



Sentient Science Bearing & Gear Damage Class

Metal Particles: A measure of the level of particles in the filter housing base or on the oil sump magnet

Damage Class -1

Can't See

Damage Class 0

Like New

Damage Class 1

Minor Defect

Damage Class 2

Medium Defect

Damage Class 3

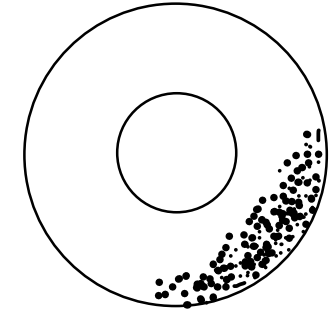
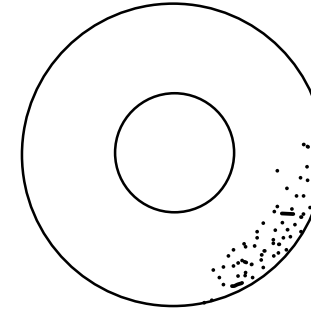
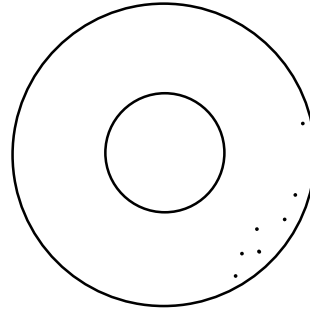
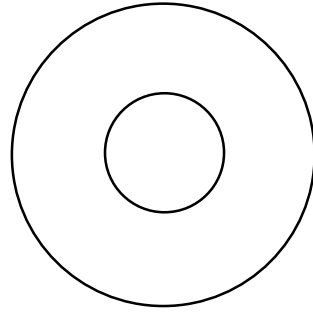
Major Defect

(No Particles Visible)

(Small amount of metal particles observed)

(Medium amount of particles observed, some may be larger in size)

(Sizeable amount of particles observed in filter base)



Base of Oil Filter Housing

Oil Level: The relative level of oil in the Gearbox's visual glass tube

Damage Class -1

Can't See

Damage Class 0

Like New

Damage Class 1

Minor Defect

Damage Class 2

Medium Defect

Damage Class 3

Major Defect

Damage Class 4

Critical Defect

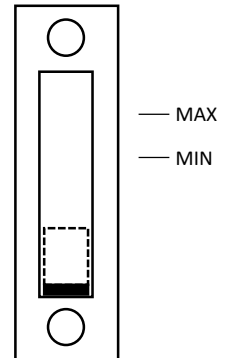
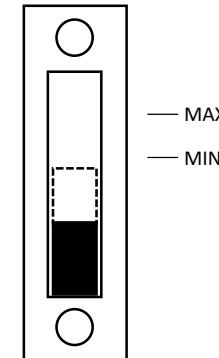
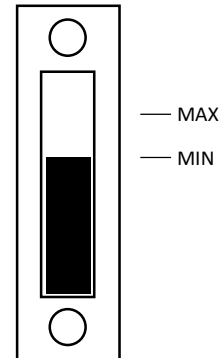
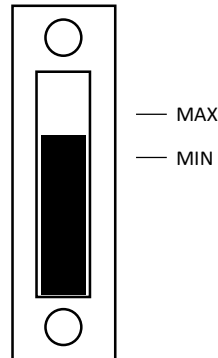
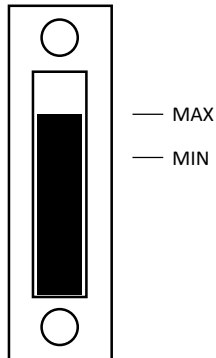
(Oil level at MAX mark)

(Oil level between MAX and MIN mark)

(Oil level at MIN mark)

(Oil level between MIN and 1/2 way between MIN and bottom of glass tube)

(Oil level < 1/2 way between MIN and bottom of glass tube)



