should be close to each other. A crack which cuts across the magnetic field attracts the magnetic particles to form an indication and indicate defects.

Current is passed around the part parallel to the defects to be found.
Dry powder must be dusted lightly and gently to the magnetized area. Watch for indications to form as the powder is applied.

Gently blow off the excess powder, while the magnetizing current is still flowing.

Magnaflux magnetic particle powder is available in three colors: red, black, or grey. Select the powder which gives the best color contrast with the part being inspected.

If the Magnaflux XB-2A Powder Blower is used, it applies the powder in the desirable gentle cloud and also has low pressure air stream for blowing off excess powder. Powder may also be applied by means of powder spray bulbs or disposable plastic squeeze bottles.

A liquid suspension of fluorescent or non-fluorescent magnetic particles may be used instead of dry powder. Premixed baths of either type particles are available in bulk for application by portable applicator guns or in pressurized spray cans.

If a wet bath is used with cable magnetizing, be sure to follow agitation instructions for the inspection medium. The wet method is not recommended for use with prods.
Chart No. 4. Weld Inspection.

1. Firmly hold prods along the weld, spaced from 4 to 8 inches apart and straddling the weld.
2. By turning on the magnetizing current that part of the weld between the prods becomes magnetized.
3. While the current is flowing, lightly dust powder to the magnetized area. Watch for indications to form.
4. Gently blow off excess powder.
5. Stop current flow and look for indications.
6. Move prod tips along the weld to spots numbered 2 repeating all steps. Be sure that each spacing overlaps the previous shot.

Moving along the weld in this manner should bring out any cracks in the weld or along its edges which are parallel to the weld.

BE SURE TO:

1. Press prods firmly to the work to prevent arcing.
2. Keep the current flowing until the excess powder has been blown off.
3. Overlap the areas inspected.
4. Reduce field strength if particles accumulate excessively at prod points.
5. Increase the field strength if there isn’t some noticeable magnetic influence of the particles at the prod tips.

Field strength can be increased by increasing the amount of the magnetizing current or reducing the distance between prods.
HOW MAGNETIC PARTICLE INSPECTION WORKS

Chart No. 5. Large Areas.

The inspection of a large area is accomplished by inspecting many smaller areas in sequence.

When the prods spaced 8" apart give good evidence of a magnetic field around prod tips, the surface adequately magnetized for inspection will be oval in shape, and about 4" wide. To completely inspect a large area for cracks in one direction prod spacing will look like this:

For complete inspection the entire area will have to be covered in this manner and then the process must be repeated with prod positions at 90° to the first direction.

BE SURE TO:

Follow the six operations enumerated in Chart 4 for every prod spacing.

Critical areas such as change of section in complicated casting or fabrications should be inspected before finishing operations are performed. Then repairs can be made more easily. The direction of the magnetic field should be at right angles to the crack for best detection.
HOW MAGNETIC PARTICLE INSPECTION WORKS

Chart No. 6. Cable Coils.

To look for transverse (cross-wise) cracks in shaft or pipe.

1. Wrap 2 to 4 turns of cable loosely around part keeping each turn close together.

2. Turn on magnetizing current.

3. While current is flowing, lightly dust powder to the magnetized area. Watch for indications to form.

4. Gently blow off excess powder.

5. Stop current flow and examine surface for indications of powder held to crack or defect.

Such cable wrapping usually will create an effective magnetic field from 6” to 8” on either side of the coil. If the part is long you will have to move the cable along from the first position and repeat the 5 steps of magnetization and powder application until the whole length of the part is covered.

To inspect hollow parts:

1. Thread 2 to 4 turns of cable through eye of part keeping turns close to each other and to the part.

2. Turn on magnetizing current.

3. While current is flowing, lightly dust powder to the magnetized area. Watch for indications to form.

4. Gently blow off excess powder.

5. Stop current flow and examine surface for indications of powder held to crack or defect.

Move cable around the opening to examine area which was under the cable in the first operation. Repeat all 5 inspections steps above.
DEMANETIZATION

Use AC current for demagnetization.

1. Make a 2 to 4 turn coil loosely around the part.

2. Energize the coil.

3a. Remove the coil from the part a distance of at least three feet.

3b. Remove the part from the coil a distance of at least three feet.

4. Turn off current.

CAUTION: Do not turn off the current until the part is out of the magnetic influence of the coil or demagnetization will not be complete.

The coil should be energized with a current as strong or stronger than that used for magnetization.