TRIBOLOGY UPDATE: *ISSUE 39 – December 2020*

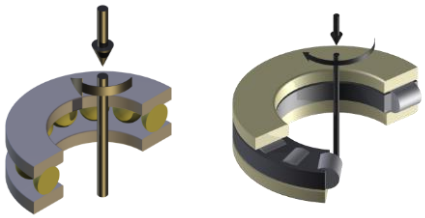
This is the latest issue of our **Tribology Update** newsletter.

WORK IN PROGRESS – DEVELOPMENT

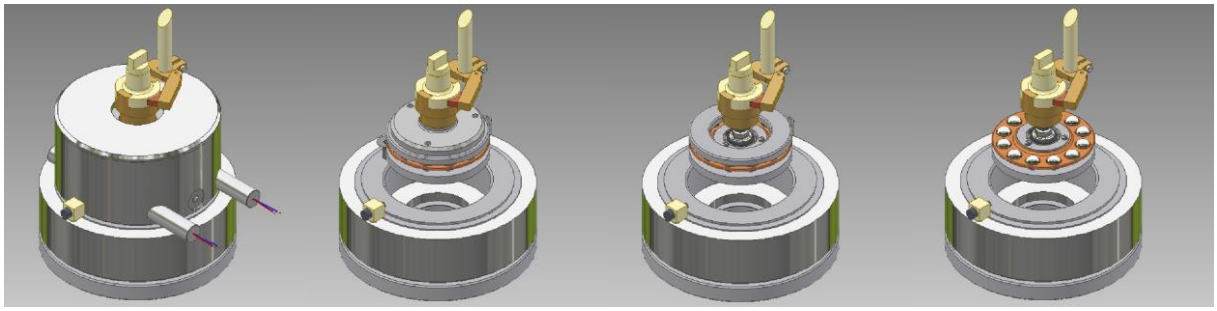
TE 86 Hip Joint Simulator - Design Update

The current design of TE 86 uses a single mechanical drive system for generating Flexion/extension (FE) and Abduction/adduction (AA) motions, but does not include Inward/outward Rotation (IOR). Although not mandatory, the latest ISO standard (ISP 14242-1-2014) specifies IOR motion, hence to be fully compliant, we have decided to implement IOR on the TE 86. This involves replacing the existing mechanical drive with independently controlled semi-rotary pneumatic actuators for FE and AA and a linear pneumatic actuator for generating IOR.

TE 92 & RCF 2 Rolling Contact Fatigue with Electrical Discharge



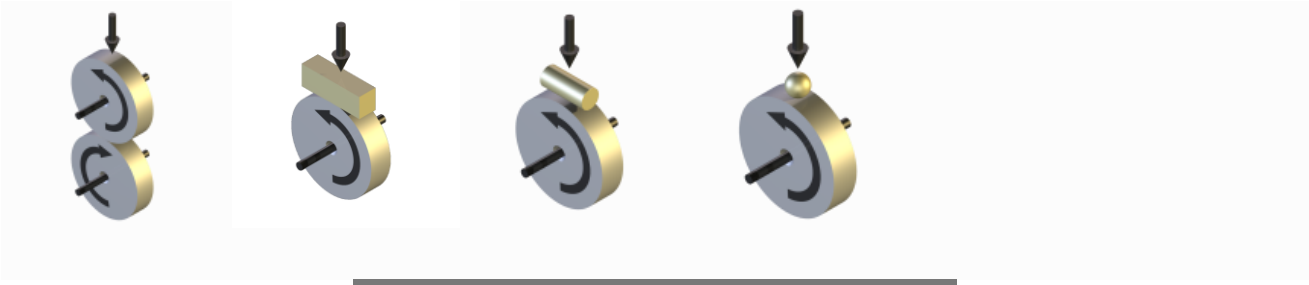
There is currently a lot of interest in Electrically Induced Bearing Damage (EIBD) and Electrical Discharge Machining (EDM). We are exploring how best to model the relevant mechanisms using our standard ball and roller thrust bearing on disc test geometries. These can either be used with all metal rolling elements or with all but one rolling element replaced with ceramic balls or rollers. This arrangement then ensure that the discharge always occurs through just one rolling element, rather than randomly through multiple rolling elements.

