

Machine Marks on Gear Flanks: Their Cause and Prevention

QUESTION

What causes shaving cutter marks on gear flanks and can they be prevented?

Expert answer provided by Jim Caldwell, Star SU LLC

Ideally, the shaved gear tooth surface should be smooth with very light, uniform feed marks and have a soft, non-glossy appearance. It may not always be possible to attain the ideal condition due primarily to factors such as the gear tooth dimensions (module, face width, number of teeth), the method of shaving (conventional or plunge), having a suitable cutter design, or the machine condition and cycle parameters. The good news is that undesirable shaving marks can be prevented—or at least minimized. There are several common types of shaving marks, each stemming from different causes. Below we will define (describe) them and identify potential remedies.

Glossy stripes near one face.

With conventional shaving it is common to see a series of stripes on the side of the gear where the shaving cycle stops. These stripes will be glossy in appearance and their width will coincide precisely with the width of the serrations on the cutter. These stripes or pressure marks are the result of tool pressure remaining at the end of the cycle. Often these pressure stripes are merely cosmetic and no action is necessary. However, if too much tool pressure remains at the end of the cycle, you will be able to see and feel undesirable ridges accompanying these pressure stripes.

Preventive measures:

- Add an extra pass to the machine cycle.
- If the machine allows, try using a negative infeed on the last pass in order to reduce pressure.
- Shave with a slight diagonal angle (10° or 12°).
- Consider reducing the amount of shaving stock.
- Consider going to another method of shaving, such as underpass or plunge.

Consistent, heavy feed marks. The gear has somewhat consistent, heavy feed marks across the entire face

width—from top to bottom—marks that sometimes are even visible in a lead trace. If it is a new application, it could be a problem with the machine cycle. The cutting time may be insufficient to remove the stock, or the feed direction may be wrong. It could also mean that the tool being used is

not compatible with the part; check the manual or with the vendor.

If it's a plunge shaving application, it could be that the tool has become dull, which will cause the waviness you are seeing across the face of the part.

Tearing or gouging near the tooth tip.

A very rough tearing or gouging occurs across the entire face width, but only in the upper portion of the tooth (Fig. 1). The dedendum of the tooth will have a completely normal, shaved appearance. This condition tends to occur in conventionally shaved pump gears or in other applications having a low number of teeth, high pressure angle, or larger

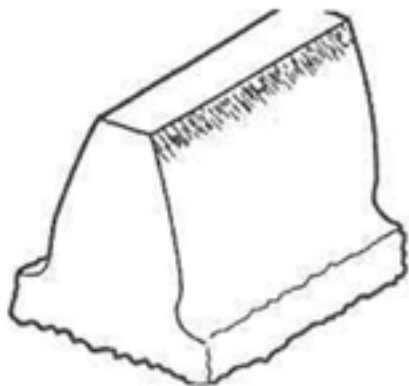


Figure 1 Example of tip gouging.

Email your question—along with your name, job title and company name (if you wish to remain anonymous, no problem) to: jmcguinn@geartechnology.com; or submit your question by visiting geartechnology.com.

For Related Articles Search

shaving

at www.geartechnology.com

modules. It occurs when the involute sliding velocity is too high relative to the helical sliding with the cutter. The following actions have proven effective to ameliorate this condition:

- Slow down the rotation speed of the cutter to a minimum.
- Make sure the coolant is not degraded; change as needed.
- Certain cutter profile modifications have proven helpful; check with your vendor.
- Consider having the cutter redesigned. It may be possible to change the helix angle and serration dimensions of the cutter design to rid yourself of this condition.

Random marks or irregular scratches.

If the marks do not occur in a consistent fashion across the face width or around the circumference of the gear, here are a few of the more likely causes:

- Damage to some of the cutter teeth.
- Gears being shaved without having been properly deburred, resulting in heavy burrs from hobbing or shaping breaking off during shaving and getting lodged in the mesh or between the cutter lands, causing heavy random marks on the part.
- Too many shaving chips circulating in the coolant, causing a scratchy finish; chip separator not working properly or dirty machines are the likely causes.
- Insufficient coolant flow or misdirected coolant nozzle, allowing chips to collect on the part, rather than being carried off by the coolant flow.

Jim Caldwell is the Gear Cutting Tool Product Manager for Star SU LLC.

