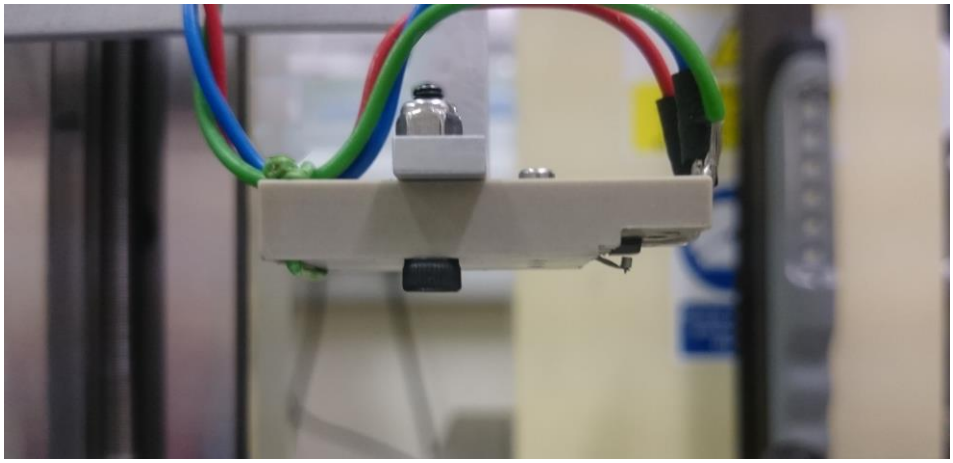
TRIBOLOGY UPDATE: *ISSUE 32 – SEPTEMBER 2016*

This is the latest issue of our **Tribology Update** newsletter. The last year has been exceptionally busy for us, so we have a lot to report. For further information, we can be contacted by e-mail at ***info@phoenix-tribology.com***.

WORK IN PROGRESS – PRODUCT DEVELOPMENT:

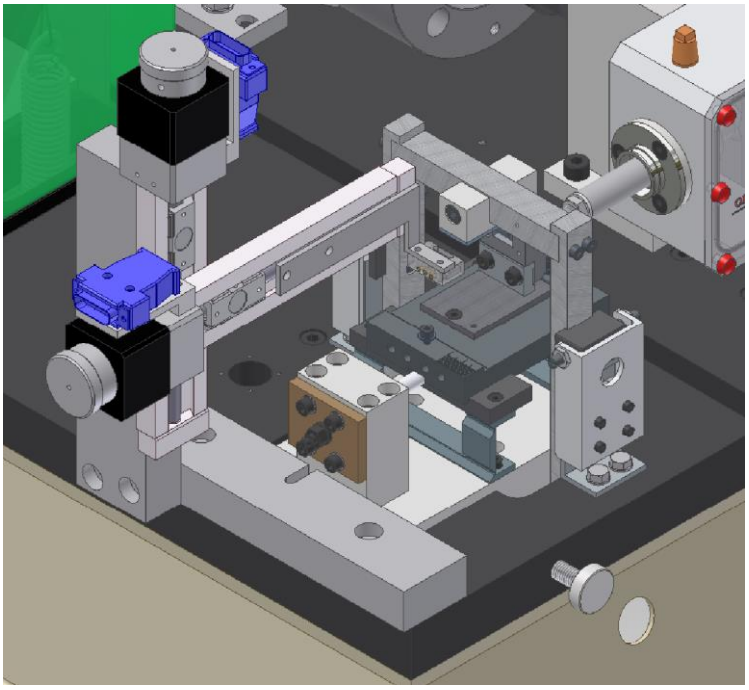
TE 77 Surface Profile Project

We announced details of our periodic, in situ, profilometry measurement project in Tribology Update 31. The actuation system has now been installed on a TE 77 machine and the prototype sensing head designed, manufactured and proved. Because the stylus, when making a measurement, is exposed to lubricant and debris in the fixed specimen bath, it has to be treated, potentially, as a consumable item; minimising the cost of manufacture was thus an essential objective.

