

Table of Contents

REF: Service Procedures 11M	1
Accessing Transmission Gear Damage	1
Minor Forms of Tooth Distress	1
Frosting	1
Offset Frosting	1
Healing	2
Gear Pitting	2
Initial Gear Pitting	2
Combinations	2
Major Forms of Tooth Distress	3
Progressive Forms of Tooth Distress	3
Major Factors of Tooth Distress	3
Gear Tooth Breakage	3
Gear Tooth Fractures	3

[Go To Technical Menu](#)

REF: Service Procedures 11M

Accessing Transmission Gear Damage

Minor Forms of Tooth Distress

These are changes that may happen on a gear tooth's surface but doesn't necessarily point to a failure. Minor forms of distress are based on gearing operation under normal conditions, which may or may not occur on any gear in the life of a transmission. Subtle changes in the entire system over the life of a transmission (as it breaks in) can affect how the gears mesh together, which may change tooth form. This is why frosting may be found at relatively high mileage. No failure will occur and, after adjustment, the distress is likely to heal over.

Frosting

During tooth mesh, specific areas of the tooth surface are in contact during each stage. However, variations in the tooth form between mating teeth may produce a slight change in the contact pattern. This results in light wear as the mating gears try to adjust to a common pitch line. Since this wear is in a sliding zone starting near the root of the gear, it causes a form of micro-pitting. Magnification is required to see the tiny pits. To the naked eye, it looks like a band of off-white discoloration known as "frosting".

There is a lack of sheen at this stage. A gear should not be replaced simply because of frosting unless it also shows other signs of distress, such as tip loading, misalignment, severe surface irregularities, etc. If so, further investigation is needed.

Offset Frosting

There are acceptable tolerances in tooth lead. Mating gear teeth can successfully operate with lead variation in opposite directions. However, a small amount of load shifting may occur. Slight wear may take place until the load is again evenly distributed across the entire width of the tooth. This may also result in frosting in the dedendum portion and sometimes in the addendum portion of the tooth, "offset" from the tooth center.

Under normal conditions, healing will take place and gear life will not be lost. A gear should not be replaced simply because of offset frosting unless it also shows other signs of distress. If so, further

investigation is needed.

Healing

The pitch line is generally well defined. The balance of the frosting will take the shape of the contact area, no matter what it might be. Under normal conditions, the contact zone wears away; the rate of wear decreases until the point is reached where it polishes itself out and the frosting is totally replaced by a very shiny area.

No further wear takes place. This is called “healing” and absolutely no gear life is lost at this stage.

Gear Pitting

There is another surface condition which is normal in the early life of a gear and common in any carburized involute spur gear. It is the result of microscopic variations in tooth form and surface material microstructure. Lubricant normally fills the irregularities of both teeth while in mesh. Lubricant builds a film of oil and no metal-to-metal contact takes place. Under load, oil pressures and surface stress develop between the teeth. The specific cause of this stress is debatable. One theory is that repeated high horsepower applications may cause oil pressures sufficient to overstress the microscopic areas of the tooth surface. Small surface fractures may start, and repeated loading may increase the fracture until the area is weak enough to break out, forming a pit.

The pit size will vary, depending on the depth of the initial fracture and how far the pitting has progressed. The pitting will progress until the tooth can carry the load without further distress. This rarely exceeds “initial” pitting and the distressed areas can heal.

Initial Gear Pitting

Initial pitting is the mildest stage of pitting. It consists of definite pits from pin hole size, just larger than frosting and barely noticeable to .030” (.762mm) in diameter.

Generally, initial pitting continues until the tooth is able to carry the load without further distress. Do not replace a gear because of initial pitting, as it will not cause noise and in many cases will heal over.

Combinations

Under normal operation, a gear can have a combination of tooth distress, frosting and/or initial pitting. All are likely to heal over.

Major Forms of Tooth Distress

Major Factors of Tooth Distress

These are progressive forms of tooth distress. Not all transmissions operate under normal conditions throughout their lives. Adverse conditions may exist which can result in distress progressing beyond minor levels above. The severity of the conditions, including the length of time involved, will determine the rate of progression. Any breakdown of the lubrication, or reduced oil film, can increase the possibility or acceleration of tooth surface distress. More importantly, inadequate lubrication for a sustained period will likely cause the distress to advance to a more severe stage.

Gear Tooth Breakage

Gear Tooth Fractures

Common causes of inadequate lubrication are:

- Low lube level
- Inadequate lube viscosity
- Use of incorrect lube
- Use of oil beyond its functional life

[Go To Technical Menu](#)

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Last update: **2023/10/18 04:16**

