Experiment Number 15

*What effect does stopping and starting have on wear, friction and contact potential?*

**Background**
This experiment is designed to compare steady state with stop-start running, with a view to identifying whether an equilibrium roughness condition is achieved, dependent on the test conditions.

**Method**
The specimens were hardened nitride pin on hardened and ground NSOH B01 tool steel.

**Test Conditions**
- **Initial Load:** 20 N
- **Test Load:** 100 N
- **Stroke:** 25 mm
- **Frequency:** 0 to 5 Hz
- **Number of cycles:** 84,400
- **Temperature:** 50°C
- **Fluid:** 10 ml PAO + FM

**Test Sequence 1:** Steady State Running
Ramp load to 100 N in 1 minute and run at 100 N and 5 Hz until number of cycles achieved

**Test Sequence 2:** Long Cycle Stop-Start
Ramp load to 100 N in 1 minute, run-in for 15 minutes at 100 N and 5 Hz, then ramp frequency to zero in 10 seconds, hold for 10 seconds, ramp speed to 5 Hz in 10 seconds, hold for 10 seconds. Repeat sequence until number of cycles achieved

**Test Sequence 3:** Short Cycle Stop-Start
Ramp load to 100 N in 1 minute, run-in for 15 minutes at 100 N and 5 Hz, then ramp frequency to zero in 10 seconds, hold for 1 second, ramp speed to 5 Hz in 10 seconds, hold for 1 second. Repeat sequence until number of cycles achieved
Results:

**Figure 1:** Steady State Running – Complete Test

**Figure 2:** Long Cycle Stop Start – Complete Test
Figure 3: Short Cycle Stop Start – Complete Test

Figure 4: Long Cycle Stop Start – Run-in and First Cycles
Figure 5: Long Cycle Stop Start – Initial Film Build-up

Figure 6: Short Cycle Stop Start – Run-in and First Cycles
**Figure 6:** Short Cycle Stop Start – Approaching Test End

**Figure 7:** High Speed Data - Steady State Running – Test End
Figure 8: High Speed Data – Long Cycle - Stop-Start – Test End

Figure 9: High Speed Data – Short Cycle - Stop-Start – Test End
Figure 11: Low Speed Friction, Contact Potential & Noise Signal – Steady State Running – Test End

Comments

1. Stop-start tests produce higher contact potential at test end than running the same number of cycles at constant speed. This would imply that the surface roughness generated with stop-start is lower than with steady state running.
2. The mean friction force is lower at test end with the stop-start tests, in particular with the long cycle procedure.
3. The friction noise is higher at test end with the stop-start tests, which is somewhat unexpected in light of the higher contact potential and lower mean friction force. This may be due to some localised disturbance in the specimen surface, generated during the stop-start process.
4. The long cycle stop-start procedure produces lower friction and higher contact potential than the short cycle stop-start test. This is a curious result: the total number of reciprocating strokes is the same for both tests, but, because the duration of each cycle is shorter for the short cycle test, the samples will have been subjected to more stop-start events. It may be that if the cycle time is too short, the contact never properly stabilises.