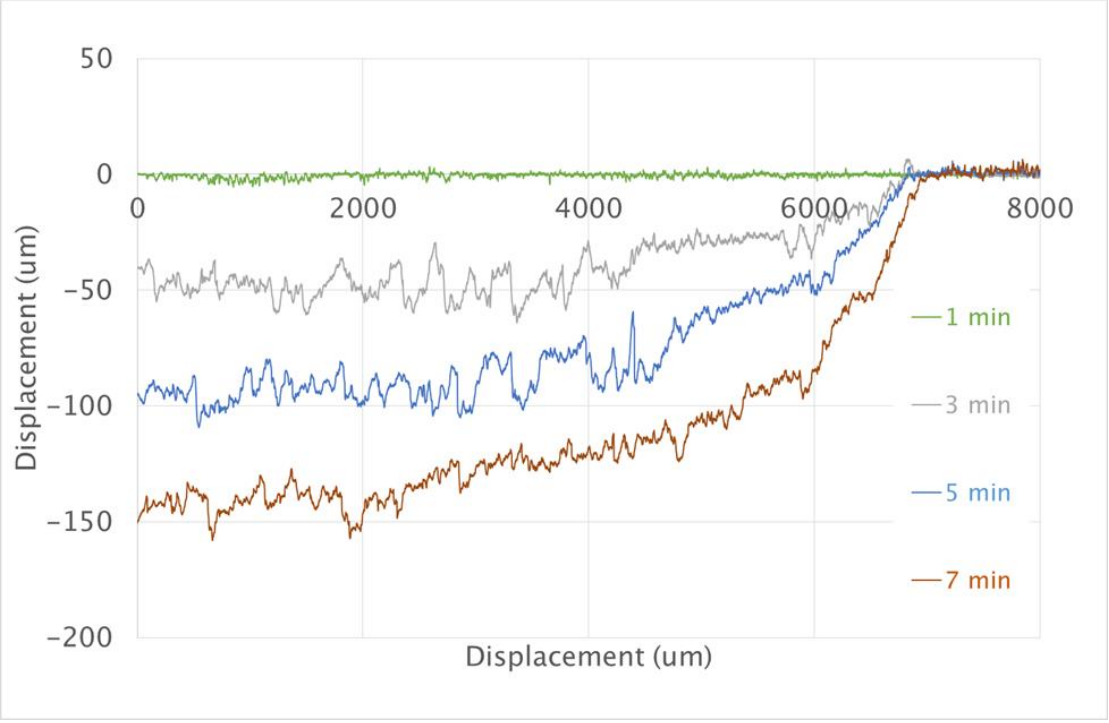


The sensor comprises a conventional record player stylus complete with unmodified suspension tube, with a tiny neodymium magnet bonded to the end of the arm, immediately above the tip. Vertical motion is then detected using a Hall effect sensor. The result is a probe providing more than adequate linearity and vertical resolution, using components that cost just a few pounds.

The sequence of operation is to run the machine for a set number of cycles, then pause the motion, with the reciprocating head at the stroke end furthest from the probe. With the machine operating at the maximum stroke of 25 mm, parking the reciprocating head in this position allows access for the probe to measure more than half the fixed specimen wear scar. Two axis linear slides are then used to position and index the probe, the complete measurement cycle being fully automated and programmed as part of a standard test sequence.



The next part of the development process is to modify the probe to incorporate a compressed air jet for probe and wear track cleaning, with the possible addition of a miniature microscope camera to the measuring head, to allow image capture of the surface, during the measurement cycle.



Initial results are encouraging!

TE 79/R Potentiostat

We can now fit the same potentiostat system as used on the TE 92 and TE 93 rotary tribometers to the reciprocating adapter on the TE 79 Multi Axis Tribometer, thus allowing electro-chemical experiments to be performed with reciprocating motion.

TE 92 ARKL Test

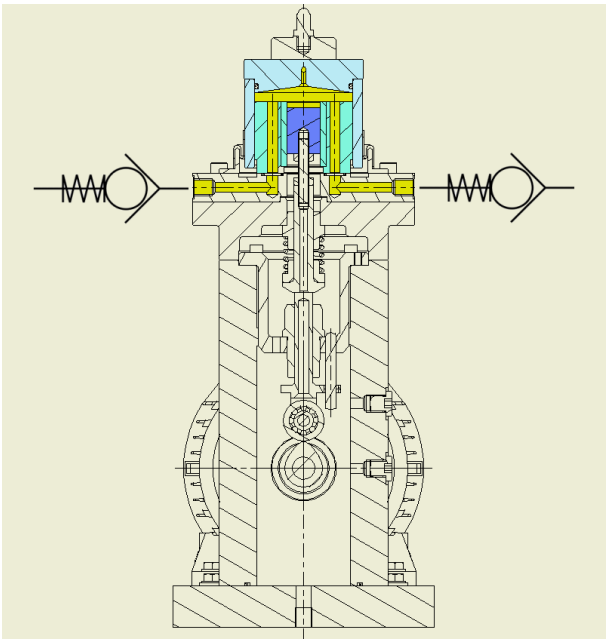
We recently noticed that the 51208 bearing used on our rolling thrust bearing test adapter, which was developed fifteen years ago for a well-known bearing manufacturer, is the same size as that specified for VW-PV-1454 (ARKL test).

