

Abstract

Title	Lubrication concepts for low temperatures
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Upcoming missions in planetary exploration covering research but also screening for resources towards human habitation. They require mechanisms operating at (very) low temperatures. On Mars down to -80°C and on moon even lower ($< -130^{\circ}\text{C}$). The mechanisms located on e.g. rovers are additionally under pressure for mass reduction and low energy budgets. The latter leads to the search to replace grease lubrication combined with heating. (Grease lubrication is well known for long life. However, heating is necessary as grease cannot operate at such low temperatures, and this is consuming energy which is not available.)

Several projects are under way to investigate the effect of temperature on efficiency of gears and bearings. In this paper, a survey is proposed to collect results from several projects done between involved partners. The paper will focus only on aspects related to the influence of temperature on the efficiency of gears and on torque of ball bearings. Data from dry lubricated and fluid/grease lubricated variants will be compared. These data will reflect the initial state of the components like Harmonic Drive[®] gears (HDs), planetary gears and ball bearings. Those have been tested within the ESA-projects HDGSA, Mechanisms that operate at low temperatures, SLPMC2 and DeRisk-A3Lub.

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