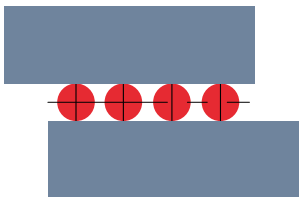
Rolling, sliding and coating

What is it about?

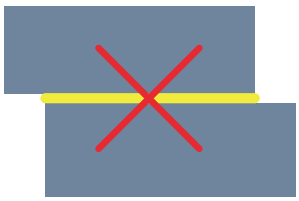
Whenever a movement has to be performed, two solids must move against each other. Such movements occur frequently in injection molding and punching tools: Pressure plates, upper and lower plates, ejector and nozzle side, turning cores and hot runner needles move – both rotatory and linear. All these applications require the highest level of precision – because this is what ultimately determines part quality. And the precision should not only be consistent when the mold is delivered, but throughout its entire lifespan as far as possible.

The theory

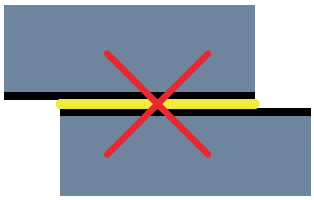
The field of tribology describes the friction between solids in a scientific way. The influence of forces, coefficients of friction, surface condition, wear condition and lubricant are investigated in detail. A particularly large influencing variable is the «tribological system»: Do two surfaces slide against each other? Do rolling elements roll between two surfaces? Are there hydrodynamic sliding effects?



Tribological system with rolling elements,..



...sliding surfaces with a lubricating film,...



...coated sliding surfaces with a lubricating film,...

...and solid friction, which is possible with and without coating.

Two systems are relevant for linear guidance: rolling systems and sliding systems. In the former, rolling elements roll between the two contact surfaces; in the latter, the two contact surfaces – supported by lubrication – slide against each other with direct contact. Sliding guides can still be optimized for the respective application by coatings, but the tribological system is not fundamentally changed by such coatings. Solid friction is a special case: the lubricating film between the two sliding surfaces is broken off. Cold welding then causes sudden increased wear, which contributes to the failure of the guide. Solid friction can occur with coated and uncoated sliding surfaces.

The rolling systems on the other hand, which work with balls or rollers, operate without friction and, depending on the system, also have the higher wear resistance. Due to a precisely defined preload of the rolling elements, the systems also offer no backlash, which reduces wear and further increases precision.

The reality

In reality, the theoretical suppositions can be confirmed: rolling guides are more durable than coated sliding surfaces, while coated systems are more durable than hardened surfaces.

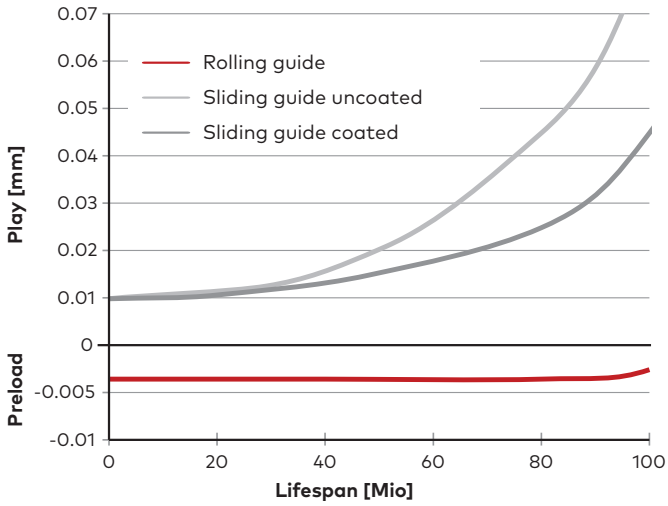
In practice, more precise end products can be produced with rolling guide units, and this over a longer period of time with less maintenance and servicing. In addition, the reality shows a clear wear limit: as soon as preload is no longer present, the rolling guides must be replaced. In the case of sliding guides with play, the decision as to when the play is considered «too big» amust be made by the specialist or the quality control department. In the case of quality control, bad parts have already been produced at this point.

A special aspect of the failure characteristics is also evident in the use of coatings. While uncoated sliding systems show an almost linear wear, coated surfaces show a sudden tendency to defects. Literally «overnight», failure can occur here, up to and including total breakdown. If undetected, this behavior can quickly lead to consequential damage. Rolling systems behave fundamentally different: wear and tear is very straightforward and predictable, and the replacement of affected components can be planned and performed in good time – a clear advantage for the user, who can thus successfully prevent consequential damage.

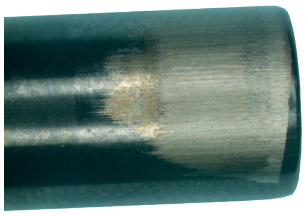
Rolling guides, on the other hand, retain their preload and thus their precision over the entire (longer) lifespan. The

quality of the parts is consistently high, bad part production and particle formation due to abrasion is prevented – rolling guides are therefore the first choice, particularly for high-end products, but also for mass production.

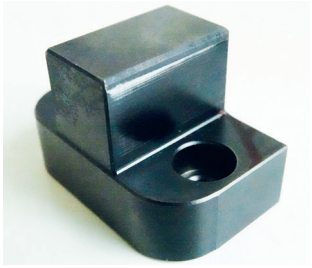
Please do not hesitate to contact us if you are interested, have questions or comments on the topic – we will be happy to help you!



Comparison of wear on different guide systems

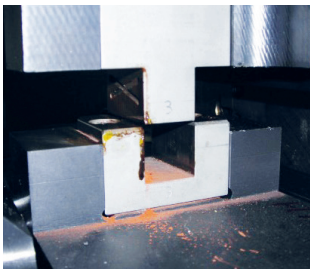


Sudden «overnight» wear on the DLC coating of an 8 mm diameter centering element after 2.1 million cycles…



…and on the DLC coating of a flat centering unit. The wear is caused by excessive surface pressure in the area of the inlet edge and the resulting solid surface friction

Wear image on an Agathon Mini Fine Centering unit after 3.6 million cycles



Defective sliding surfaces and abrasion of a flat centering unit after approx. 55'000 cycles due to solid surface friction at the boundary surfaces