

The information contained in this figure is provided for the evaluation of contamination found on the drive system chip detectors.

It is impossible to depict the shapes of all possible particulate contamination, especially those particles not generated within a gearbox, as a result of component wear or failure. However, the following basic assumptions will permit a rather accurate assessment of any debris found, even though the particles may be severely distorted as a result of passing through gear meshes.

DESCRIPTION:

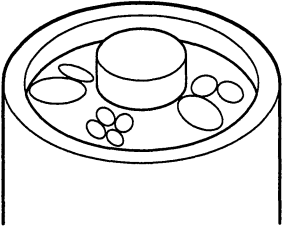
- 1. Material, from the surfaces of gear teeth or rolling element bearings is quite hard. Particles broken from these surfaces may have razor-sharp edges but rarely have sharp pointed ends. With few exceptions, surfaces of such particles will not appear smeared (as if cut by a shear) under magnification; a grainy appearance on the fracture surfaces is more common.

When damaged by passing through gear meshes, these hard particles tend to breakup with relatively little deformation.

- 2. Foreign ferrous material introduced into gearboxes is often much softer than the surfaces of gear teeth and bearings. The same is true of most nongear and nonbearing components within gearboxes. The softer materials are usually quite ductile and malleable, i.e., particles from such materials can be readily bent or rolled into a wide range of shapes without fracturing.

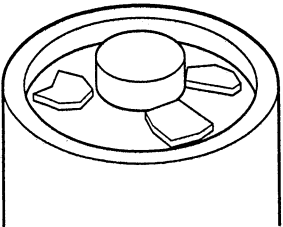
Fragments of the softer material are capable of being torn or sheared from the parent component without suffering brittle fracture (easily broken or snapped). Instead, during separation the fragments are distorted and stretched such that they often exhibit surfaces that appear stretched. Ends of soft material fragments are often sharp-pointed; the ductile nature of the material permits such a condition.

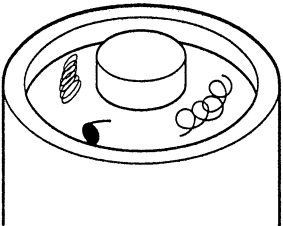
Each type of debris has been identified as significant debris or insignificant debris at the beginning of the explanation of significance to aid in troubleshooting. Recurring accumulation of insignificant debris will require overhaul/repair of gearbox.

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>A few moderately-sized and/or numerous small nearly-flat flakes:</p> <p>Under magnification one side of flakes appears very smooth. Flakes are silvery in color with an occasional black side.</p> <p>Common term for this condition is flakes.</p>	<p>(SIGNIFICANT DEBRIS)</p> <p>This is a classic indication of rolling element bearing failure. Although less common, this can also indicate spalling of gear teeth.</p> <p>OVERHAUL/REPAIR GEARBOX</p>

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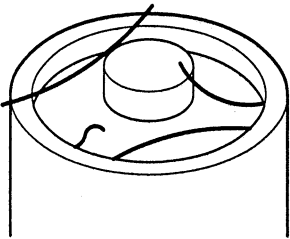
Figure 63-2. Metal particle identification and disposition (sheet 1 of 5)

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>Irregularly-shaped ferrous chunks of various sizes and shapes:</p> <p>Under magnification one or more sides of particles appears rough and grainy. Color of particles is silvery-gray often with one or more sides black.</p> <p>This condition has no common term.</p>	<p>(SIGNIFICANT DEBRIS)</p> <p>Existence of this type of debris most likely indicates gear and/or bearing damage within the drive system component.</p> <p>OVERHAUL/REPAIR GEARBOX</p>

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>Spiral curls or comma-shaped particles:</p> <p>When examined under magnification, particles are often smooth and shiny on their convex surfaces and quite rough on the other surfaces and edges. Color of particles is usually dull gray on rough surfaces.</p> <p>Common term for condition is manufacturing debris.</p>	<p>(INSIGNIFICANT DEBRIS)</p> <p>Particles are fragments of chips or shavings produced during the machining of ferrous components. Such contamination is often introduced into the drive system components on tools, during dusting operations within the component assembly area using compressed air.</p> <p>No corrective action is required following discovery of such material. Recheck detector daily for 25 hours.</p>

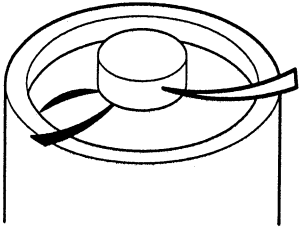
212-M-63-2-2

Figure 63-2. Metal particle identification and disposition (sheet 2)

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>Hair-like ferrous debris:</p> <p>May have rectangular or triangular cross sections. Generally 0.030 inch or less in thickness. Length may range from 0.100 inch to over 1.000 inch. Color of debris is usually light gray although one or more sides may have a black appearance.</p> <p>Common term for condition is hairs.</p>	<p>(INSIGNIFICANT DEBRIS)</p> <p>Debris commonly are scrapings, produced as components are interference-fitted together during assembly of the drive system component. Debris of this general shape is also produced, after long term operation, at the corners of wearing surfaces of such parts as transmission planetary supports. This type debris can be introduced into the component during periodic servicing.</p> <p>Hairs can appear on chip detectors at any point in the life of the drive system component. However, discovery of such material does not necessitate any corrective action. Recheck detector daily for next 25 hours.</p>

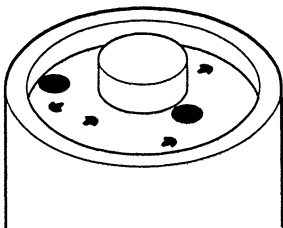
212-M-63-2-3

Figure 63-2. Metal particle identification and disposition (sheet 3)

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>Irregular-shaped ferrous particles:</p> <p>Usually triangular in cross sections. Often spiked-like in appearance. Under magnification, one side of triangular section will usually appear sheared. Color may be silvery-gray or black with one or more silver sides. Existence of two or more particles of this type on a chip detector at any one time is rare.</p> <p>Common term for condition is manufacturing debris.</p>	<p>(INSIGNIFICANT DEBRIS)</p> <p>Particles of this type are commonly the result of tool slippage during assembly of the drive system component. An example would be the sliver of metal torn from the edge of a screw slot as a screwdriver blade slips out of place.</p> <p>This type of debris would most likely appear during the first 50 hours of operation following component assembly or extensive maintenance.</p> <p>No corrective actions are required following discovery of such material. Recheck detector daily for next 25 hours.</p>

212-M-63-2-4

Figure 63-2. Metal particle identification and disposition (sheet 4)

TYPICAL APPEARANCE	DESCRIPTION	SIGNIFICANCE
	<p>Tiny whisker-like particles or groups of dark microscopic particles:</p> <p>When removed with tape or paper towel, apparently-large chips disappear into a black smudge.</p> <p>Common term for condition is smudge or fuzz.</p>	<p>(INSIGNIFICANT DEBRIS)</p> <p>Generally microscopic wear particles produced by normal wear within drive system component. Particles are often grouped by the field of the chip detector magnet to assume the shape of apparently large chips.</p> <p>Such material is common in gearboxes having several hundred operating hours. In such cases, this condition does not necessitate corrective action.</p> <p>Appearance of this type of debris in relatively new or recently-overhauled gearboxes may indicate bearing or gear micropitting. In such cases detector should be inspected more frequently for signs of progressing damage. Recheck daily for next 25 hours.</p>

212-M-63-2-5

Figure 63-2. Metal particle identification and disposition (sheet 5)