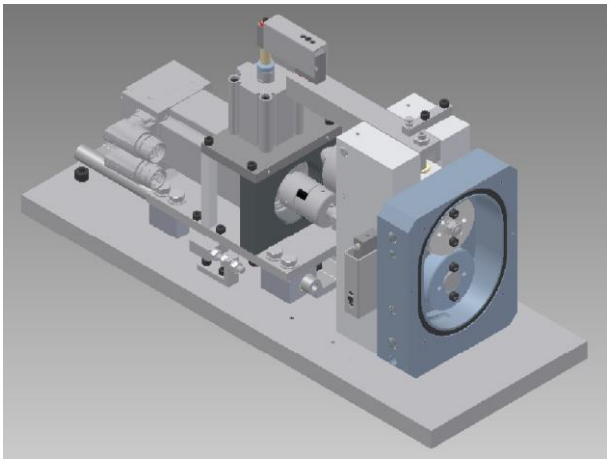


With regard to the voltage source, we have the option of either using a variable voltage source with PWM output or a continuous voltage source applied via brush gear and a split ring armature, so that the pulse always occurs at the same circumferential position. It will take some time to determine the optimum solution.

COMPLETED PROJECTS – DEVELOPMENT

TE 53 Multi-Purpose Friction & Wear Tester – Design Update



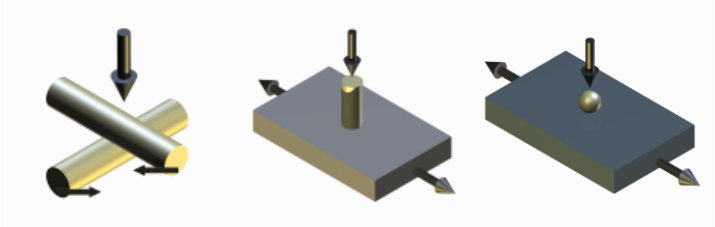


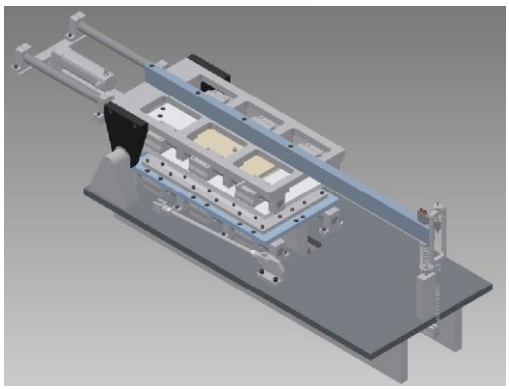
We have completed an update of the long-established TE 53 design, which:

- replaces the original dead-weight loading with pneumatic loading
- replaces the original gear-motor with a.c. servo motor
- implements PLC control

As well as improving functionality, the changes result in a reduction in price.

