TRIBOLOGY UPDATE: ISSUE 45 – February 2025

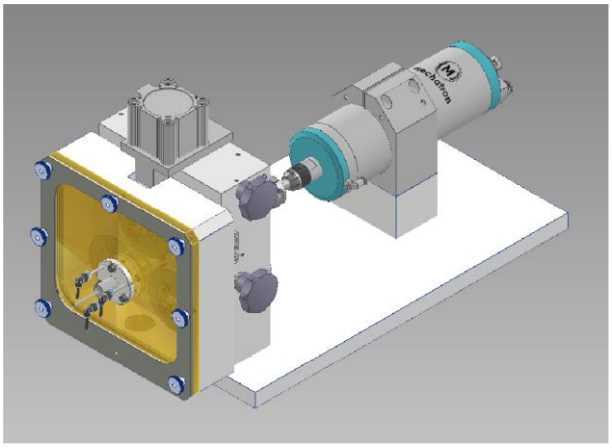
This is the latest issue of our Tribology Update newsletter. During the last few months, three new members have joined our team:

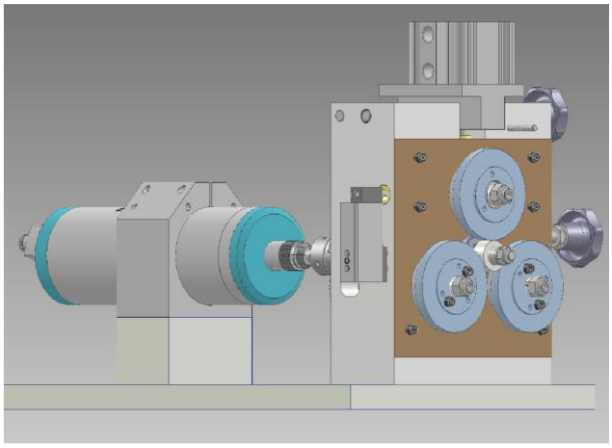
- Jonathan Rodrigues is a software engineer with a BSc in Computer Science from MES College in Goa and an MSc from the University of The West of England. He is currently working on the new COMPEND GUI and assorted new device drivers.
- Dr Suresh Chettri has a Bachelor of Mechanical Engineering degree (Kathmandu University), an MSc in Energy and Environmental Engineering (University of Duisburg-Essen (UDE)) and a PhD in Mechanical Engineering (Swiss Federal Institute of Technology, Lausanne (EPFL)). He has experience in the design and development of test-rigs for fluid dynamics, roto-dynamics and tribology.
- Andrei Cosofret has a BEng from Gheorghe Asachi Technical University in Romania and joins the team as a mechanical design engineer.

WORK IN PROGRESS – DEVELOPMENT

ST–PR Standard Test – Pitting Rig

We are currently working on a new addition to our Value Engineered Standard Test Machine product range.

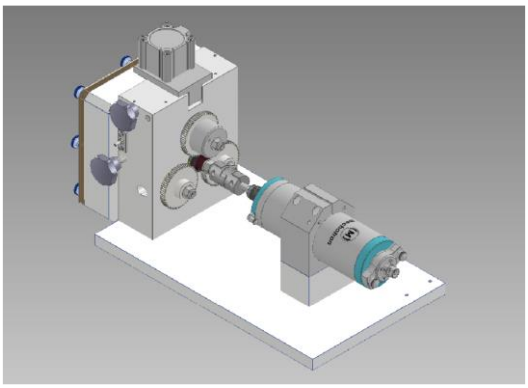




Existing three disc on roller machines are high cost and have several key limitations:

- The test roller diameter is too small resulting in a hertzian contact length that is too small to be a representative model of a gear contact.
- The test roller cannot be of larger diameter because increasing the diameter increases the torque generated, resulting a requirement for increased transmitted power.
- Because these machines are compact, twin motor, recirculating power design, increasing the motor power capacity is not an option.