Metal shavings – metal debris generated from damage on gearbox components

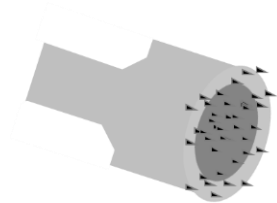
Damage Class -1
Can't See



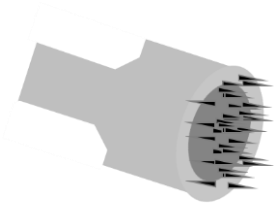
Damage Class 0
Like New



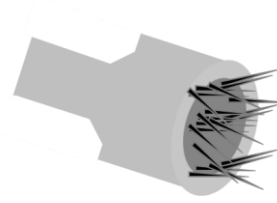
Damage Class 1
Minor Defect



Damage Class 2
Medium Defect



Damage Class 3
Major Defect

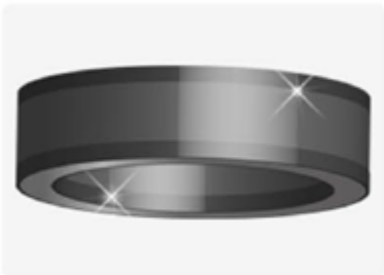


Brinelling – Elliptical wear marks in axial direction caused by oscillation, vibration under loads

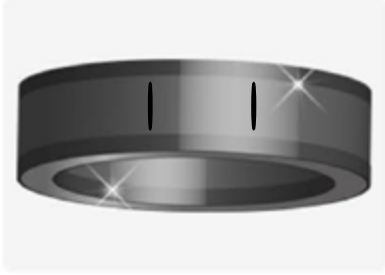
Damage Class -1
Can't See



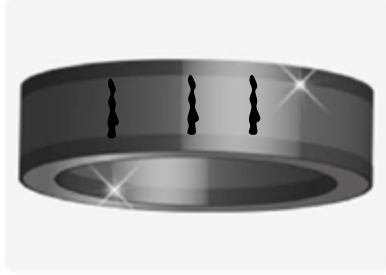
Damage Class 0
Like New



Damage Class 1
Minor Defect



Damage Class 2
Medium Defect



Damage Class 3
Major Defect



Circumferential Marks: Lines or scratches in the rolling direction of the bearing. This is considered a secondary damage mode and is caused by foreign particle contamination.

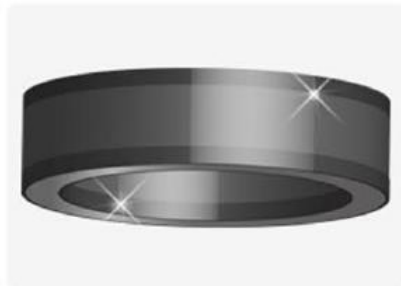
Damage Class -1

Can't See



Damage Class 0

Like New



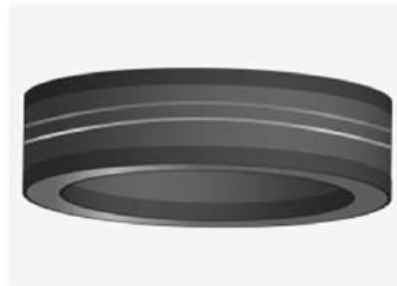
Damage Class 1

Minor Defect



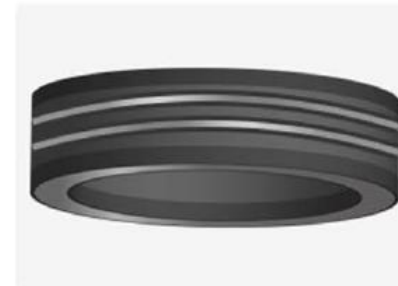
Damage Class 2

Medium Defect



Damage Class 3

Major Defect



Corrosion: Rusty / discoloration of the bearings due to oxidation of the metal at the areas of raceway and/or rollers. This is typically as a result of poor lubrication and/or limited surface to surface contact between rollers and raceways.