TE 69 Load Scanner - Design Update

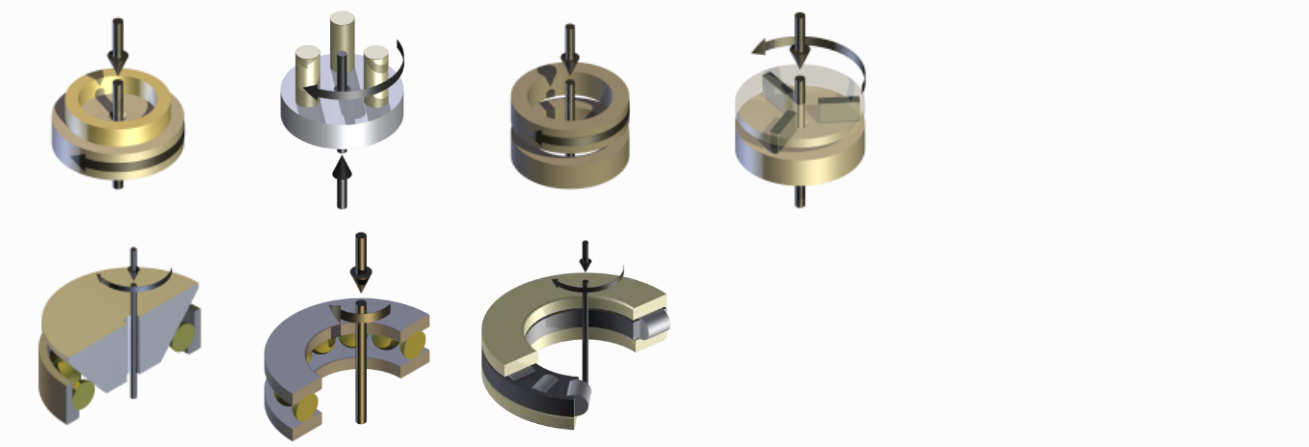




The original load scanner design used a single ball-screw actuator to move both carriages and to tension the loading spring, so that the load varied with stroke position. Subsequently, various users requested that we provide means to run the crossed-cylinder geometry, but at constant load. The logical solution to this, and other requirements, is to replace the single, large, actuator, with three smaller, independently controlled actuators. This allows the following test configurations to be implemented:

- Load Scanner Mode with Crossed Rod Specimens
- Constant Load Mode with Crossed Rod Specimens
- Pin on Plate Mode with Constant Load
- Pin on Plate Scratch Test Mode with Ramped Load

TE 92 Rotary Tribometer - Re-package – Test Adapters



The number of test configurations available on the TE 92 continues to increase, resulting in numerous free-standing test adapters, many with common features. By rationalising the designs, we can reduce the number of specimen baths to just two, thus avoiding unnecessary duplication and cost:

- Self-aligning heated reservoir for area contact tests, used with:
    - Three Pin on Disc Tooling
    - ASTM D3702 Thrust Washer Specimen Tooling
    - LVFA (small) Specimen Tooling
    - Vane Pump Specimen Tooling
    - Suzuki Test Specimen Tooling
    - Three Pad Thrust Bearing (Stribeck) Tooling
- Self-aligning heated reservoir for rolling contact fatigue tests, used with:
    - Cone on Angular Contact Bearing Tooling
    - Ball Thrust Bearing on Disc Tooling
    - Roller Thrust Bearing on Disc Tooling

The heated reservoir for area contact tests will now be included, at no additional cost, as part of the base machine package. Tooling for different area contact tests must be ordered separately. The heated reservoir and tooling for rolling contact fatigue tests must also be ordered separately.

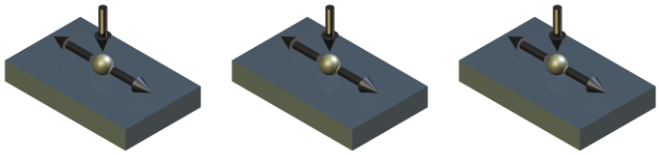
TE 92 Rotary Tribometer - Re-package – Drive Pulleys

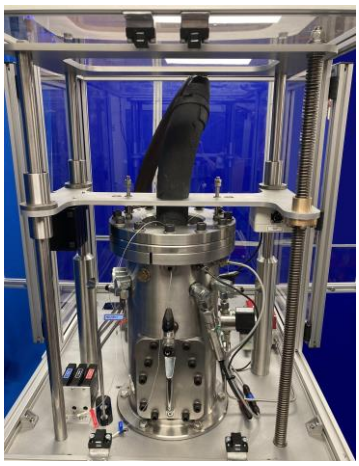
The electro-magnetic clutch, used on rotary tribometers since the 1980s, has become both obsolescent and, with modern vector controllers, redundant. The clutch was only necessary for four-ball extreme pressure tests, in particular where the balls weld. This function can be provided using a torque limiter. The standard belt drives now included will be:

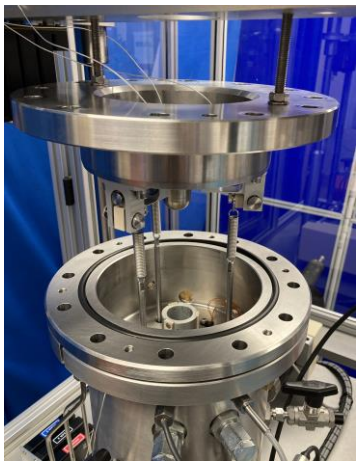
- TE 92: timing belt drive and torque limiter for speeds from 0 to 3,000 rpm and Poly-V belt drive for speeds 0 to 6,000 rpm
- TE 92HS: timing belt drive and torque limiter for speeds from 0 to 3,000 rpm and high-speed flat belt drive for speeds 0 to 10,000 rpm

WORK IN PROGRESS – PRODUCTION

TE 60 High Pressure Hydrogen Reciprocating Tribometer

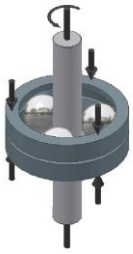






The TE 60 machine is nearing completion. Full details of this three-station reciprocating tribometer are available of the web site.