Unlike the ARKL test, our adapter uses just one race from the 51208 bearing, with the lower race replaced by a flat disc and the balls retained by a special cage. The spin induced between balls and flat disc promotes fatigue failure.

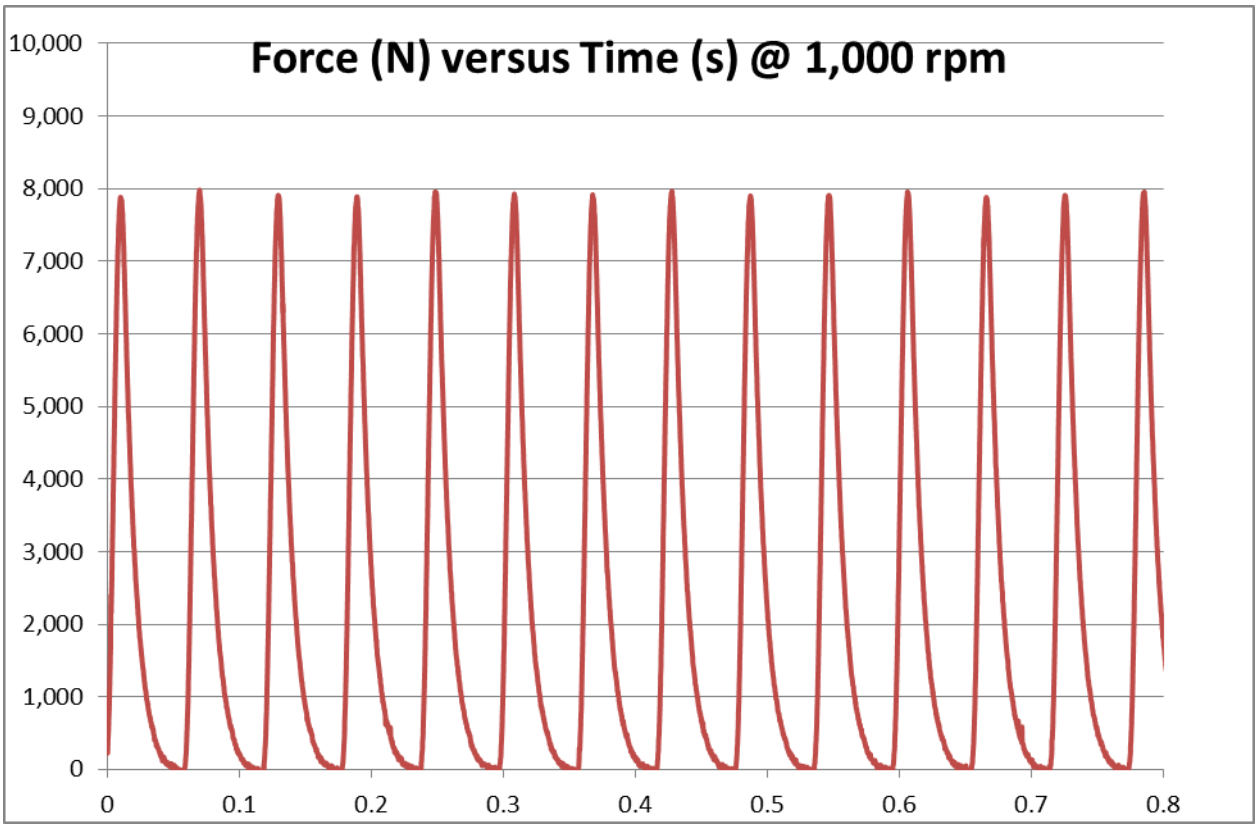
There appears to be no reason why, instead, we could not use the complete bearing and thus perform the ARKL test, if required.