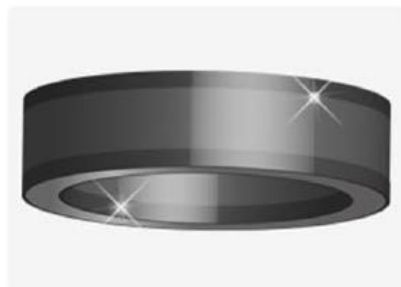
Damage Class -1

Can't See



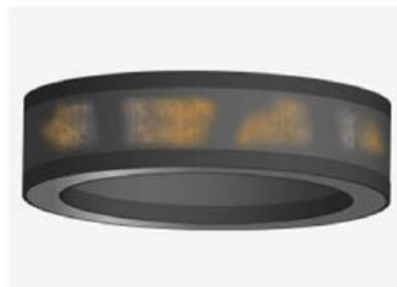
Damage Class 0

Like New



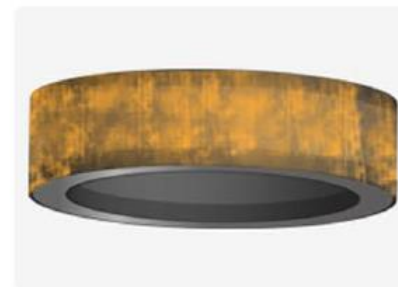
Damage Class 1

Minor Defect



Damage Class 2

Medium Defect



Cracks: Cracks can be accompanied by spalling and other damage. Generally found on the bearing raceways.

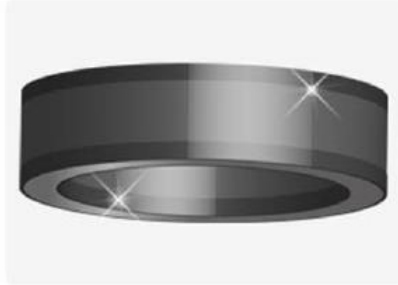
Damage Class -1

Can't See



Damage Class 0

Like New



Damage Class 2

Minor Defect

(Single or multiple clean cracking in inner race only – NOT through)



Damage Class 3

Medium Defect

(Through Cracks, may include minor spalling)



Damage Class 4

Major Defect

(Cracks with medium to major spalling)



Dents: Indentations caused by trapped particles between the bearing rolling surfaces. Will appear as concave to circular spots on the bearing roller or race surfaces. Often with a dark ring around the spot.

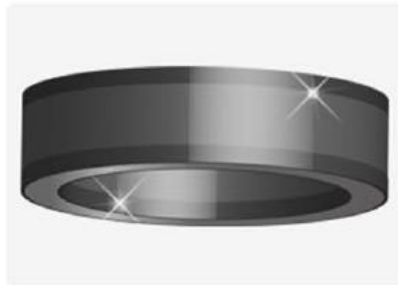
Damage Class -1

Can't See



Damage Class 0

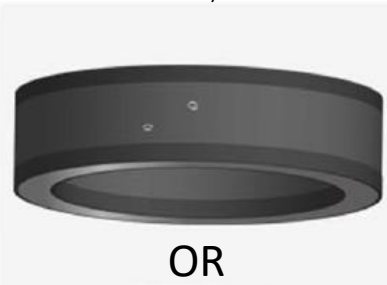
Like New



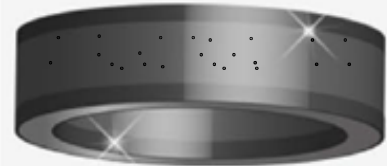
Damage Class 1

Minor Defect

(Up to 3 dents, size < 5 mm in visible area)



OR



((minor indentations, size < 2 mm in visible area)

Damage Class 2

Medium Defect

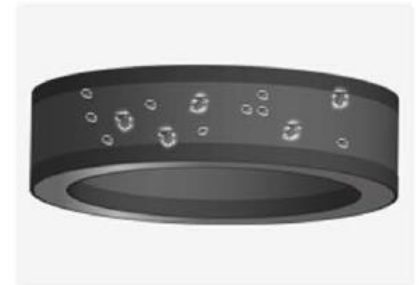
(Single dent > 5 mm, and/or between 3 and 10 dents <5mm)



Damage Class 3

Major Defect

(Multiple dents > 5 mm, and/or >10 dents <5mm)

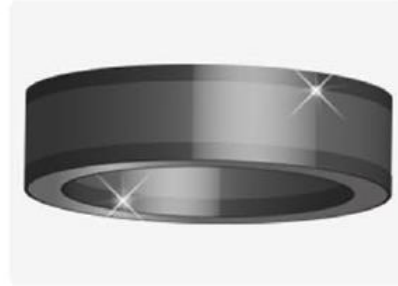


Micropitting: Bearing rollers and/or races appear to have a frosted, matte, or grey-stained surface.