Mechanical torque circulation pre-dates electrical power circulation and requires only a single motor with sufficient capacity to drive the system losses, in other words, to rotate the mechanical torque loop, as happens in an FZG machine. With this arrangement, the transmitted power through the tribological contact can be much higher than the motor power. The only disadvantage of this type of arrangement is that test must be run at fixed slide-roll ratios, set mechanically, by appropriate gear pairs.



Our new design uses gears to set the slide-roll ratio, much as in the **TE 53 Multi-Purpose Friction & Wear Tester**. The maximum specimen speed, with contact slip, is 6,000 rpm. At zero slide-roll ratio, with the gears removed, the maximum specimen speed is 12,000 rpm. The two lower rollers are electrically insulated for ECR measurement and the traction between the upper roller and the specimen roller is measured with a force transducer.

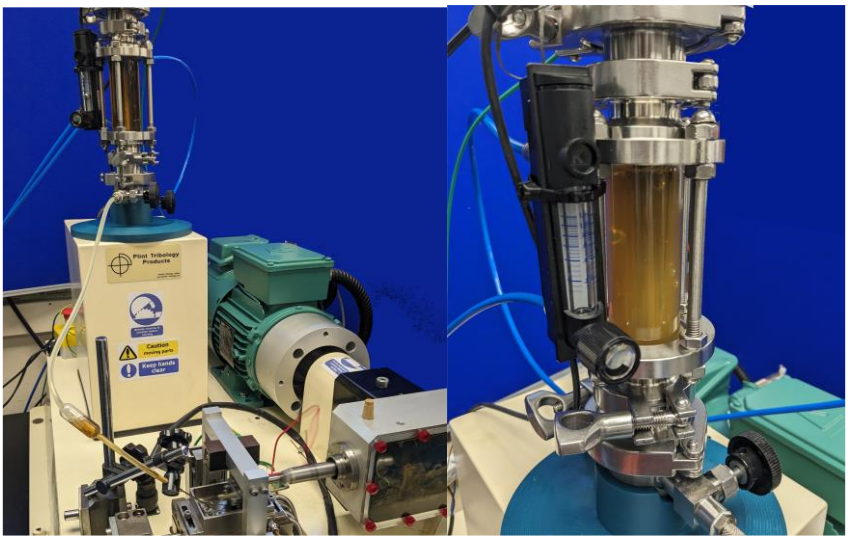
TE 104 Four Station Long-stroke Reciprocating Tribometer

The original TE 104 machine is designed to run under pressurised hydrogen, which adds considerably to the cost and complexity of the machine. We have a client who wants a similar device, but without the hydrogen capability, for running tests in non-explosive gases. We can achieve what is required by removing the outer nitrogen chamber and all the hydrogen and explosion rated components from the original TE 104. This means we will end up with two machines that we will designate as:

- TE 104H Four Station - Pressurised Hydrogen - Reciprocating Tribometer
- TE 104N Four Station - Pressurised Non-Explosive Gas - Reciprocating Tribometer

  Apart from the test gas, the rest of the specification will remain unchanged. Watch video here.