TE 92 Three Ball on Rod Rolling Contact Fatigue Adapter



This adapter is designed to run the standard three ball on rod rolling contact fatigue test geometry on a TE 92 or RCF 2 machine. Three balls, separated by a retainer, are loaded against a rotating rod specimen, by applying an axial force across two taper bearing cups, mounted above and below the three balls. The original design, dating from the 1970s, used pre-set compression springs to apply the axial load; in this application, the axial load is generated using the machine's standard pneumatic loading system.

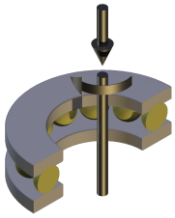
High Throughput Tribometers

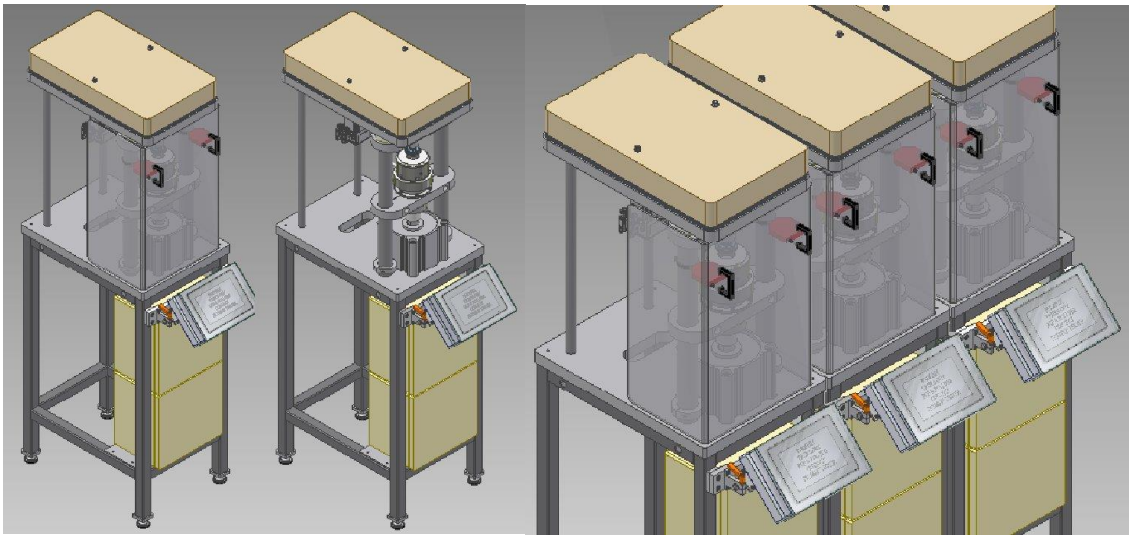
Design of the range of high throughput, single function, multi-station tribometers, introduced in Tribology Update 38, is now complete and details have been added to both the web site and our price list.

In response to market demand, two further machines have been designed, following the same basic formula:

- Single function
- Multi-station
- Easy to Operate
- Control via PLC
- Data exported on USB stick

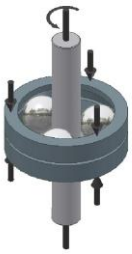
RCF 5 Multi-station Thrust Ball Bearing on Disc Machine

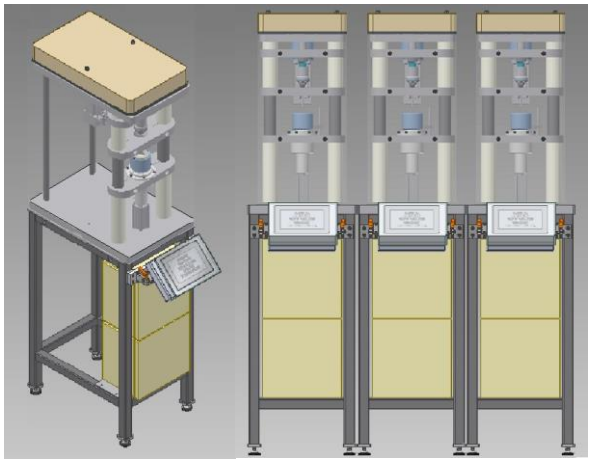




This single purpose, modular, machine incorporates the TE 92 Ball Thrust Bearing on Disc Tooling and Adapter. Production of a three-station unit is currently underway.