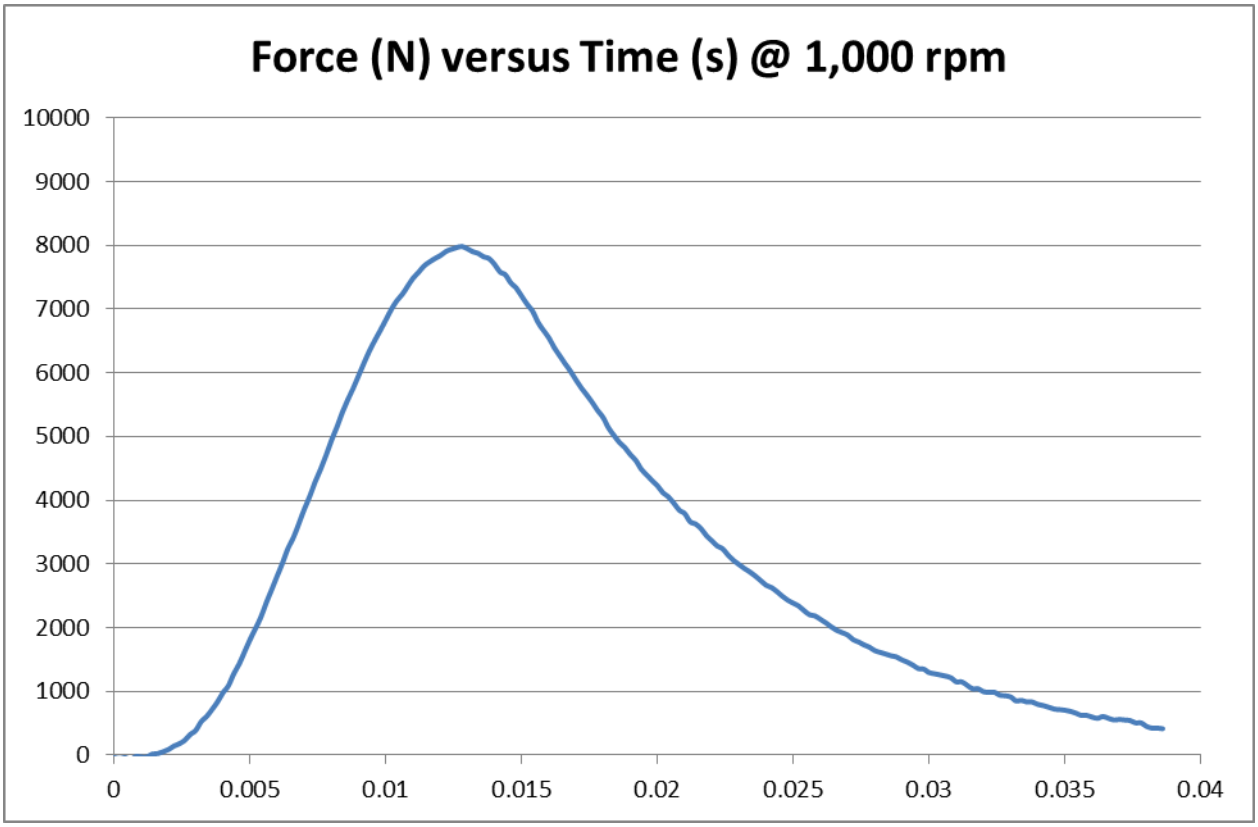
Pulse Actuator & Journal Bearing Fatigue Rig

We continue to work on this development, as we still believe there is a requirement for a low-cost and robust means of applying a pulsating load, as a component part of a basic bearing fatigue rig.



The current design incorporates, as before, a fixed piston and a floating cylinder, thus providing a compact, single acting, actuator. A second, smaller diameter, cam driven, piston, now runs in a bore through the middle of the fixed piston. The net result is the combined functionality of a plunger pump, a pressure intensifier and an actuator, in a single, compact, assembly. High pressures are confined to the actuator, meaning that only low pressure pipe work and a simple low pressure circulating pump is required external to the actuator.