Damage Class -1
Can't See



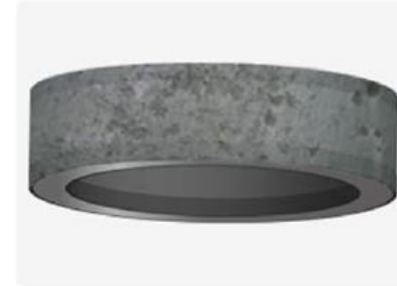
Damage Class 0
Like New



Damage Class 1
Minor Defect
(Single or multiple spot micropitting or frosting observed within area of race)



Damage Class 2
Medium Defect
(Extensive micropitting or frosting observed across race width)

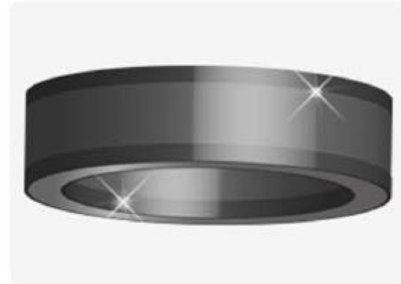


Scuffing (wear): Also known as scoring and smearing, scuffing is a result of small seizures caused by sliding under improper lubrication and severe operating conditions. The scuffed area will appear to have a rough or matte texture, however, under magnification, the scuffed surface appears rough, torn, and plastically deformed.

Damage Class -1
Can't See



Damage Class 0
Like New



Damage Class 1
Minor Defect



Damage Class 2
Medium Defect



Damage Class 3
Major Defect



Spalling: The flaking or fracture of metal contact surfaces. Other primary damage modes can turn to spalling as they progress in damage.

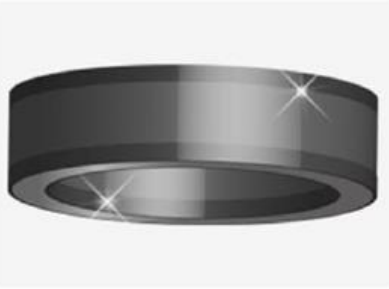
Damage Class -1

Can't See



Damage Class 0

Like New



Damage Class 1

Minor Defect

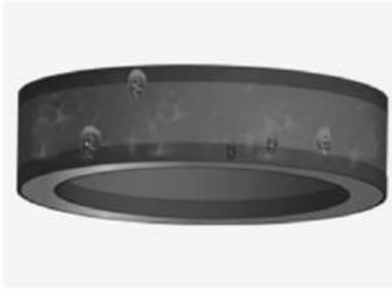
(one point of spalling, <5mm in diameter, up to several spots visible)



Damage Class 2

Medium Defect

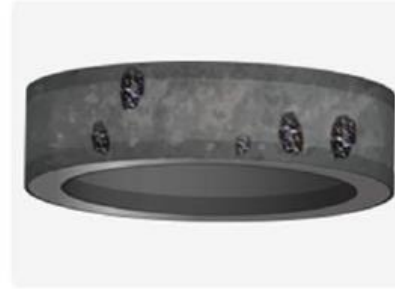
(Discreet points of spalling, >5mm in diameter, or numerous spalling <5mm across visible surface)



Damage Class 3

Major Defect

(Non-continuous spalling >5mm in diameter across visible surface, some clean race area still observable) within spalling area



Damage Class 4

Critical Defect

(Continuous spalling >5mm in diameter across visible surface, NO clean race area still observable within spalling area)



Bearing Spinning: Caused by improper tolerancing of bearings within a bearing journal.

Damage Class 2

Medium Defect

(Scuffing / wear on outer surfaces of races is a sign that the bearing is spinning in the bore)



Abrasion (wear): Small scratches or gouges on the tooth surface in the direction of sliding. Abrasion is a secondary damage mode caused by foreign particle contamination.