RCF 6 Multi-station Three Ball on Rod Machine

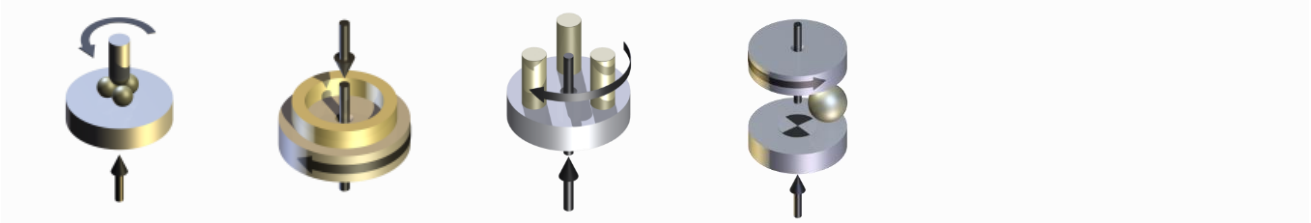


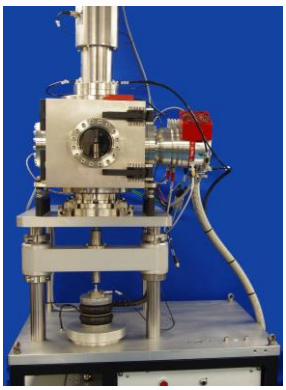


This single purpose, modular, machine incorporates the TE 92 Three Ball on Rod Rolling Contact Fatigue Adapter.

COMPLETED PROJECTS - PRODUCTION

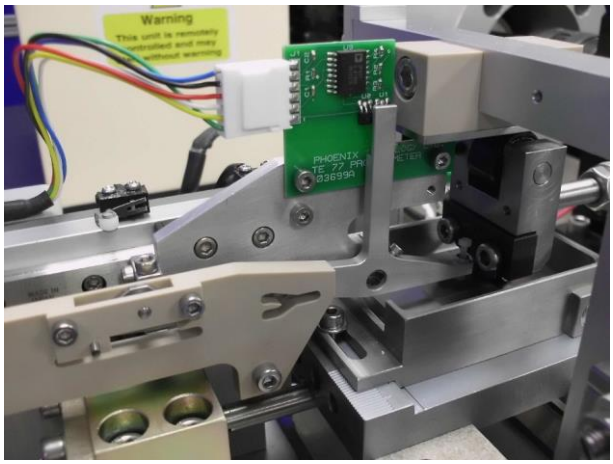
TE 91 Precision Rotary Vacuum Tribometer - Re-design





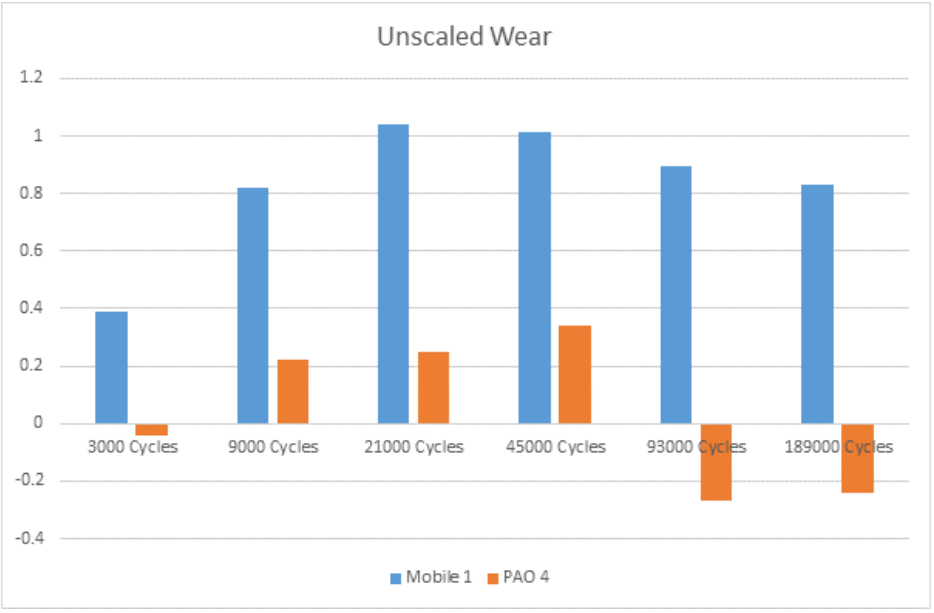
We have re-designed the chamber, to make it easier to install test adapters.

