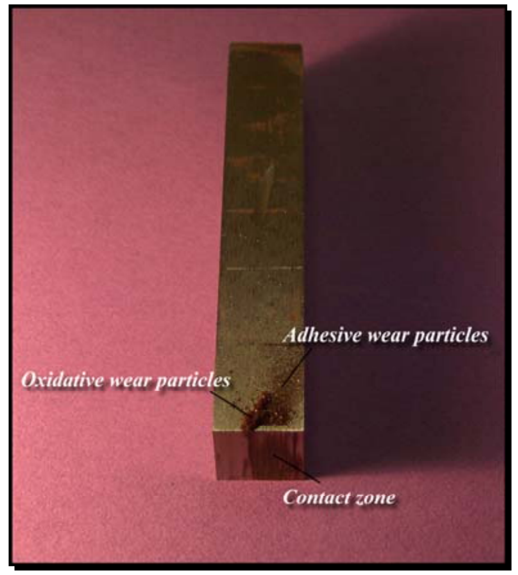
Adhesive wear (cold weld wear)

Adhesive wear is generally the most important type of wear at all non-lubricated moving parts, or moving parts which operate at partly lubricated conditions. Coldwelding describes the formation of small connections whereby tiny disruptions arise during translation. These disruptions leave small malformations at the surface, called adhesive wear. Materials with a limited capacity to dissolve in another material will generally show up a limited tendency to coldweld formation. The roughness of a material can of course add a (temporally) grinding component to the wearprocess.



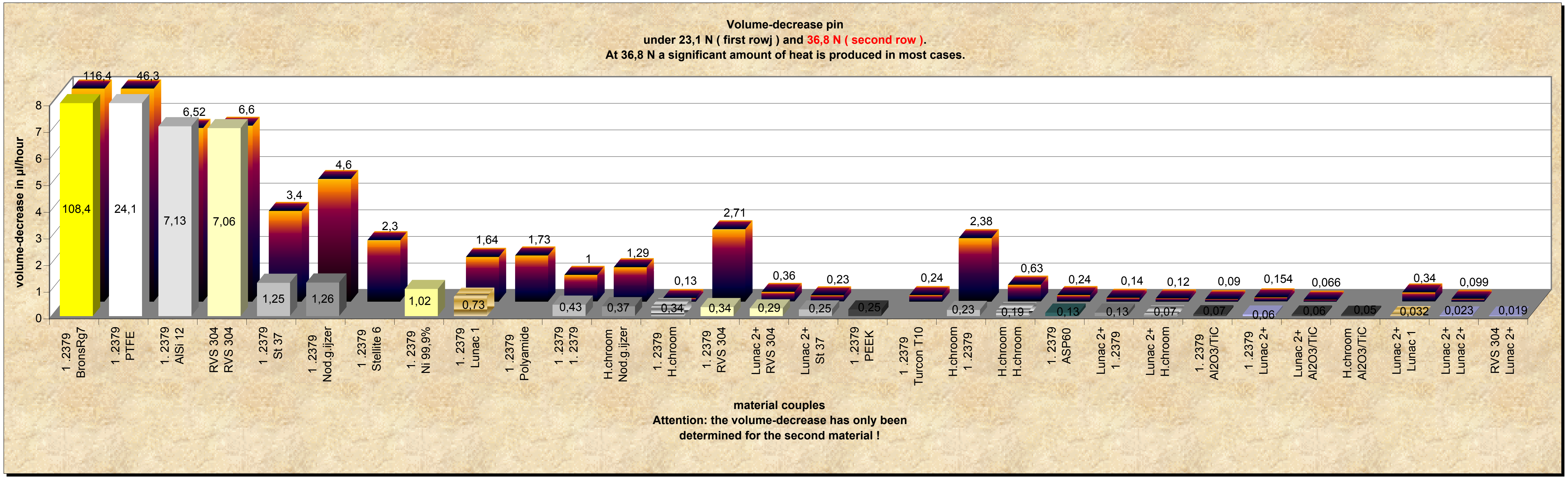
Conditions: non-lubricated / free of abrasive medium / no protection gas
Speed: 0,7 m/sec Load: 23,14 and 36,8 N
Temperature: 30 °C Average test time per pin: 5 hours (7 times repeated)

This stift represents the unique occasion of showing two types of wear together after a 7 hours testrun. The brown particles at the left side represent oxidative wear and the metallic particles at the right side, pure adhesive wear. The ring transported the wear particles from the contact zone to the upper part of the stift.

First record: Ring (the adhesive counterpart, no measurement. For example the 1.2379 steel record at the first bar)

Second record: Pin (measurement of volume-decrease. The bronze record at he the first bar **)**

Attention: at some "couples" the materials of pin and ring are also been put in reversed order.
By these means, insight has been created in the "sacrificing" behaviour of materials in an adhesive wear test.
At Lunac 1 and 2+, 1.2379 (normal tool steel) and ASP 60, the hardened versions were choosen.



Hardchromium, aluminium, stainless steel, nodular cast-iron and most of the hardened types of steel, will experience extra wear, under most (high loaded) circumstances by loosing their protective oxide layer and the, with that, coupled de novo oxide creation. The relatively chemical inert Lunac 2+ and the pure ceramic Al_2O_3/TiC do not possess this extra wear phenomenon. Ceramic and trans-ceramic materials like Lunac 2+ do stand a similar material as a counterpart exellently in contrast to most metals. Hardchromium suffers more wear in a "couple" with 1.2379 at 23,1 N, despite the limited hardness of the latter. This feature normally refers to the embedment of wear particles in the softer material. At higher loads this system changes dramatically. The chromium wear reduces and the 1.2379 wear increases a tenfold, producing a lot of ironoxides (tribo-oxidation) ! Hard plastics (like PEEK) show frequently a large difference in abrasive and adhesive wear. The applied different loads indicate a stable of less stable system under varying conditions. Consequently, a material should be assessed in this perspective of varying loads as well.

The most important ways to prevent adhesive wear without lubrication are:

1- Raising the hardness and so preventing 'microplastic' distortion of the surface
2- Applying covalent bonded materials (ceramics and transition metals)
3- Applying ceramic/ceramic, metal/plastic or metal/ceramic couples
4- Excluding kubic planar (Nickel or Austenitic steel) or homogeneous arranged metals

The most important ways to prevent tribo-oxidation without lubrication are:

1- Applying metals with a higher 'own' nobility or applying a protective medium
2- Applying plastics or (trans)ceramic couples at moving or vibrating parts