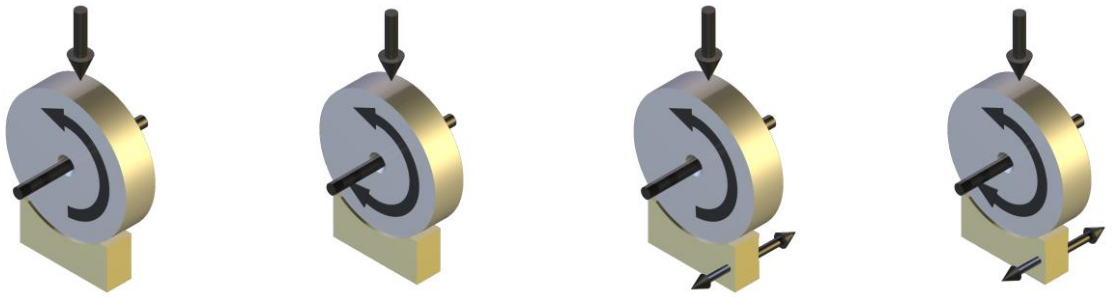
TRIBOLOGY UPDATE: *ISSUE 36 –December 2018*

This is the latest issue of our **Tribology Update** newsletter. For further information, we can be contacted by e-mail at ***info@phoenix-tribology.com***.

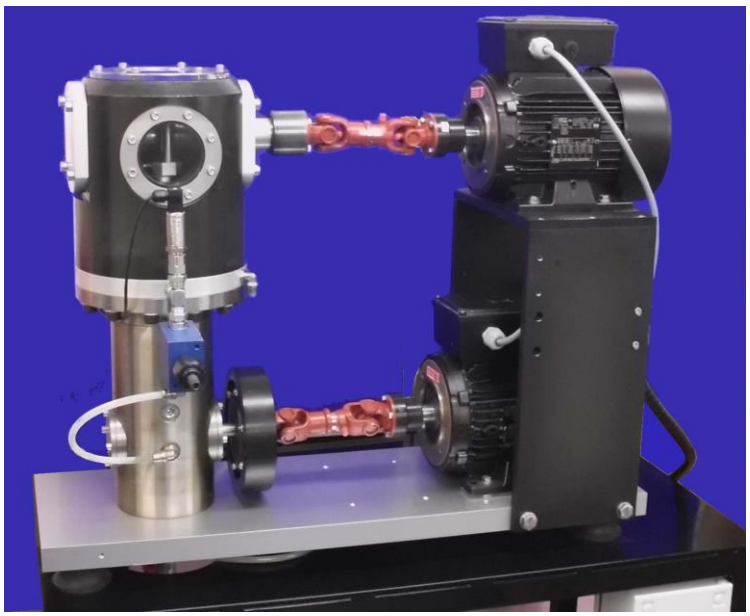
WORK IN PROGRESS – DEVELOPMENT

Journal Bearing Friction Rig



We are currently working on the design and manufacture of a journal bearing friction rig for testing partial and full journal bearings, providing continuous rotation, oscillating rotary motion and axial motion, with maximum applied radial loads of up to 5 kN. Friction torque and axial thrust are measured with a combined axial force and radial torque transducer. The bearing under test is mounted in tooling supported on an air bearing, which allows load to be applied without the introduction of parasitic friction losses.