TE 77 In situ Profilometer



Proving that a measurement system actually works, reliably and repeatably, is one thing. Learning how to integrate the measurement into an experiment and interpret the results is another matter; it is perhaps no surprise that it has taken us some considerable time to reach this point.

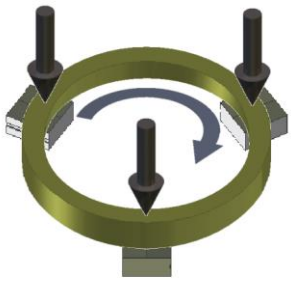
In modelling wear in real lubricated systems, we are potentially dealing with measurements of just a few microns; a cylinder liner typically loses about 10 microns depth of material during its service life.



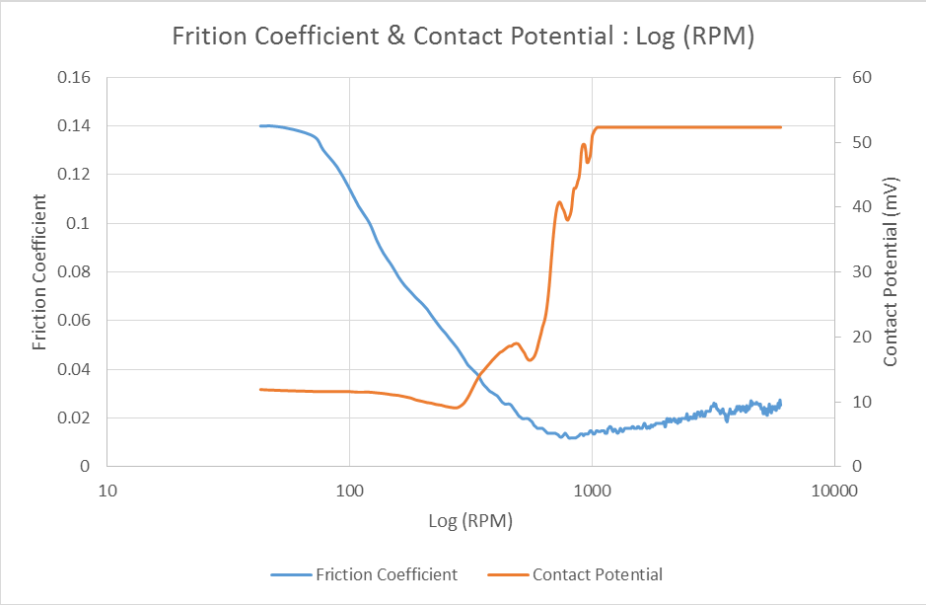
In some systems, where adhesive material transfer takes place, we may observe "negative" wear.

A video detailing how the system is fitted to the machine, operated and the data processed and presented, is available on-line.

TE 92 Three Pad Thrust Bearing (Stribeck) Test Adapter



The new three pad adapter, introduced in Tribology Update 38, using taper/flat-land pad specimens, allows a Stribeck Curve to be generated in under ten minutes, with less than 250 ml lubricant sample



The test involves a speed sweep, from zero to 6,000 rpm, with data recorded at 10 rpm speed increments. The lubricant in this example was an ISO VG 68 oil, at 40°C and the load was 100 N, giving a contact pressure of 1.33 MPa.

OTHER NEWS

On-line Tutorials and Training Videos

With the continuing pandemic hindering our ability to travel and to provide on-site training, we are aiming to provide as much content as possible on-line. Links to current training videos and lecture are provided on our web site.

George Plint and David Harris

Phoenix Tribology Ltd