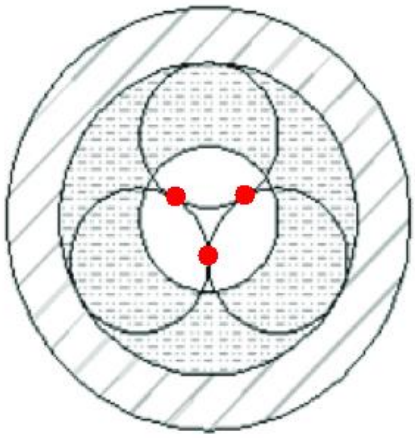
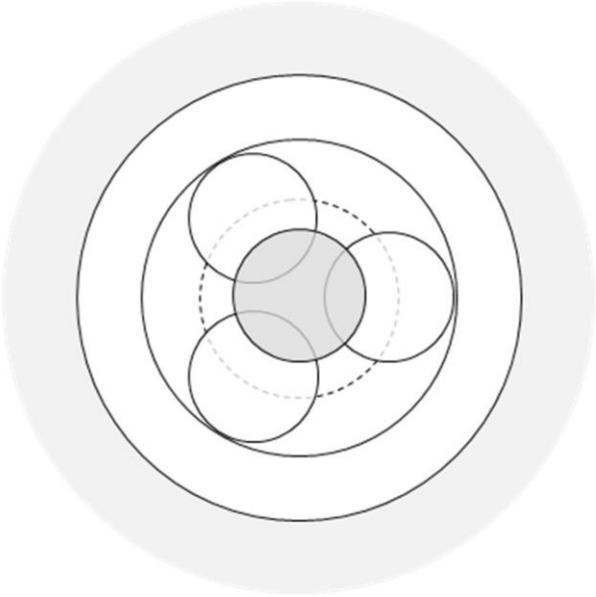
Guidance - Rolling Four Ball Geometry



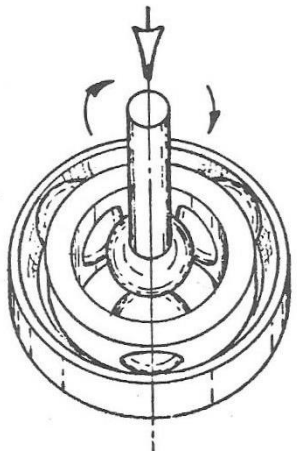
One of the potential issues with the rolling four-ball test geometry is the sliding friction between the three supporting balls. The geometry is complicated, but it should be fairly obvious that as the three supporting balls rotate while progressing around the lower race, a sliding contact is generated at each supporting ball contact, with the surfaces sliding at equal speed in opposite directions. With smaller diameter balls, this does not normally present a problem. However, as the ball diameters increase, the sliding speeds, hence frictional losses also increase.



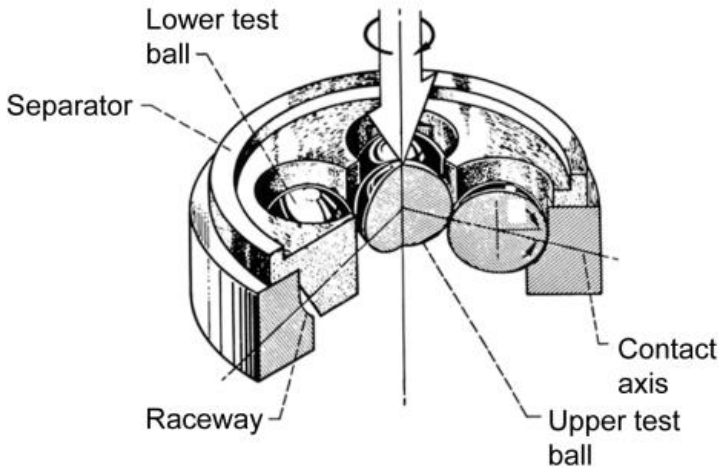
The solution adopted by numerous researchers (including Cameron-Plint Tribology in the 1980s) is to separate the three supporting balls with a cage. This thus replaces the sliding contacts between the balls with a sliding contact at approximately half the speed between ball and cage. This has two beneficial effects:

1. The contact angle between upper rotating ball and lower supporting balls becomes shallower, so that a higher contact pressure is achieved for a lower total axial force.

2. The space between the supporting balls is increased allowing much more effective cooling through lubricant circulation.



As well as rolling four-ball test geometries with cages or "separators", some researchers have also adopted a rolling five-ball test geometry in which the upper ball is supported on four lower balls.



Perhaps the key objection to this geometry is that the load at each point of contact between upper ball and supporting ball is statically indeterminate, whereas with three supporting balls, the load is fully determinate.