TE 92 ROTARY TRIBOMETER
Description

The TE 92 Rotary Tribometer is a versatile test machine for research and development work on materials and lubricants. With collinear rotating and loading axes and an open test platform the TE 92 can accommodate a number of tribology test geometries, many relating to international test standards.

The test spindle projects downwards from a housing with precision, greased for life, bearings. The drive motor is connected to the test spindle by different pulley arrangements, depending on torque and speed requirements.

Location for holders for the rotating specimens is provided by a tapered hole (TE 92 and TE 92HS) or spigot (TE 92HP) in the end of the test spindle, with accurately machined diameter and end face.

The machine has servo controlled, low inertia, pneumatic loading with force transducer feedback and vector speed controlled motor with encoder feedback. The machine is floor-standing.
Three versions of the machine are available:

**TE 92**

Standard speed machine with 2.2 kW motor, single phase supply and timing belt drive with torque limiter test spindle pulley. Test spindle main bearing: taper roller. Maximum speed: 6,000 rpm.

**TE 92HS**

Standard and high speed machine with 2.2 kW motor and single phase supply and timing belt drive with torque limiter test spindle pulley. Including additional flat belt drive for high speeds. Test spindle main bearings: matched pair of super-precision angular contact bearings. Maximum speed with timing belt fitted: 6,000 rpm. Maximum speed with flat belt fitted: 10,000 rpm.

**TE 92HP**

Standard and low speed, high torque, machine with 4 kW motor and three phase supply and including shaft mounted epicyclic gear-box. Test spindle main bearing: taper roller. Maximum speed with gear-box fitted and 1:1 ratio selected: 2,000 rpm. Gear-box ratios 1:1 and 2.72:1. Maximum speed with gear-box removed: 6,000 rpm.

**Load and Torque Measurement**

Test adapters are mounted on an aluminium cross beam which is guided by linear bearings on the vertical machine columns. The beam is loaded from underneath by a pneumatic bellows actuator assembly which includes an in-line force transducer for measurement and feedback control of load. There are two interchangeable loading assemblies TE 92/1 and TE 92/2 providing a 500:1 turn-down ratio on load.

The test adapters are placed on a thrust bearing that permits free rotation under the influence of frictional torques generated in the contact. Each adapter includes a torque arm so that this rotational movement is resisted by a strain gauge force transducer mounted on a bracket attached to the upper plate.

**Temperature Measurement**

Adapters TE 92/3, TE 92/4 are mounted on a heated block which incorporates two electrical resistance heater elements. The heated block locates on the thrust bearing of the load cross-
beam. The TE 92/6 Reservoir includes integral electrical heating for tests up to 200°C. A 600°C electrical furnace TE 92/HT, completely enclosing the test pieces, is available.

Thermocouples are located in the adapters to measure the temperature of the test sample (either material or lubricant) and this measurement is used as the feedback for control. The temperature is maintained by software PID controllers.

**Vibration Measurement**

The 4-ball rolling contact fatigue tests require the machine to be shut down by detecting the onset of pitting. A piezo-electric sensor is mounted on the machine frame to detect vibration levels. The sensitivity of the detection circuit is adjustable by the operator. A sudden rise in the level of vibration, caused by the pitting damage in the test adapter, will trip the circuit and stop the motor rotating.

**Control and Data Acquisition**

Control and data acquisition are implemented via host PC running COMPEND 2020 Windows compatible software, in conjunction with a Phoenix Tribology USB micro-controller interface.

Automatic control is implemented via user programmable test sequences. Manual control is implemented using on screen toggles. Data is stored to hard disc in either .csv or .tsv file formats.
Accessories and Adapters

TE 92/1 Low Load Actuator Assembly

The TE 92/1 provides a loading range of 20 to 1,000 N and this is used for pin on disc, thrust washer and 4-ball wear tests.

TE 92/2 High Load Actuator Assembly

The TE 92/2 provides a loading range of 200 to 10,000 N and this is used for taper bearing shear stability, 4-ball EP and rolling 4-ball tests.

TE 92/3 Sliding Four Ball Test Assembly

The TE 92/3 comprises a test reservoir, clamping nut, thrust face and clamping ring for the three test balls, integral torque arm and thermocouple sensor. The clamping ring is designed to hold
the test balls at the defined contact angle for 4-ball testing. The thread of the clamping nut is designed to provide the correct clamping torque for 4-ball EP testing. The upper ball is placed in a split taper collet, which is a push fit into the spindle taper. The test assembly is also designed to locate on the TE 92/SCOPE Microscope Assembly to allow post-test measurement of wear scars.