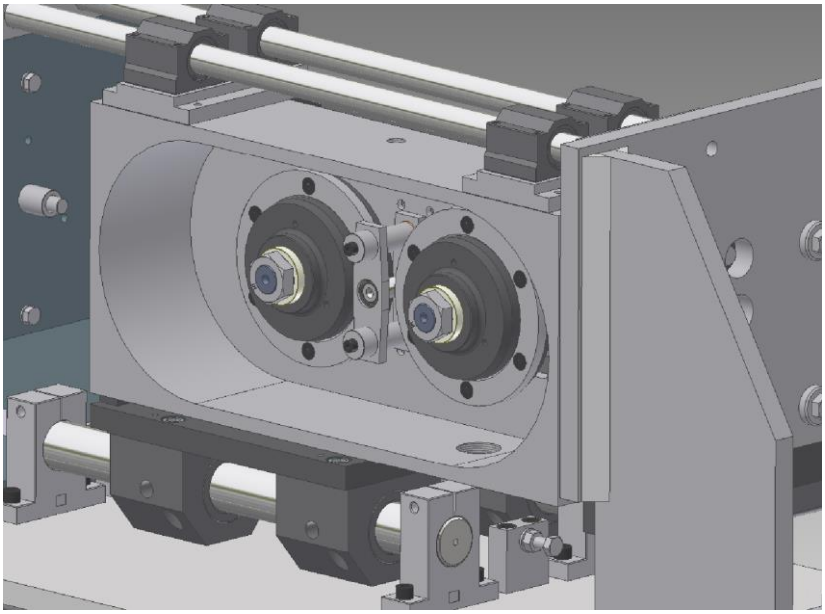


Initial tests with a 75 mm diameter bore actuator have shown that we can generate an 8 kN spike, with a rise time of approximately 10 msec, at 1,000 rpm, hence 1,000 pulses per minute, with the pressure relief valve set at 25 bar. Subsequent tests will involve increasing the relief valve pressure to 50 bar and maybe 100 bar. Subsequent developments will involve increasing the actuator bore to perhaps 150 mm, to increase the force generated by a factor of four. The eventual aim is to produce a device that will generate a spike of perhaps 100 kN or more.

WORK IN PROGRESS – IN PRODUCTION:

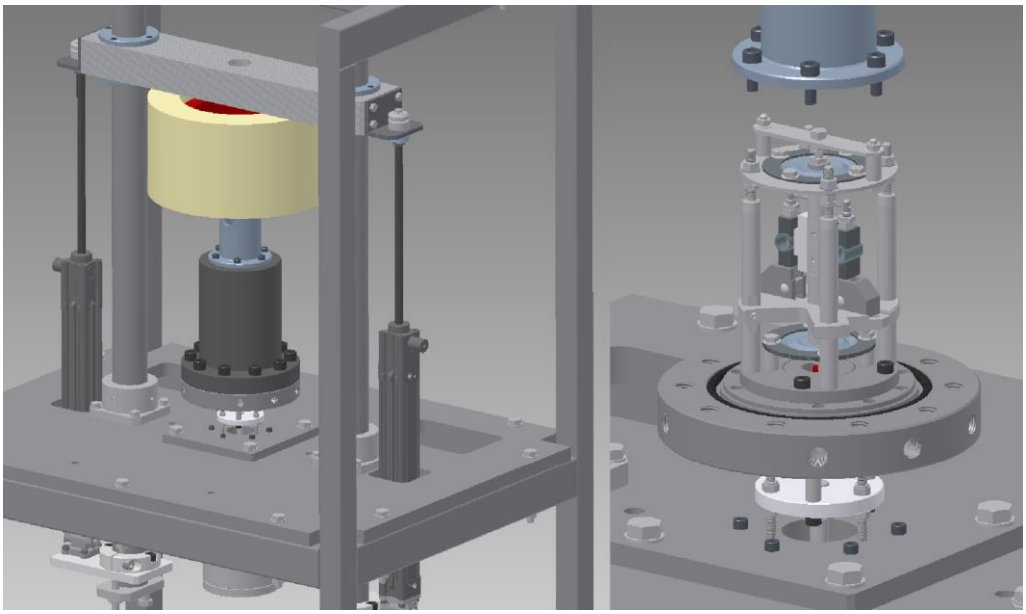
RCF 3 Rolling Contact Fatigue Rig

With major components derived from the large TE 73 two roller machine, RCF 3 is a new two roller on rod sample, rolling contact fatigue rig, in essence, an updated and higher speed version of the old GE Polymet machine. Unlike the latter, where the drive was through the small diameter rod sample, with RCF 3, both the large rollers are driven.



Rollers between 200 mm and 250 mm diameter can be accommodated and rod samples from 20 mm to 50 mm diameter. The rollers can be driven at speeds up to 6,000 rpm, which would result in very high rotational speeds for the rod sample. Whether this is sustainable remains to be seen, but we will in due course be probing the upper limits of speed and load, just to confirm, what is achievable. The maximum load that can be applied is 21 kN.

Autoclave Harmonic Fretting Rig



Work on the autoclave fretting rig (Tribology Update 31) progresses slowly. We are waiting for final test and delivery of the autoclave. So far, this has proved to be one of our more demanding projects!

