CHARLES R. STRAIT, PETRON CORPORATION, USA, CHALLENGES CLAIMS THAT THE USE OF CLEAR OPEN GEAR LUBRICANTS WILL RESULT IN MORE EFFICIENT GEAR COOLING WHEN COMPARED TO DARK OPEN GEAR LUBRICANTS.

Introduction

In recent years, there have been a number of statements that suggest the use of clear open gear lubricants will result in gearing running cooler than if dark types of open gear lubricants were used. Is there any merit to these claims? This article will show that the answer to this question is emphatically 'no'.

Accurate infrared measurements

Non-contact (infrared) thermometers are traditionally used to determine the temperature of rotating gearing. These can either be handheld or permanently affixed to the machine to record the 'emitted' energy that originates from the gears. To be accurate, the user needs to know how close the test object is to a perfect emitter of energy.

Understanding an object's emissivity or its characteristic radiance is a critical component in the proper handling of infrared measurements. Emissivity is the ratio of radiation emitted by a surface or blackbody, and its theoretical radiation predicted from Planck's law [W (L, T (=C1/(L^5*(exp (C2/LT)-1)]. A material's surface emissivity is measured by the amount of energy emitted when the surface is directly observed. There are many variables that affect a specific object's emissivity, such as wavelength of interest, field of view, the geometric shape of the blackbody and temperature.[1]

Most permanent probes and handheld meters come with a fixed emissivity setting of 0.95. This means that they are only accurate if the object you are trying to record a temperature from has a surface or a coating that allows 95% emitted temperature to be transmitted to the meter or probe. Most gearing has a very low emissivity since they are typically machined gears manufactured out of very hard materials. This causes the gearing to be very reflective by nature and a very poor choice for getting accurate temperature reading from a non-adjusted probe or meter. When Petron Gear Shield NC, for example, is applied to a bare metal gear, the reflective nature of the gear is gradually reduced as the lubricant film builds up; this is observed as the lubricant films transitions from a transparent colour through light amber to a dark brown. A corresponding increase in emissivity occurs as the reflective nature is reduced. The true temperature of a dark product, such as Gear Shield NC, is now able to be recorded with non-adjustable probes and meters as the emissivity approaches 0.90.

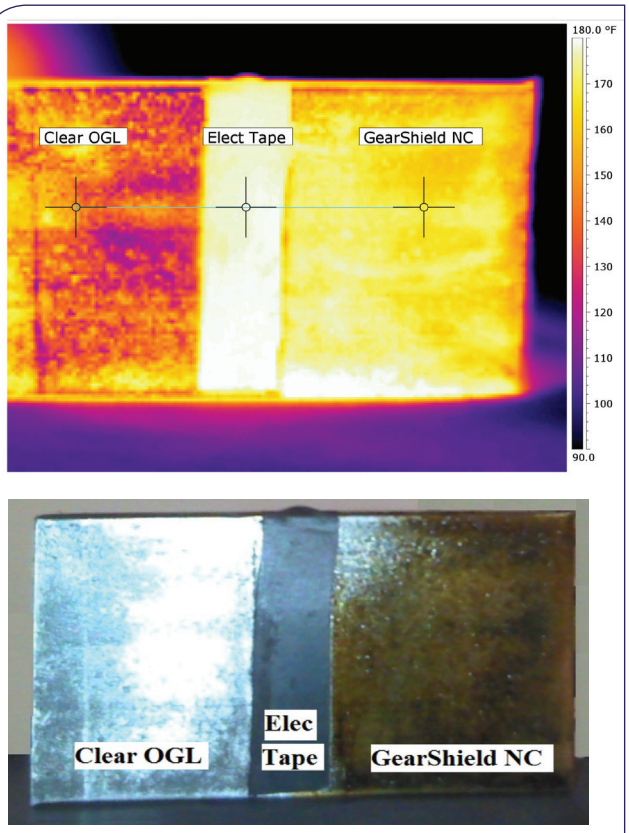

Figure 1. Test plate 0.60 emissivity (top: thermogram; bottom: photo). Clear OGL temperature: 150˚F; Electrical tape temperature: 179.1˚F; Gear Shield NC temperature: 173.6˚F.