TE 77 Tests with Miniature Oil Treatment Unit

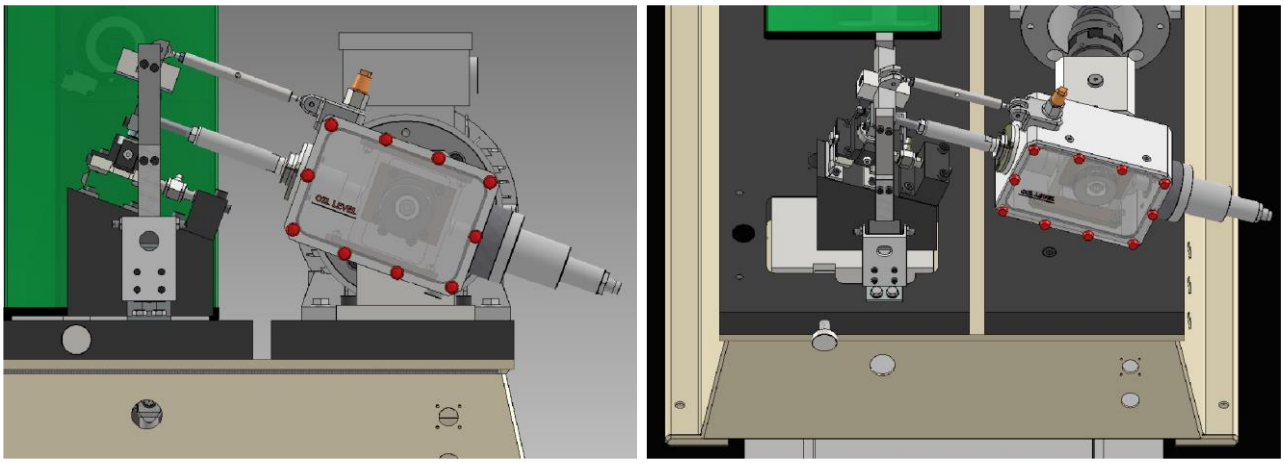


We are running a series of tests on TE 77, using the oil treatment reactor and a marine engine lubricant, which is subjected to exposure to gaseous ammonia and steam. The lubricant is drip fed onto the specimen contact, drains from the specimen bath, and is then pumped back to the top of the reactor. The aim is to see if we can detect any changes in friction and wear response, compared with running air only with treatment. We will be presenting our results at the STLE Annual Meeting.

TE 77 DIN51834-6:2024-01 Test Adapter

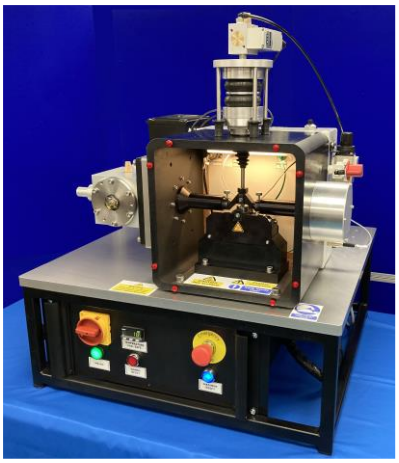
A new test for brake fluids has been published, which involves reciprocating a steel ball, at short stroke, on a rubber flat. To comply with the procedure, the test must be run with the fixed sample inclined at 20 degrees. The standard is:

> DIN51834-6:2024-01 Testing of lubricants – Tribological test in the translatory oscillation apparatus – Part 6: Quantification of the friction-induced wear development of brake fluids in EPDM-metal contacts



We have designed an adapter that allows tests to be run at short stroke, with the TE 77 reciprocating mechanism rotated through 20 degrees.

