

## Gearboxes Stay Cool !

GEARBOXES DELIVER IMPROVED RELIABILITY & LONGER OPERATING LIFE UNDER COOLER RUNNING CONDITIONS...says Bain Nicholson, Operations Manager, Deritend RMB Large Rotating Machines.

There are substantial benefits to be gained, in terms of improved reliability and longer operating life, for users who monitor and actively control the operating temperatures of their gearboxes. The first step on the road to achieving these benefits is to select the right gearbox for the job. This usually means selecting helical, bevel helical or planetary units, which are over 90% efficient, rather than worm boxes, which struggle around the 50% mark.

Cooler running temperatures can help extend the life of bearings and oil seals; experience shows that a reduction in temperature of around 14 degrees C can double the life of nitrile seals used in gearboxes, whereas an increase of 14 degrees C can halve it. For example, a gearbox may operate for 12,000 hrs at 52 degrees C, but another (in same application) may only operate for 6000 hours at 65 degrees C before seal failure occurs.

This effect is not limited to nitrile seals; Viton seals, lubricant and internal gearbox components also suffer adversely from operating at excessive temperatures for long periods. If this is allowed to continue, then several problems may arise including: burnt lubricant, scoring on bearing raceways, and damaged seals and gears, all of which can lead to premature failure of the gearbox.

Having established that too much heat is bad for gearboxes, the question is: how can

gearbox users gauge the correct operating temperature? Well a general rule of thumb used to be that if a person could hold their hand on a gearbox housing for a few seconds without discomfort, then the gearbox temperature was not too high. What makes this test redundant are today's Health and Safety regulations, and the fact that all humans have a different tolerance to heat: the limit of human touch is generally in the range from 54 degrees C to 60 degrees C.

Today, planned maintenance programmes mean that instruments, rather than hands, are used for measuring temperature - contact thermometers, thermocouples or, in applications where direct temperature measurement is not possible, non-contact infrared thermometers. These units absorb ambient infrared (IR) radiation given off by a heated surface. In addition, increasing numbers of companies are now using thermal imaging to detect when a gearbox is running hotter than normal. The benefits of this technology are that it can also detect leaks, by revealing hot oil running down gearbox casings.

The heat generated in gearboxes is the result of friction: as load increases, temperature increases, and as load decreases, temperature decreases. In addition, friction caused by faulty bearings, misalignment, imbalance, misuse, or just normal wear can also lead to excessive heat generation, along with the usual prime suspect of inadequate lubrication. Finally, there is the case where gearboxes are exposed to direct sunlight, the radiated heat raising the normal operating temperature to unacceptable levels.

In the case of bearings, heat problems occur when a large temperature difference builds up between the shaft inside a bearing and the housing surrounding the bearing (due to misalignment, for example). The differential thermal expansion causes the bearing to lose internal clearance and become pre-loaded. This results in increased heat generation which will increase the differential temperature, leading eventually to thermal runaway and melt-down

Although bearings can have major issues with temperature, by far the most the most

temperature critical component in a gearbox is the lubricant. This performs a dual function: it reduces friction by separating the moving components and transports and distributes the heat from the friction points: gears, bearings and seals, to the gearbox housing, enabling it to dissipate the generated heat.

The viscosity of the lubricant decreases drastically with increasing temperature, impairing its ability to maintain an Elasto Hydro Dynamic (EHD film) between the moving components in contact, so the choice of viscosity is critical. However, there is generally not a problem within one ISO grade, but it is better to err on the high side of two viscosity grades where there is any uncertainty.

The maximum housing limit on most industrial gearboxes is in the range 82 degrees C to 93 degrees C, with limits for standard rubber oil seals at 100 degrees C; fluorinated rubber oil seals at 150 degrees C; mineral oils, 100 degrees C, and synthetic oils, 150 degrees C, plus. Bearings and steel gears have temperature limits that typically exceed 120 degrees to 150 degrees C, and usually do not limit the thermal capacity of most general-purpose industrial gearboxes.

If the housing temperature of a gearbox exceeds the manufacturer's limit, then there are a few options to consider. Where physical space allows, a larger reducer should be considered or auxiliary cooling should be employed. This may include shaft driven fans, electric fans or radiant cooling systems. In cases where the gearbox is subjected to strong sunlight and there is no facility for forced cooling, then the gearbox should be painted a reflective colour and partly shielded, so as not to interfere with natural convection.

Photo Captions:

Picture 1: This is a thermographic image of the gearbox taken from a Flir thermal imaging camera, it shows that the gearbox is running too hot and requires action to prevent it from failing prematurely.

Picture 2: The wear life of components in a gearbox driving a conveyor system such as this can be halved if the gearbox is running too hot without anyone noticing - here it looks normal to the naked eye.

#### About Deritend RMB

Deritend RMB specialises in 24-7 industrial gearbox repairs, refurbishment, replacement, machining and fabrication and offers one of the most comprehensive gearbox breakdown engineering, machining and fabrication services in the UK. Deritend RMB became part of the Deritend Industries group of companies in August 2007 and also supplies a wide range of premium brand replacement gearboxes, motors, drives and general power transmission products.

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