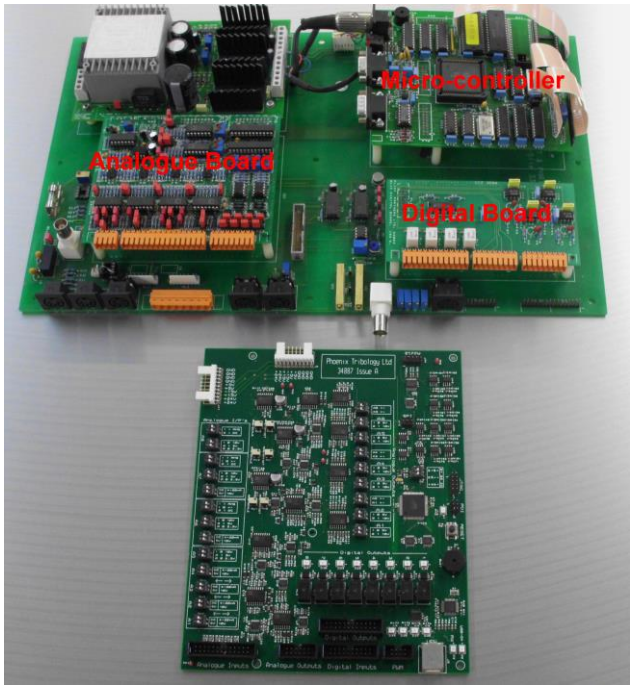
SLIM Replacement

Our H8/532 micro-controller based Serial Link Interface Module, or SLIM for short, first came into service more than twenty years ago. SLIM, in conjunction with COMPEND software, has provided us with a remarkably stable and cost effective platform, entirely under our own technical control, for a very long time. Whereas the H8 continues to be available, finding its way into washing machines, microwaves and endless other domestic appliances, many of the other system components, such as amplifiers and DACs, are becoming obsolete, so it is time for a change.

With the move to a new micro-controller and to surface mount components, the new interface combines the functionality of the original SLIM micro-controller with the separate analogue and digital boards in a single PCB. The new processor is an ATXMEGA 256A3 chip and the controller has the following inputs and outputs:

- 6 x analogue outputs
- 4 x PWM outputs
- 8 x analogue inputs
- 2 x tacho inputs
- 8 x digital inputs
- 8 x digital outputs
- 3 x rms:dc converters

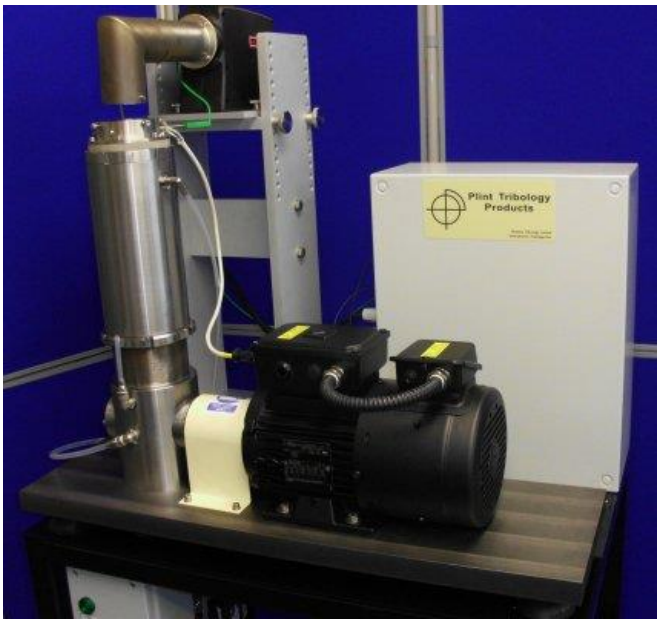
Whereas the original SLIM had only RS232 serial communications, the new device has both USB and RS232 communications and hence has acquired the name USLIM.



In addition to the micro-processor board, we are also designing a new motherboard on which to mount the USLIM. This is to provide a direct, drop-in replacement for existing SLIM motherboard units, eliminating any requirement to modify existing control cabinets or machine wiring. We hope this will offer the most cost effective and convenient way of keeping machines running for at least another twenty years.

WORK COMPLETED:

TE 35 Valve Impact Rig



Valve seat recession is dependent on the velocity of the valve at impact with the seat. Clearly, the velocity of the valve at any part of the cycle is of no relevance. It follows that using a standard automotive, variable velocity cam, to generate the motion, will require very precise adjustment of the relative position of valve and seat, in order to achieve the required impact velocity. As wear occurs, the position of impact, relative to the motion, will change and hence the velocity of impact.