ST-RT Standard Test - Reciprocating Tribometer – Specimens



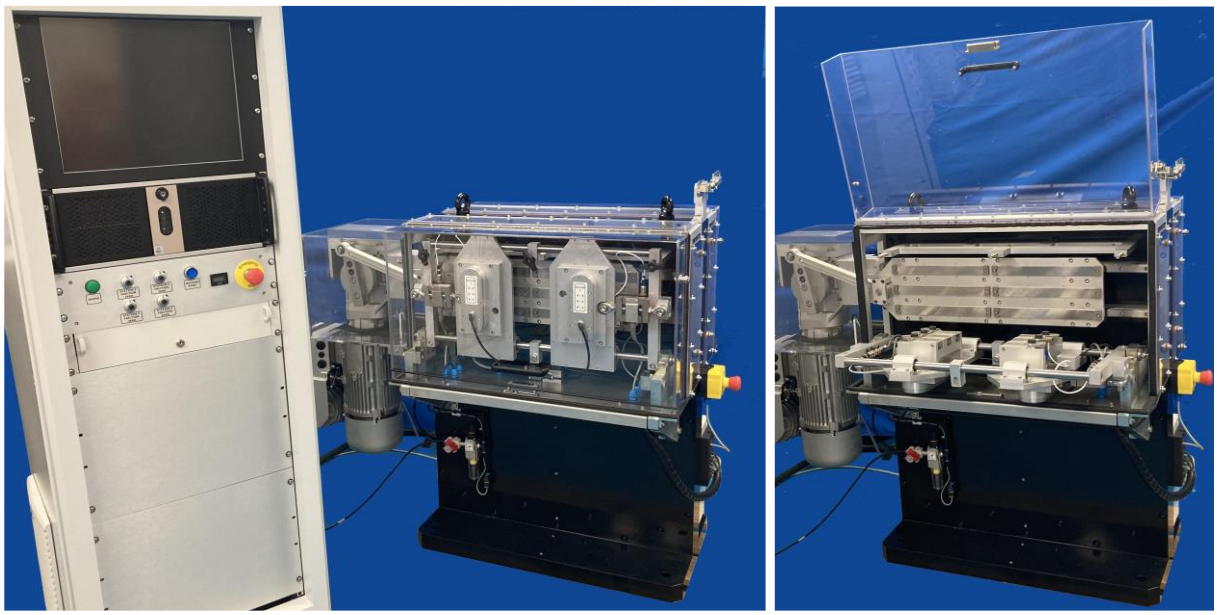
Prototype specimens, using the same material and surface finish, as specified in numerous ASTM standards, are currently being evaluated. Watch video here.

ST-BA Standard Test - ASTM G223 Twist Compression

We have had numerous enquiries for an alternative to the Tribsys twist compression tester, which appears to be no longer available. We have therefore decided to design and build our own version, as part of our Value Engineered Standard Test Machine product range.

COMPLETED PROJECTS – DEVELOPMENT

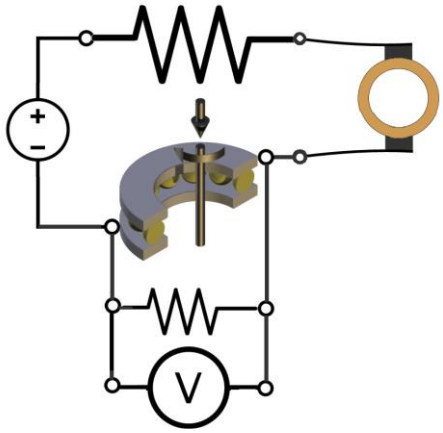
TE 108 Polymer Production Test – Long Stroke Reciprocating Tribometer

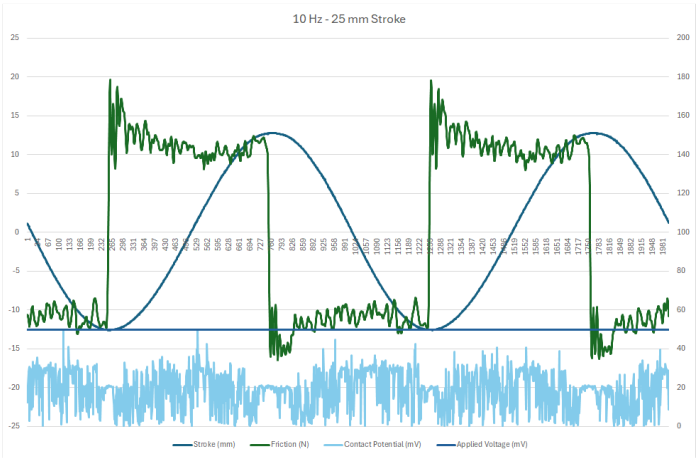


This machine was designed and built in 2022 and has now been in continuous service for a number of years. We have now decided to add it to our product portfolio. Watch video here.

