

New Standard for Large Ring Gears for Mills, Kilns

Tom Shumka, Global Inspections-NDT, Inc.

Methods of examining large ring gear teeth to detect surface breaking discontinuities have often been time-consuming and limited in terms of data collected. Methods such as visual and magnetic particle inspection can miss critical discontinuities. However, a new ASTM international standard provides a more effective method for gear examination using eddy current array, a technology that has been widely used but, until now, not standardized.

Eddy current inspection is based on Faraday's electromagnetic induction law. Eddy currents are created through a process called electromagnetic induction. The eddy current array (ECA) was developed just before the 20th century, and the technology provides the ability to drive electronically multiple eddy current coils placed side by side in the same probe assembly. General Electric was the first to use ECA on gearing in the late 1980s. ECA has been used for years in the aircraft and nuclear sectors plus numerous other applications that require fast and accurate surface inspections. This practice will help to standard-

ize the use of this non-destructive testing approach for large ring gear inspections.

To understand operational and production behavior of operational machinery, a robust data collection and examination process must be established. ASTM International Standard E2905 was written for ring gear examinations. This method detects 100 percent of all gear tooth surface discontinuities, larger than 0.015 of an inch. There are two electromagnetic methods that are the basis of this standard: Eddy Current Array (ECA) and Alternating Current Field Measurement (ACFM) ASTM E2261.

Eddy current inspection addresses the need to detect surface breaking discontinuities electronically, and to have the ability to accurately size any surface-breaking cracks found on cast and forged gear and pinion teeth faster and more effectively than other methods. It will scan the addendum, dedendum and root of a gear tooth in 15 seconds. The whole depth of a tooth including the root can be scanned in one pass. This method will benefit both the manufacturer and the aftermarket service sectors.

Prior to the new standard, there were three types of inspections for gearing, besides visual:

1. Magnetic Particle (MT) - ASTM E709. Electromagnetic: Slow process, can miss indications and gear teeth have to be wiped clean to remove any residue.
2. Dye Penetrant (LT) - ASTM E1417: Same issues as Magnetic Particle. At best, these two methods can determine whether a flaw exists, but are unable to provide information on defect severity such as sizing – length and depth.
3. Ultrasonics ASTM A609: Requires couplant — faster than the above two methods, has a “blind” spot for surface, but can see depth.

Enter Eddy Current Inspection

The benefits of eddy current inspection for gear manufacturers include that it is much faster than magnetic particle and dye penetrant as a final inspection. Each tooth flank and root can be scanned in 15 seconds. It allows manufacturing to provide the client with an electronic map of addendum, dedendum and root area of each gear tooth when it leaves the plant.

Benefits for Aftermarket Services

E2905 is an excellent NDT electromagnetic method for the aftermarket service sector.

Cleaning has never been easier. 36' diameter ring gears can be cleaned in less than an hour. There is no need to wipe the gear teeth down after the cleaning, saving numerous person hours.

The method is cleaner, faster, documentable, and covers a larger area in less inspection time. Also it greatly improves probability of detection compared with other non-destructive testing methods used today for gearing applications.

Once the ring gear is inspected and leaves the factory, follow up inspections will deliver consistency, efficiency and standardization, a service valued by customers worldwide.



The Ease of Ring Gear Cleaning

Over the years, ring gear cleaning using high viscosity, asphaltic-based lubricants has become something to be avoided at all costs. There is now a ring gear cleaning procedure that not only simplifies the cleaning process, but reduces numerous hours of labor. The exception to this is if the lubrication is an oil bath system. In this case, no cleaning is required. The actual time of cleaning a ring gear is under an hour. There is no need to wipe the gear teeth down by hand after inspection to remove residue as in magnetic particle or dye penetrant inspections. The ability to fully visualize the gear teeth is critical for a true gear inspection or audit.

Case Study

An excellent example of the benefits of this method is shown below. The client requested an inspection on a 34' diameter ring gear. Once again, the gear teeth are visually inspected as the teeth are scanned. On tooth 244A, (Figure 13) ECA detected two cracks that could not be visualized.

The next step was to size the cracks. Utilizing alternating field current measurement (ACFM), both cracks were sized. The larger crack was sized at 3.63" L x .68" deep. The sizing took less than three minutes. To further validate the characteristics of the crack, MT was used to visualize the crack and to document it. Moving forward, these cracks can be monitored through the inspection hole, on the gear guard, in less than fifteen minutes. Typically this mill would go down for scheduled maintenance four times a year, thus providing a comfort level to the client that any propagation of the cracks can be monitored.

Conclusions

- The inspection can take place alongside other maintenance personnel.
- E2905 will allow SAG and ball mill maintenance planners to reduce the time it takes to perform gear inspections.
- Planners that used to allow 36 hours to perform maintenance and inspect the gear set, now allow 18 to 24 hours for this job.

- It is conceivable to inspect four mills (2 x 34') and (2 x 24') in two days.
- This process provides comprehensive and accurate inspection data. This is very important in determining the integrity of the gear set.
- It reduces the reliance on human interpretation using other inspection methods.
- Insurance companies have all acknowledged the benefits of this method.

- This method provides real-time mapping of the inspected region, facilitating data interpretation, improving reliability and probability of detection (POD).
- All of this helps in minimizing catastrophic failures, resulting in reduced maintenance costs and increased uptime. ⚙️

WHEN YOU NEED IT RIGHT
THE FIRST TIME

The Broach MASTERS

Much More
Than Just a
Broach
Company!

& Universal Gear

The quality and precision of our Broaches, Shaper Cutters and Gears have won customers world-wide - from the smallest gear shop to NASA and the Mars Rover.

- Broach & Shaper Cutter manufacturing & repair
- Gear & Spline—prototype to production
- Master Gears & Gages
- Small & fine pitch

Precision. Performance. Perfection.
The First time and every time.

The Broach Masters, Inc.

QUALITY TOOLS
SERVICE
DEDICATED TO EXCELLENCE

1605 Industrial Drive
Auburn, CA 95603
Phone: (530) 885-1939
Fax: (530) 885-8157
Web: www.broachmasters.com
Email: info@broachmasters.com

U.G.C.
MADE IN U.S.A.

Made in USA