

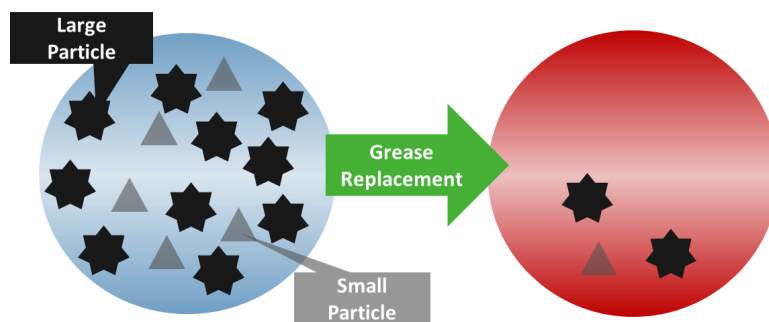
Kawasaki Customer Service

Ferrography

OVERVIEW

Ferrography is a preventive maintenance practice that analyzes the size and density of iron particles found in reduction gear grease to determine unit wear. Reduction gears are a major component of the robot arm, and sudden failure of these units can cause extended downtime. Including cost-effective ferrography in your preventive maintenance (PM) routines helps you avoid unplanned loss of production by accurately identifying robots that require maintenance.

As the robot's reduction unit wears, the size of iron particles flaking off into the surrounding grease increases. When ferrography tests are conducted, the ratio of large to small iron particles is analyzed and reported as the Wear Severity Index (SI), which informs the robot user of the current reduction unit wear. As the number of large particles begins to greatly outnumber small particles, the reduction unit enters into what is called an "Error" stage, and maintenance can be scheduled prior to failure. When the Severity Index reaches the "Error - Warning" status, an increase in the frequency of grease analysis is recommended. The reduction unit should be replaced once the "Error - Abnormal" status is reached.



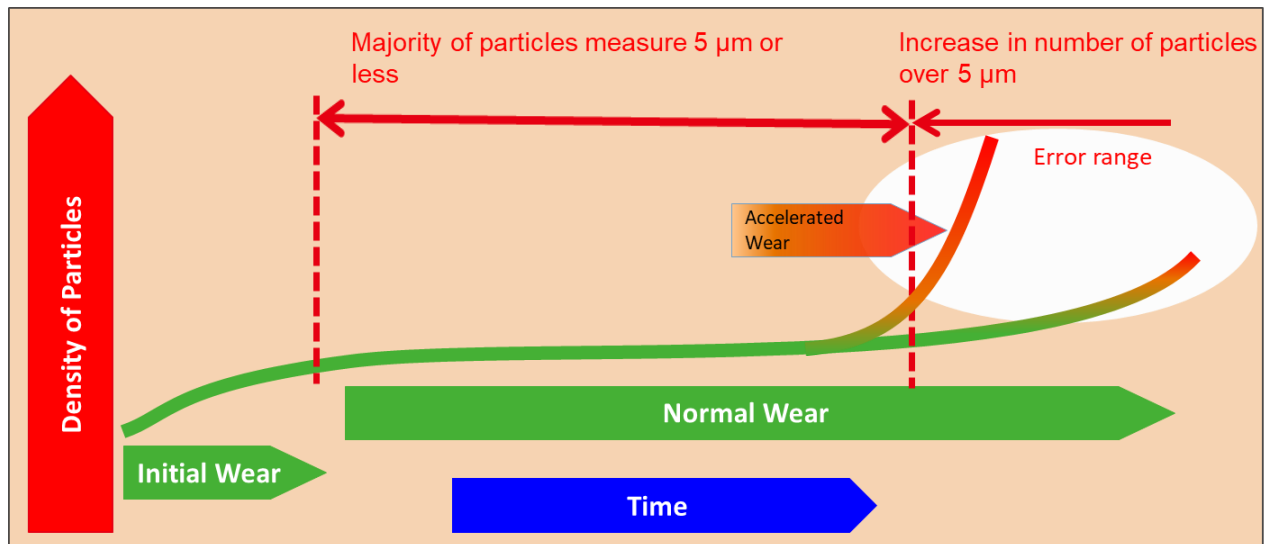
ANALYSIS EXAMPLE

Status	Wear Severity Index
Normal	< 4,000
Error - Warning (initial wear)	4,000 – 10,000
Error - Abnormal (worn out)	> 10,000



Grease Iron Content (wt%)	Wear Severity Index	Results
0.048	4,641	Taper roller bearing is showing signs of wear

PARTICLE WEAR OVER TIME



RECOMMENDED FERROGRAPHY INTERVALS

For optimal performance, regular ferrography testing should begin after 5,000-10,000 hours of robot operation depending on robot model, and at minimum be continued at such intervals throughout the robot's lifecycle, much like regular PM routines.

The following factors contribute to reduction gear unit wear and the need for routine grease analysis:

- High temperature environmental conditions that exceed recommendations
- Excessive end-of-arm tooling (EOAT) weight
- Robot programming that includes sudden, abrupt deceleration or frequent hard stops

It is easiest to collect grease samples while your robots are undergoing routine PM inspections and services. If you are performing your own PM routines, you can collect grease samples on your own with guidance from our Customer Service team and ship them to Kawasaki Robotics for ferrography. If Kawasaki Robotics is performing your robot's PM routines, ferrography can be added to the services contracted.

All ferrography testing is done at Kawasaki Robotics Americas headquarters in Wixom, Michigan, at a low cost of \$285* per 6-axis robot. Contact your account manager if you are interested in this service.

* Subject to change

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