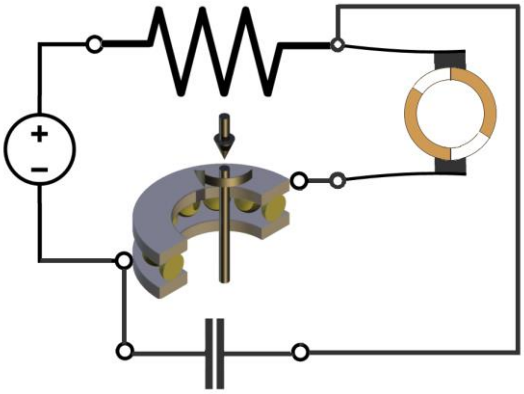
Test Electrification

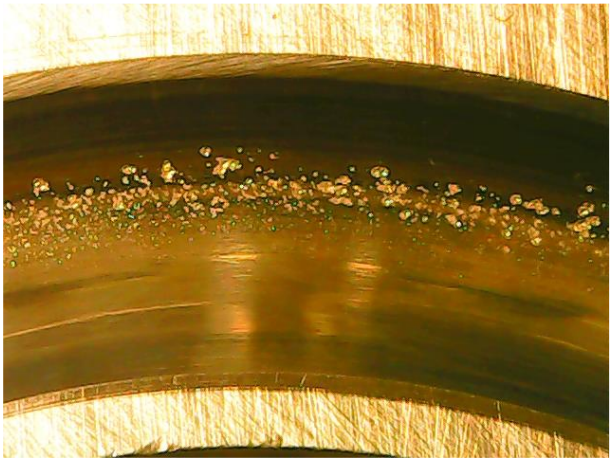
We now have an extensive range of different test electrification systems.



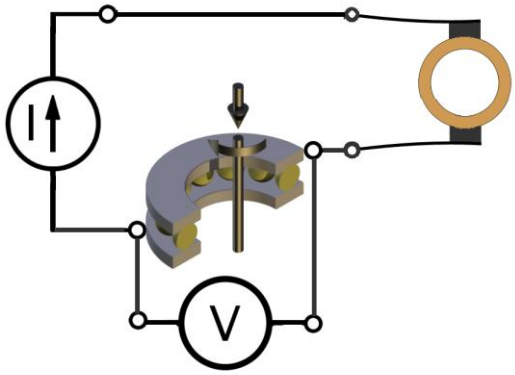


This is the original Lunn-Furey Electrical Contact Resistance Circuit, fitted to numerous different tribometers. It is essentially a high ratio potential divider with the tribo-contact acting as an electrical switch, in parallel with the low resistance side of the potential divider, with the resulting voltage being measured. The voltage across the tribo-contact is typically set to a maximum of between 20 and 50 mV.

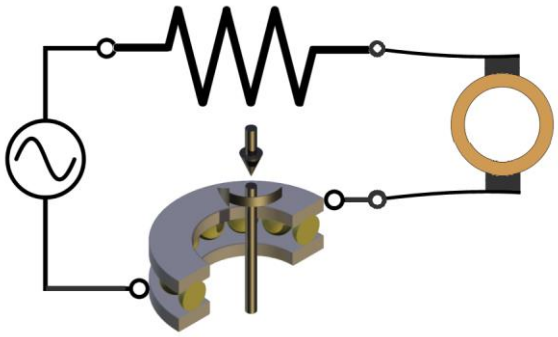




This is the Electrical Discharge Machining (EDM) Circuit, in which a capacitor is mounted in parallel with the tribo-contact and split ring commutator. The capacitor charges during the non-conducting part of the cycle and will discharge, depending on the tribo-contact resistance, during the conducting part of the cycle. Applied voltages are typically in the range 6 to 24 volts. The number of discharge pulses are recorded. This arrangement is used for modelling the damage caused by common mode generated electical discharges in motor bearings.



This is a schematic of the LCR Low Resistance Measurement Circuit, which incorporates a constant current source, producing a voltage output proportional to the resistance of the tribo-contact. Although schematically a very simple circuit, practical implementation is somewhat more complcated.