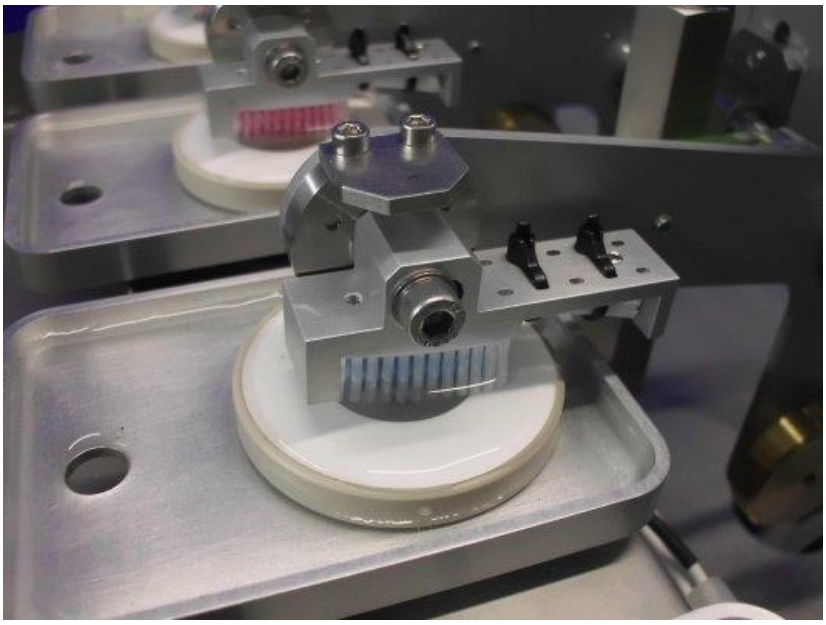
The logical solution is to use a constant velocity cam, so that it does not matter where the impact occurs relative to the motion, the velocity will always be the same. A constant velocity cam is of course only possible in theory, however, a cam that produces constant velocity over a substantial part of its rotation is entirely feasible. Furthermore, the mechanism does not need to produce any velocity greater than that required at impact, thus reducing the loading on cam and follower and the required motive power.

It has taken us some time to arrive at what seems, in retrospect, an obvious solution!

TE 38 Long Stroke Low Load Reciprocating Rig

We have re-designed an earlier version of a long stroke, low load, reciprocating tribometer, incorporating a number of improvements. The key challenge, as always, when operating at very light loads and hence very small friction signals, is to ensure an adequate signal to noise ratio. The loading and motion mechanisms incorporate porous air bearings, to ensure smooth motion, with minimal stiction.

TE 85 Eight Station Orbital Motion Tooth-brushing Test Machine

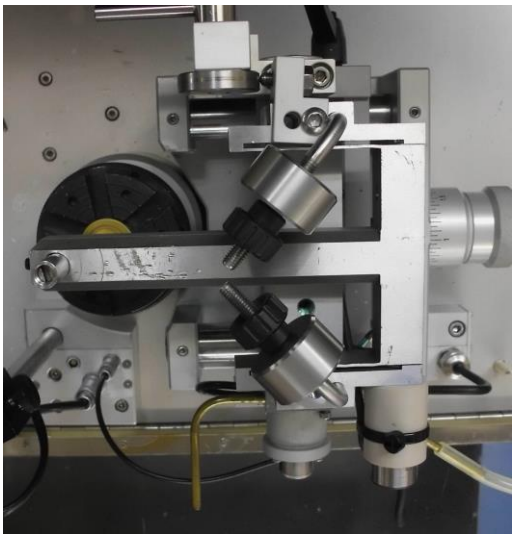


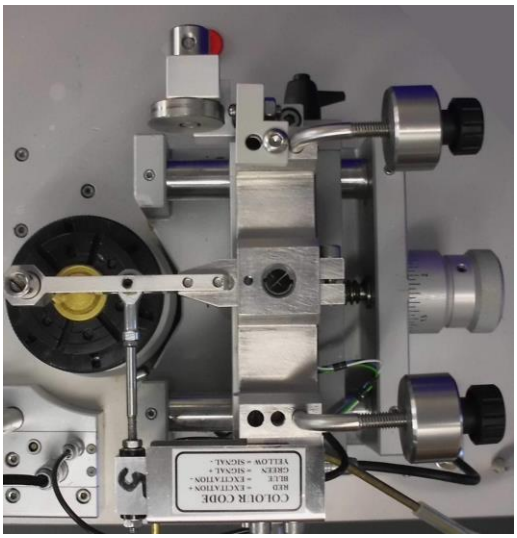
We have used the twin Scotch Yoke drive system from the TE 87 Circular Translation Pin on Disc Machine to drive the motion plate on a new, light load,

orbital motion, tooth-brushing machine. Optional three-axis force transducers can be fitted to each test station, to allow measurement of normal load and friction.