Damage Class -1
Can't See

Damage Class 0
Like New

Damage Class 1
Minor Defect

Damage Class 2
Medium Defect

Damage Class 3
Major Defect



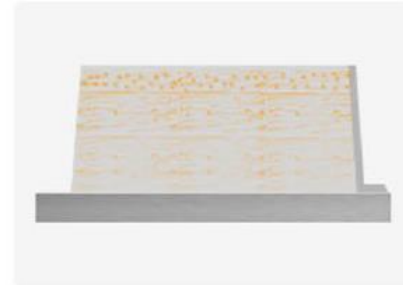
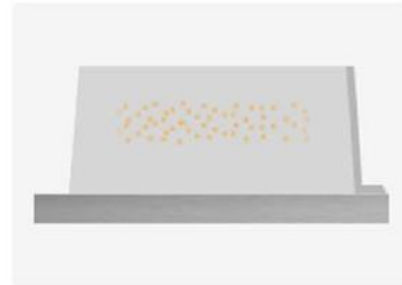
Corrosion: Rusty / discoloration of the gear tooth surface due to metal oxidation. This is typically as a result of poor lubrication and/or limited surface to surface contact.

Damage Class -1
Can't See

Damage Class 0
Like New

Damage Class 1
Minor Defect

Damage Class 2
Medium Defect



Micropitting: Gear teeth appear to have a frosted, matte, or grey-stained surface.

Damage Class -1
Can't See

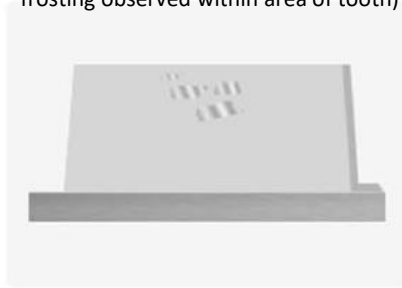


Damage Class 0
Like New



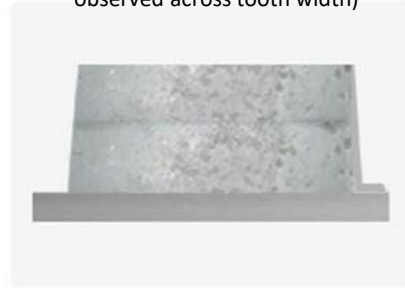
Damage Class 1
Minor Defect

(Single or multiple spot micropitting or frosting observed within area of tooth)



Damage Class 2
Medium Defect

(Extensive micropitting or frosting observed across tooth width)



Standstill Marks [Fretting Corrosion]: Long, relatively thin marks along the length of the gear tooth caused by small amplitude motion between two contacted metal surfaces under load. Can appear rusty colored if corroded.

Damage Class -1
Can't See



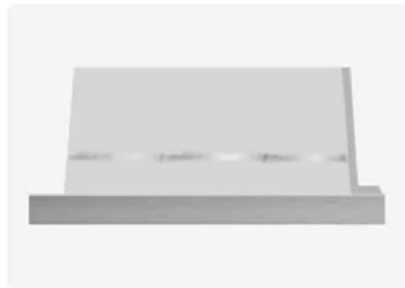
Damage Class 0
Like New



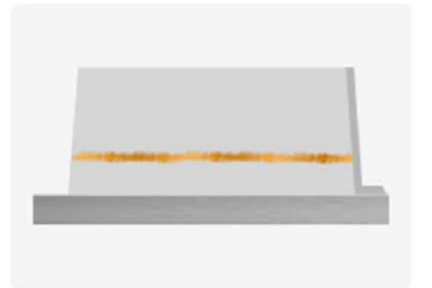
Damage Class 1
Minor Defect



Damage Class 2
Medium Defect



Damage Class 3
Major Defect



Scuffing (wear): Severe adhesion that causes transfer of metal from one tooth surface to another due to welding and tearing in which the scuffed areas appear to have a rough or matte texture.

Damage Class -1

Can't See



Damage Class 0

Like New



Damage Class 1

Minor Defect



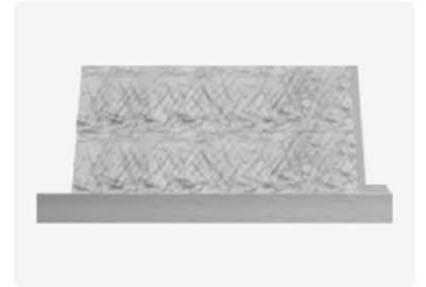
Damage Class 2

Medium Defect



Damage Class 3

Major Defect



Spalling: The flaking or fracture of metal contact surfaces. Other primary damage modes can turn to spalling as they progress in damage.