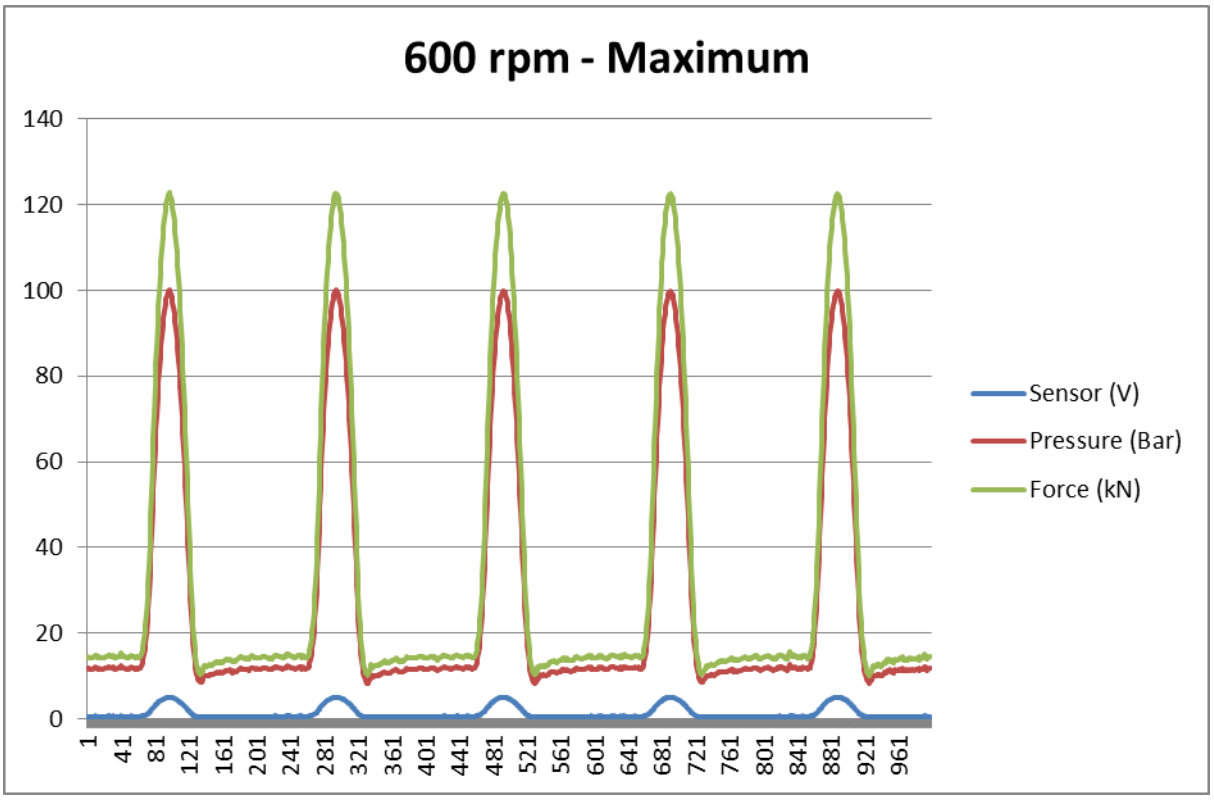
TE 36 Dynamic Bearing Fatigue Rig



We have finalised the design, performance specification and price of the dynamic bearing fatigue rig and can confirm that we have more than achieved our target of an ex-works price of less than £100,000.

