

# Tribology for the watch industry

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The watch industry must solve different tribological problems.

## Inside the watch case

- ◇ for the mechanical watches, the precision is directly related to the stability of the friction coefficient on the pivots of the balance wheel, on the gearing train and on the escapement mechanism,
- ◇ for the electronic watches, the working life is related to the energy lost by friction.

Outside the watch case, the surfaces must survive combined abrasion, corrosion and fatigue, while remaining with an attractive aspect.

Different type of tribological investigations are presented, each one related to the problems to be solved. The tests used for these investigations can be classified in 3 categories.

## **1 Standard tribological measurements**

Pin on disk tests, compatible with the DIN 50324 Standard, with low sliding speed, low load, but with high contact pressure, using 3mm diameter balls, are used to quantified tribological performances of various tribological systems.

With these tests, dry sliding life of self lubricating coatings can be compared. Performances in reducing the wear of the oils and greases in boundary lubrication conditions can be improved, for the expected humidity conditions, using special additives.

## **2 Special tests giving quantified results**

A microtribometer with a geometry shaft- on- bearing ( $\phi$  0.11 mm), and a torque sensitivity better than  $10^{-10}$  Nm, enables to quantify the variations of the friction coefficient as a function of speed, relative humidity, in order to compare the stability of the friction coefficient when the environment changes.

A centrifuging machine allows to determine the maximum acceleration which can be supported by a lubricant droplet, as a function of the mass of the droplet, and according to the creep barrier film used.

An abrasion test performed according a specification (ISO 3160-3) allows to compare the abrasion resistance of coatings and materials.

## **3 Qualitative tests**

Very specialised tests are presented

- \* Impact test can be performed on the pin-on disk tribometer to evaluate the lost of the lubricant when impacting or when opening the contact. This test is used to improve the lubricants for the escapement mechanism.
- \* Long stroke reverse sliding is used to compare dry or wet abrasion resistance of metals, plastics or leather materials.
- \* Fatigue and wear of bracelets and straps are tested with different types of movements and loads.

With all these investigations and tests, the reliability of the Swiss watches is controlled and improved.