This is the Programmable Continuous AC/DC Current Source Circuit. It allows a current of up to 1 amp to be passed through the tribo-contact. This is the sort of continuous current that might be generated in large rotating electrical machinery.

WORK IN PROGRESS – PRODUCTION

RCF 2 Rolling Bearing Tribometer (High Load – Medium Speed)

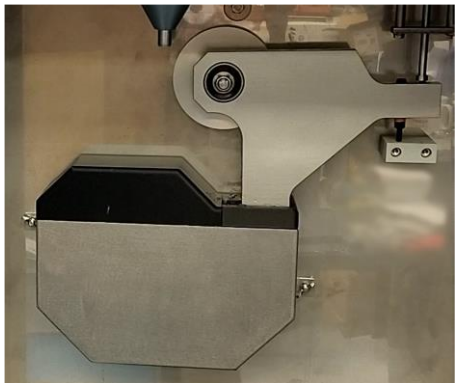
We are currently building a large rolling bearing tribometer, capable of applying high axial loads (up to 40 kN), with a maximum speed of up to 7,500 rpm. All the bearings specified for this machine are taper roller and have limiting speeds that are typically 2,000 to 3,000 rpm. The largest bearing we must accommodate will have an I/D of approximately 110 mm and an O/D of perhaps 175 mm. Bearings of this size are not designed to run at high speeds, so there is no point specifying higher speeds for this application.

The machine includes facilities for measuring friction torque and vibration, plus an LCR circuit for low value resistance measurement. We are going to reassign the old RCF 2 designation for this new machine.

COMPLETED PROJECTS – PRODUCTION

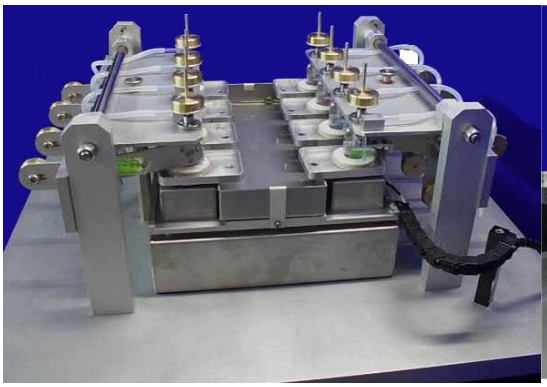
TE 65 Multiplex Sand/Wheel Abrasion Tester





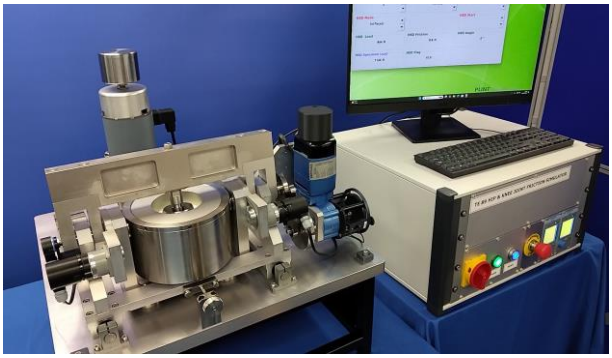
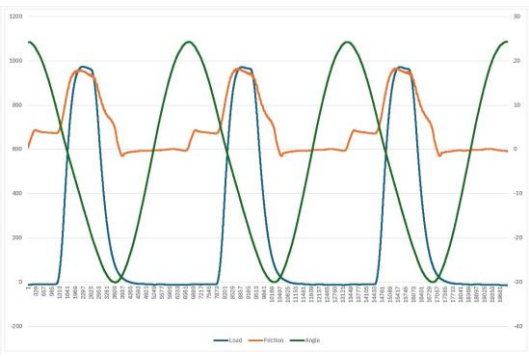
The first production unit of our updated TE 65 unit is on its way to a client. Watch video here. Although not formally parts of our Value Engineered Standard Test Machine product range, the same engineering principles have been applied.