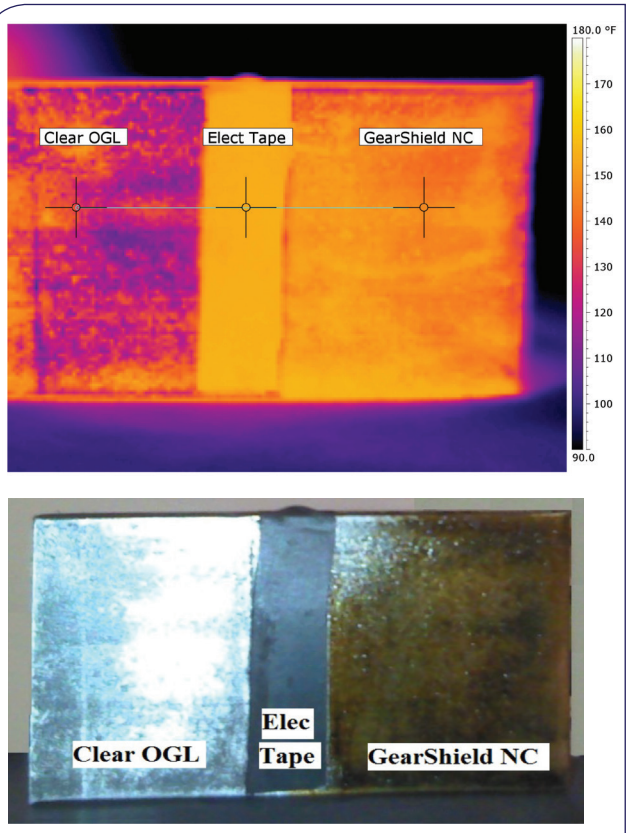

Figure 2. Test plate 0.90 emissivity (top: thermogram; bottom: photo). Clear OGL temperature: 132.4˚F; Electrical tape temperature: 153.7˚F; Gear Shield NC temperature: 150˚F.

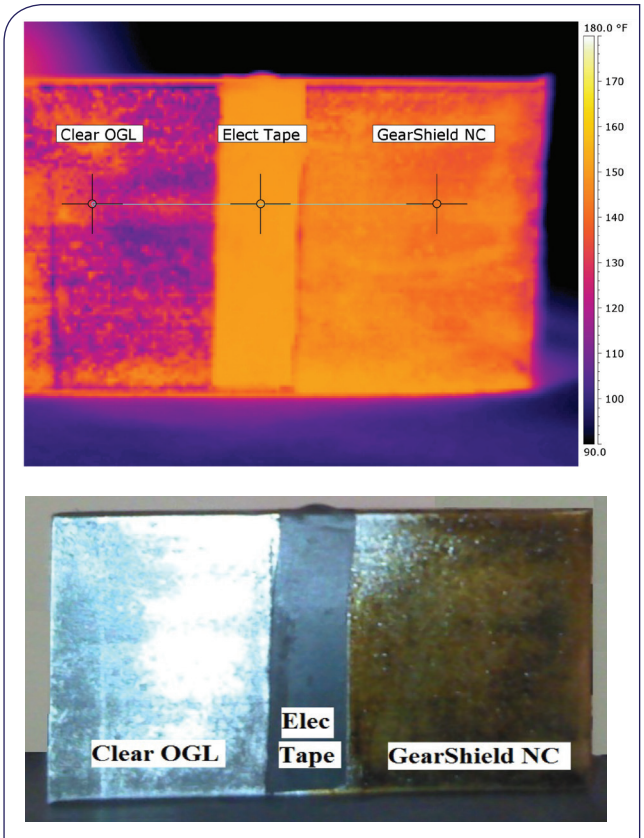

Figure 3. Test plate 0.95 emissivity (top: thermogram; bottom: photo). Clear OGL temperature: 130˚F; Electrical tape temperature: 150˚F; Gear Shield NC temperature: 146˚F.

Case studies

Some open gear lubricant suppliers claim their 'clear' or 'reflective' products cause the gears to run cooler. This is not the case. In reality it means that the clear lubricants do not modify or change the emissivity of the highly reflective bare metal gears. This will cause the meters and probes to register a lower temperature than the true temperature because the probe software believes it is receiving 95% of the energy being emitted when it is actually receiving only approximately 60% of the emitted energy.

The case studies shown in Figures 1, 2 and 3 demonstrate this phenomenon. A base metal plate was heated to a consistent 150˚F. The left side of the plate has a representative sample of a clear or reflective product and the right side has a coating of Petron Gear Shield NC. In the centre is a strip of black electrical tape that has a known emissivity of exactly 0.95. This method can be used to determine the actual emissivity setting for any coating or surface. A clear product has an emissivity of approximately 0.60 or 60%. This means that if the handheld meter or probe used to record temperatures is set at anything higher than 0.60 then the recorded temperature will be proportionally lower than the true temperature.

If a lubricant supplier claims its product reduces gear temperatures, make sure to ask what emissivity setting is recommended for a true temperature for the product. This will help to determine if it is an actual temperature reduction or if it is just the improper setting of the recording device.

Reference

1. www.scigiene.com/pdfs/428_InfraredThermometerEmissivitytablesrev.