Damage Class -1

Can't See



Damage Class 0

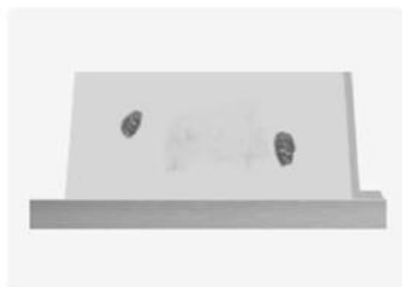
Like New



Damage Class 1

Minor Defect

(Discreet points of spalling, <5mm in diameter, up to several spots visible)



Damage Class 2

Medium Defect

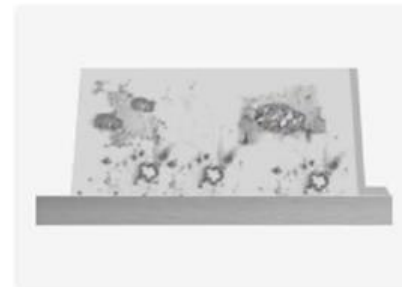
(Discreet points of spalling, >5mm in diameter, or numerous spalling <5mm across visible surface)



Damage Class 3

Major Defect

(Non-continuous spalling >5mm in diameter across visible surface, some clean race area still observable) within spalling area



Damage Class 4

Critical Defect

(Continuous spalling >5mm in diameter across visible surface, NO clean race area still observable within spalling area)



Cracks / Broken Teeth: Cracks in gear teeth are the result of material inclusion and/or bending fatigue.

Damage Class -1
Can't See

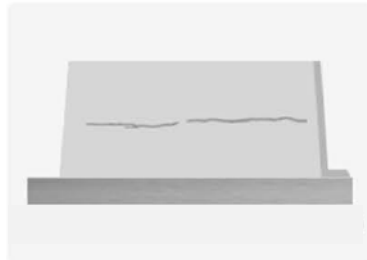


Damage Class 0
Like New



Damage Class 1
Minor Defect

(Crack observed in gear tooth)



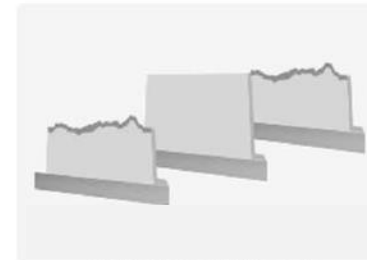
Damage Class 2
Medium Defect

(Single tooth partially broken)



Damage Class 3
Major Defect

(Single missing full tooth or multiple teeth are partially broken)



Damage Class 4
Critical Defect

(Missing full contact area on 2 or more teeth)



Dents: The result of surface indentation when a metal foreign particle is pressed between contact surfaces. Denting is a secondary damage mode.

Damage Class -1
Can't See

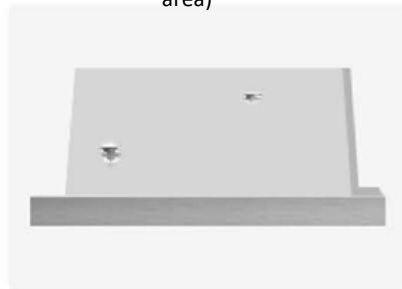


Damage Class 0
Like New



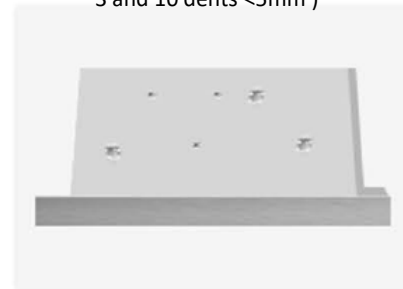
Damage Class 1
Minor Defect

(Up to 3 dents, size < 5 mm in visible area)



Damage Class 2
Medium Defect

(Single dent > 5 mm, and/or between 3 and 10 dents <5mm)



Damage Class 3
Major Defect

(Multiple dents > 5 mm, and/or >10 dents <5mm)

