

TESTING SHEAR STABILITY

HTHS is important. In a high-speed lubricated situation, high temperatures and high shear are exactly what you get. What you do **not** get is skidding high-pressure point contacts between very hard surfaces, unless a cageless ball bearing (not common in post-1925 engines) has jammed for some reason. The 4-ball test is irrelevant and totally misleading. (The balls do not roll. 3 are held static, and the fourth is held in a chuck and spun against them, generating small flat scars on the static balls.) Hard-surface point contacts respond well to aggressive chemical anti-wear substances containing active sulphur, phosphorus or chlorine. A 'hypoid' gear oil with a sulphur/phosphorus EP antiwear compound which activates at relatively low temperatures gives a very good 4-ball result, so why don't we use gear oil additive systems in engines? Because, at the temperatures reached in critical areas around the engine (e.g. top piston ring, appr. 280C) the gear type antiwear compounds are corrosive. (A fact known and understood in the automotive and lubricant industries for 60 years.) Chlorinated antiwear additives (much touted by the 'magic additive' scam artists) are even worse. They were excluded even from hypoid gear oils in the 1950s. But they give a wonderful 4-ball result!

The 4-ball tester is known in the UK as the 'Shell-Seta' apparatus, because it was developed by Shell in the 1930s, and production versions were built by the instrument firm Stanhope-Seta. However, Shell eventually disowned the test because it had no relevance to automotive lubrication. (It is still used for industrial cutting oils.)

In the early 80s Shell Germany published a set of comparative wear test results using 6 different wear test machines, including the 'vierkugel apparat' (4-ball apparatus.) In addition to 7 gear oils of various types and viscosities, they included two liquids not normally used as lubricants except perhaps in non-engineering applications: milk and beer! In fact, I am reliably informed by a retired Shell employee that the original lab. report also included 'harn' which means urine, thus proving that the robust Germanic sense of humour was alive and well. I expect the 'bier' helped. (Honestly, I'm not taking....). Sadly, I only have the published report with 'milch' and 'bier'.

Here are some of their results. Although the 4-ball was hopeless, I have to admit it wasn't as bad as the 'Falex', which identified 'Bier' as superior to everything, even hypoid 90. (My experience with this device does not improve upon these results. If there are any of these utterly useless gadgets still around, the sooner they go in the garbage skip the better.)

<u>Test Sample</u>	<u>EP Additives</u>	<u>Falex</u>	<u>4-Ball</u>	<u>FZG</u>
<u>Gear test</u>	<u>Timken</u>	(1000 Newtons)	(1000 Newtons)	(Load
Stage No.)	(Newtons)			
ISO 220 (SAE 90) 6	None 45	2.3	1.8	
Straight mineral				

220 Gear Oil >12	250	Sulphur/phosphorus	9	2.6
ATF 11	91	Zinc/S/phosphorus	1.2	3
220 Rolling-mill 10 Gear oil*	272	Lead/Sulphur	18	5.5
Hypoid SAE 90 >12	136	Sulphur/phosphorus	7	3.6
Milk** 5	136	Fat (?)	15	2.6
<u>Beer**</u> 4	<u>113</u>	<u>(??)</u>	<u>>18</u>	<u>2.4</u>

- *Note 1: Very 1930s! Haven't been available for 20 years due to lead content. Known to be corrosive even at moderate temperatures.
- *Note 2: Type/brand not stated. Probably full cream and Pilsner.

The reason why the FZG gives results in line with reality is because it uses a pair of gears running in a small gearbox, so it is hardly surprising to find that it gives good results with oils that actually work well in real gearboxes. Equally, the best apparatus for testing an engine oil is an engine. (The complex series of engine tests that are involved in the API 'S' assessments, e.g. API SH, SJ etc., include wear measurements.)

From a competition point of view, the fact that a sample of Fuchs Silkolene Pro-R 0W/20 oil that had reached 155C in a Kawasaki GP engine during the Qatar GP was still in good shape with very low wear metal contents is far more relevant than any amount of figures from obsolete wear test kit. (...and even more relevant, the engine was OK!)

JR