TE 85 Eight Station Orbital Tooth Brushing Rig



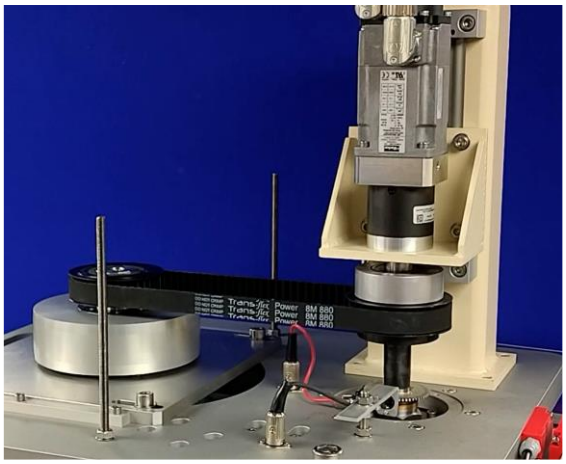

We have recently delivered another orbital tooth brushing rig. Watch video here.

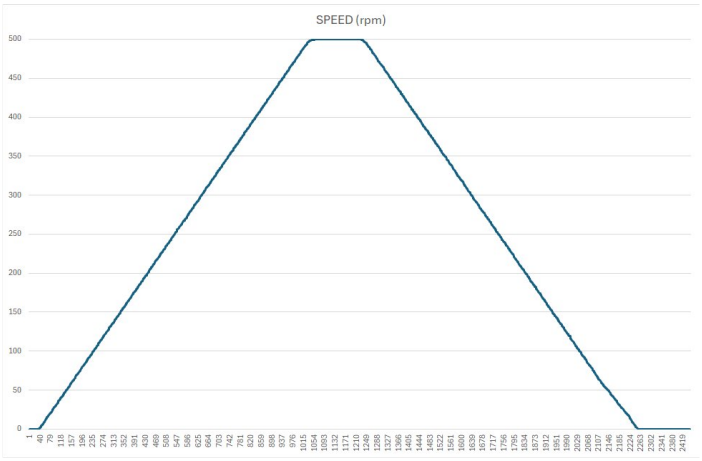
TE 89 Hip & Knee Friction Simulator

We have recently delivered an updated version of our hip and knee friction simulator. Watch video here.

TE 92 Low Speed Range Extension





We have completed a TE 92 machine with a new, low speed range capability. The standard vector motor will run from 0 to 3,000 rpm with no difficulty, but at very low speeds, it does not generate significant torque, plus, at very low speeds, motors tend to "cog", in other words, not rotate smoothly. To enhance performance at very low speeds, in the range 0 to 75 rpm, we use a highly geared servo motor, which produces high torque at very low rotational speeds. To allow continuous and precise speed control from 0 to 3,000 rpm, we mount this low-speed motor in parallel with the standard vector motor, with connection to the machine spindle via a sprag clutch. This automatically disconnects the servo motor when the rotational speed exceeds 75 rpm. Hence, from 0 to 75 rpm, the servo motor is in control and from 75 to 3,000 rpm, the vector motor is in control. Precise and smooth speed control is achieved from 1 rpm to the required maximum speed, with both increasing and decreasing speed ramps. Watch video here.

OTHER NEWS

On-line Tutorials and Product Videos

We continue to add video content to our web site including new and updated product videos:

TE 43 Impact Sliding Test Rig

TE 44 Piezo Fretting Test Rig

TE 54 Mini Traction Machine

TE 60 Three Station Pressurized Hydrogen Reciprocating Tribometer

TE 91 Precision Rotary Vacuum Tribometer

ST-FB Standard Test - Four Ball Extreme Pressure & Wear

ST-TW Standard Test - Three Pin on Disc/Thrust Washer

Conferences and Exhibitions

In 2025, we will be attending:

- Wear of Materials – Barcelona – 13th to 17th April
- STLE – Atlanta – 18th to 21st May
- A3TS – Dijon – 2nd and 3rd July

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George Plint, Cyrille Favede and James Morley

Phoenix Tribology Ltd