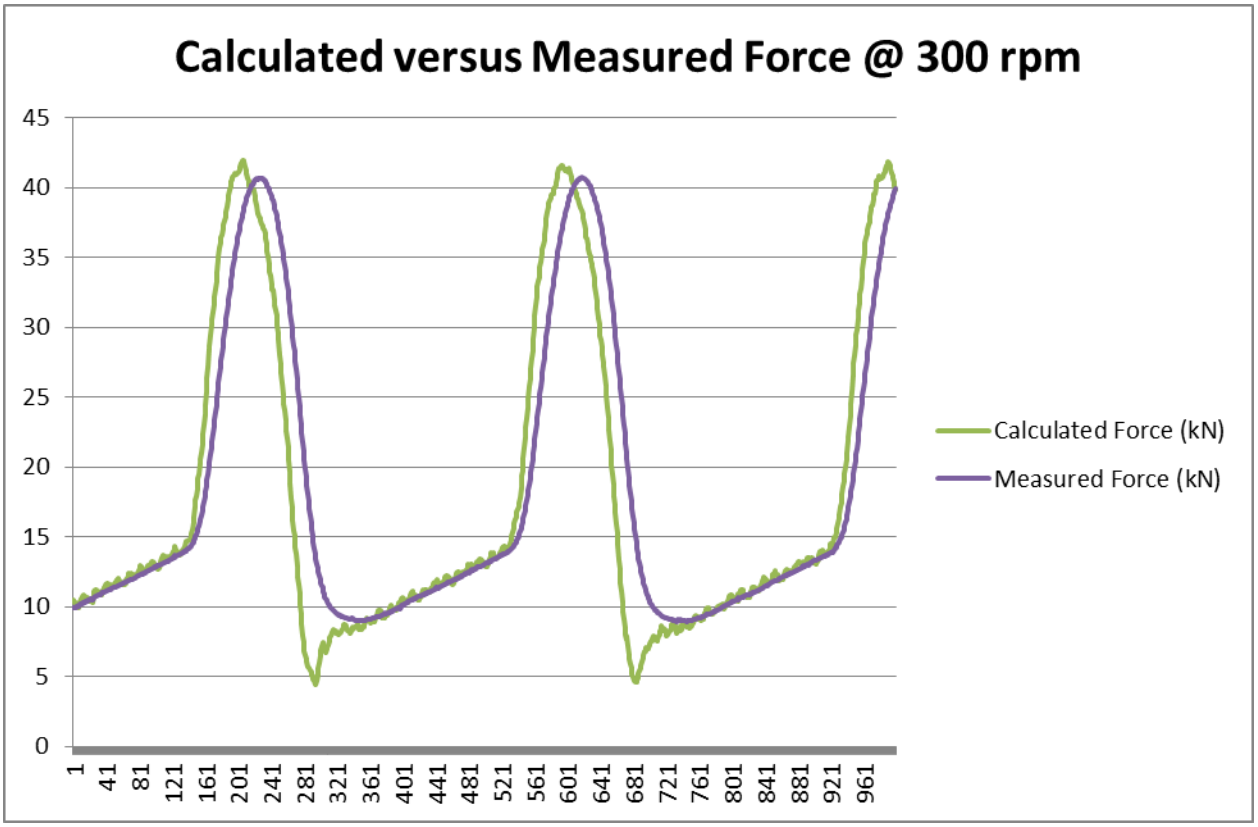
Dynamic Performance

The sensible operating range for the cam driven actuator is at rotational speeds between 600 and 1200 rpm, in other words, between 10 and 20 pulses per second. With the current cam design, pulses at 600, 900 and 1200 rpm last approximately 30 ms, 23 ms and 17 ms respectively. The maximum pressure generated in the actuator is of the order of 100 bar, corresponding to a maximum dynamic force of approximately 120 kN.



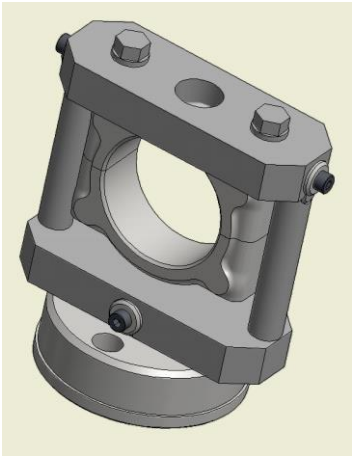
Pressure – Force Verification

We have struggled to find a force transducer with the necessary combined signal bandwidth and capacity to detect the dynamic force generated at maximum load and pulse frequency, but have managed to perform tests with a 50 kN strain gauge load cell, with the pulse rate reduced to 5 Hz, to minimise attenuation and phase shift of the force signal. The resulting force signal is compared with the force calculated from the pressure signal, confirming the relationship between measured pressure and resulting force.



Plain Bearing Tooling

We have abandoned our attempts to test crankshaft bearings as half or partial journal bearings. To avoid the risk of the bearing entry closing, which results in starved lubrication, it is necessary to choose a suitable bearing "pre-load" and "off-set". It is not obvious how to optimise these values.



Because of this difficulty, tests are now run using full journal bearings, with the bearing shells mounted in parts cut from a standard connecting rod, with oil fed under pressure through a hole drilled through the non-loaded side of the connecting rod and bearing shell, thus guaranteeing full film lubrication.

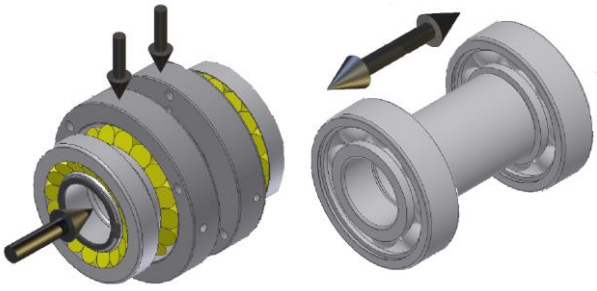
Potential Test Protocol

The pulse duration in the time domain is a function of the rotational speed of the cam and the cam profile. Because the cam and bearing shaft are independently driven, reducing the speed of rotation of the bearing shaft reduces the pulse duration in terms of angle of rotation. If we stop the shaft altogether, we can have the pulse acting in one place, with no degrees of rotation!

Reducing the bearing shaft rotational speed of course reduces the lubricant entrainment velocity, thus reducing the lubricant film thickness. Hence, running a test in which the bearing shaft speed is progressively reduced, simultaneously increases the intensity of the pulse, while reducing the lubricant film thickness.

WORK COMPLETED

RCF 4 Rolling Contact Fatigue and Bearing Friction Rig



We have now completed the design and manufacture of a high speed bearing fatigue and friction rig, with test assemblies for combined radial and axial loading and for bi-directional axial loading.