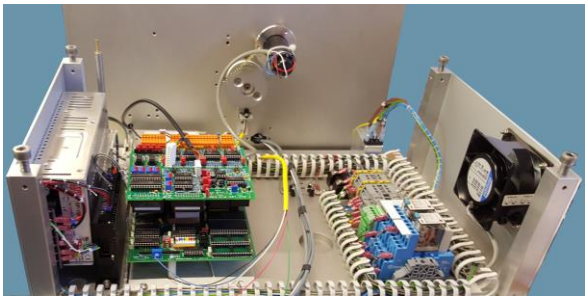
CSM Pin on Disc COMPEND/SLIM Up-cycling

Over the years we have upgraded and refurbished numerous of our own products. We have also supplied more than twenty COMPEND/SLIM upgrade packages, for Falex Block on Ring Machines. More recently, we were asked whether we could up-cycle a CSM Pin on Disc Machine. This we have now done.

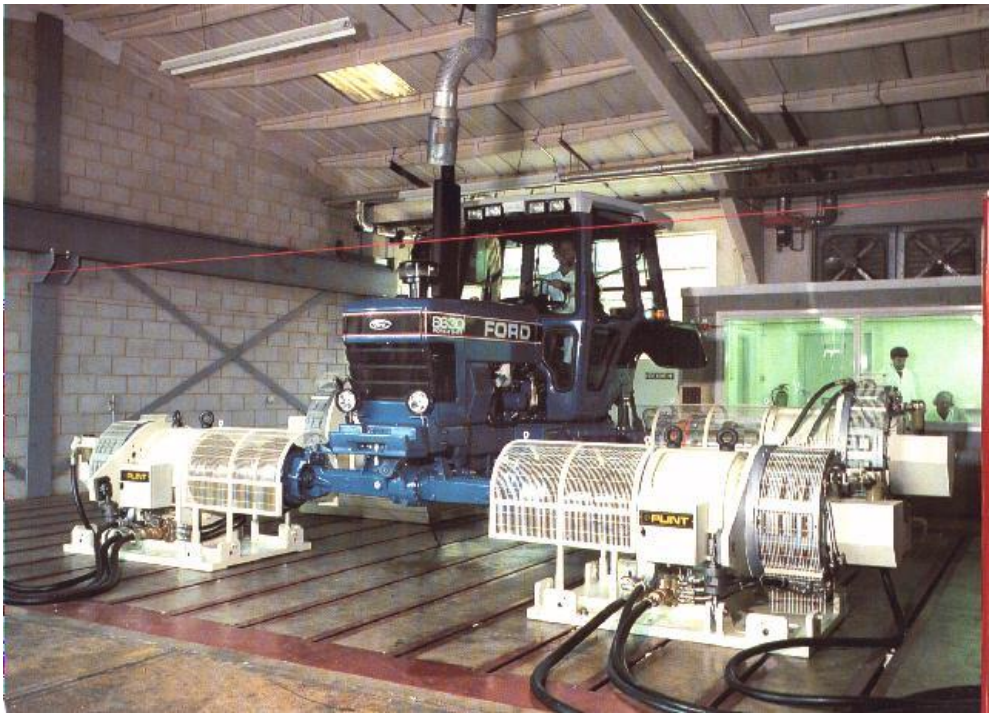




The original loading and friction measuring arm was damaged beyond repair, so the first thing we had to do was design a replacement assembly, incorporating a flexural pivot bearing and strain gauge force transducer.



The machine electronics, including the motor drive and heater circuit were replaced and a SLIM microcontroller added to provide a control and data acquisition interface. COMPEND software was then installed and configured to run the machine, offering the usual control and data acquisition features associated with our standard test machines.



COMPEND, with its assorted interfaces, was designed to be a general purpose, software configurable, control and data acquisition system. During its lifetime, it has been used for controlling everything from tribometers to engine test beds and large transmission rigs.

What will the next challenge be?

OTHER NEWS:

Phoenix Tribology Europe Ltd

We were not too happy with the outcome of the EU referendum and think it sensible to maintain a presence within the EU. With this in mind, we have incorporated a new company in the Republic of Ireland, Phoenix Tribology Europe Ltd. For the moment, this company is dormant, but we are ready to activate it, as soon as it becomes clearer what "Brexit" might mean.

Cambridge Tribology Course 2017

The 25th Cambridge Tribology Course will take place during September 2017, with dates yet to be confirmed.

George Plint and David Harris
Phoenix Tribology Ltd