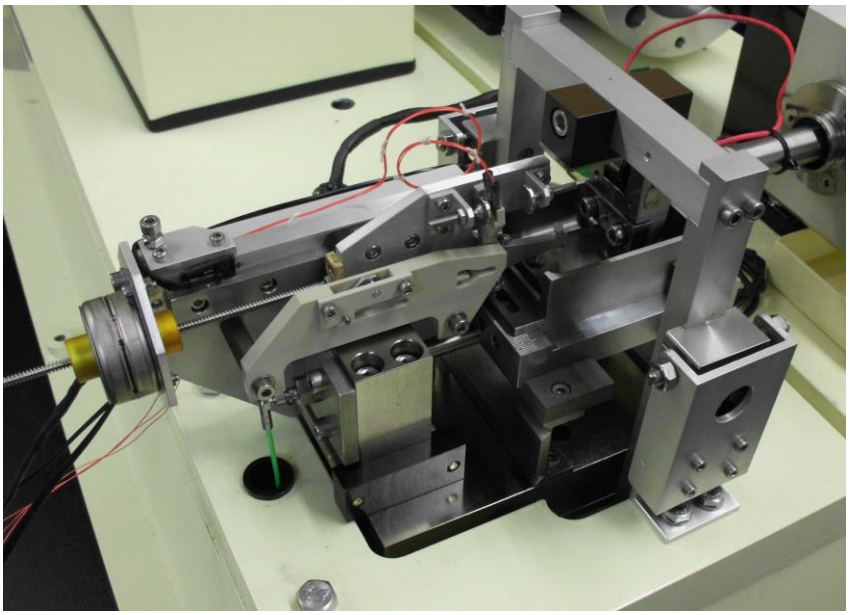
The test assembly for combined radial and axial loading uses four identical bearings mounted in a back-to-back configuration. Taper roller, spherical roller, cylindrical roller, angular contact and deep groove ball bearings can be accommodated, with shaft sizes from 40 mm to 65 mm and a maximum bearing outside diameter 140 mm. The maximum axial load is 16 kN and the maximum radial load per bearing is 40 kN.

The test assembly for bi-directional axial loading allows two deep grove ball bearings to be mounted, loaded against each other, with a maximum axial load of +/-4 kN. Shaft sizes from 20 mm to 40 mm and a maximum bearing outside diameter 90 mm can be accommodated. Uni-directional loading of angular contact bearings is also possible.

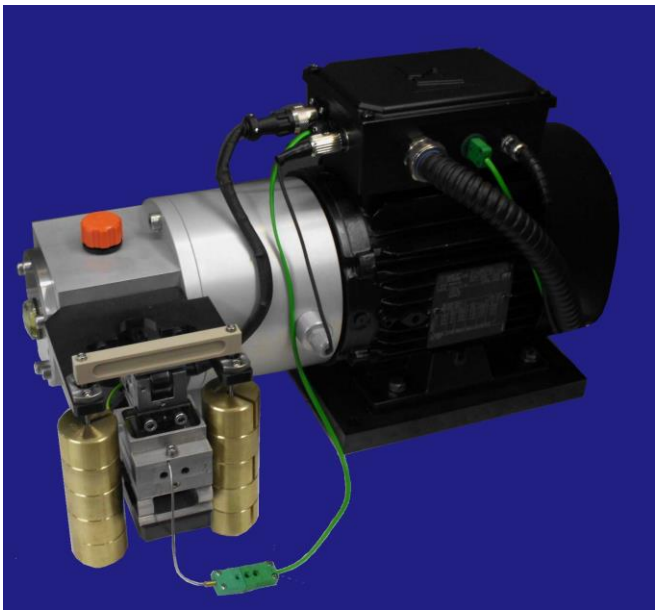
An in-line torque transducer is provided for friction measurement, with a maximum permissible speed of 10,000 rpm.

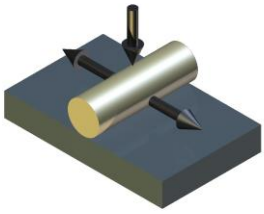
TE 77 - In situ Tactile Profilometer

We have now got to the point of finalising the design of the in situ profilometer and can confirm that we have more than achieved our target of an ex-works price of less than £10,000.



TE 81 Single Station Fuel Lubricity Test Rig





We have completed the design and manufacture of a compact reciprocating tribometer, designed for running reciprocating line contact tests at strokes up to 5 mm.

The current unit is single station, with dead-weight loading. We are currently working on a multi-station unit, with pneumatic loading, to fulfil a requirement for a high throughput, reciprocating tribometer.

OTHER NEWS

Cambridge Tribology Course 2019

The 27th and **final** Cambridge Tribology Course will take place from Monday 9th to Wednesday 11th September 2019. With four of the contributors now past retirement age, we have decided that, despite its continuing popularity, it is time to stop.

Recent Publications

Reproducing automotive engine scuffing using a lubricated reciprocating contact

TJ Kamps, JC Walker, RJ Wood, PM Lee, G Plint

Wear Volumes 332–333, May–June 2015, Pages 1193-1199

Investigating grid-to-rod fretting wear of nuclear fuel claddings using a unique autoclave fretting rig

S Lazarevica, R YLu, C Favede, G Plint, P Blau

Wear Volumes 412-413, 15 October 2018, Pages 30-37

George Plint and David Harris

Phoenix Tribology Ltd