**TE 92/3/1 Electro-magnetic Clutch (TE 92 and TE 92HS)**

Earlier machines were fitted with an electro-magnetic clutch, which allowed the user to adjust the start-up characteristics of the machine, when running four ball extreme pressure tests, and to disengage the drive rapidly, when the balls seized. This was necessary on machines with d.c. motors and thyristor controllers. With the advent of a.c. vector motors, start-up characteristics can be programmed accurately through the vector drive and the incorporation of a torque limiter in the drivetrain accommodates seizure and welding of the test balls. The electro-magnetic clutch remains available, but as an option, if required.

**TE 92/4 Rolling Four Ball Test Assembly**
The TE 92/4 comprises a test reservoir and precision polished test race. The race is designed to permit the test balls to rotate freely maintaining a defined contact angle with the upper ball fixed in the spindle. In this case there is no torque measurement and the rotation of the adapter is prevented by dowels in the heated pad locating in three holes in the load cross-beam. The upper ball is placed in a split taper collet, which is a push fit into the spindle taper.

**TE 92/5 KRL Shear Test Adapter (DIN 51350-6)**

The DIN 51350-6 and CEC test methods are for the determination of the shear stability of lubricating oils with polymer additives. For this a taper roller bearing is used to shear the fluid. The purpose of the test is to determine the permanent drop in viscosity caused by mechanical stresses under practical conditions. The test assembly comprises a test reservoir, clamping nut,
integral labyrinth for temperature control, torque arm and thermocouple sensor. The temperature of the lubricant is maintained at 60°C by means of a free-standing temperature controlled water circulating system.

TE 92/6 Shaft Hub & Heated Reservoir

The TE 92/6 is used for pin on disc and thrust washer tests. In each case the rotating specimen clamps into a holder that mounts on the shaft hub. The shaft hub locates on the outer diameter of the test spindle and is held in place by a pin that passes through the hub and shaft. The fixed specimen clamps into a holder that mounts in the base of the heated reservoir. The reservoir locates on the thrust bearing of the machine load cross-beam and has an integral torque arm for friction measurements. The reservoir is stainless steel and has two electrical resistance heaters in its base. A thermocouple gland is provided so that the temperature sensor can be pressed against the side of the specimen or holder located in the reservoir. Inlet and outlet pipe-fittings are also provided for fluid feed to the reservoir.

The fluid may be fed by gravity or circulated through the enclosure using the TE 92/LS or other suitable circulation system. A lid is provided for the reservoir to minimise loss of fluid by splashing or evaporation.

The following specimen adapters are included with TE 92/6:

Pin on Disc:

- Upper Specimen: Three Rotating Pins
- Lower Specimen: Disc
Upper Specimen: Rotating Disc
Lower Specimen: One Pin
Upper Specimen: Rotating Disc
Lower Specimen: Three Pins

Thrust Washer:
Upper/Lower Specimen: ASTM D3702 (Large)
Upper/Lower Specimen: ASTM D3702 (Small)

TE 92/6/CDS Hub & Reservoir with Displacement Sensor

The TE 92/6/CDS is identical in function to the TE 92/6 Shaft Hub & Heated Reservoir, but with a co-axially mounted capacitance displacement sensor fitted to the reservoir with a target mounted on the rotating shaft hub. As the samples wear, the sensor detects the relative displacement of the fixed specimen with reference to the rotating specimen.
The TE 92/7 adapter uses the lower race and cage of a standard angular contact bearing (SKF 7206), with the inner race replaced by a conical specimen. The cone angle is such that the rolling contact is pure rolling with no spin. With silicon nitride balls in the bearing race, contact pressures up to 5.5 GPa can be achieved. The cone is subjected to the highest number of contacts and thus it is the rolling fatigue performance of the cone material that is investigated in this test configuration.
The TE 92/8 adapter is used to convert the test machine from an axial to a radial loading test configuration. The machine crossbeam is raised and clamped in position below the spindle. The axial loading pneumatic bellows assembly is removed and the Pin on Vee Block/Block and Ring Adapter fitted to the crossbeam. The adapter comprises a linear slide assembly, which moves radially with respect to the spindle axis. The slide assembly incorporates two specimen carriers, allowing two identical specimens (vee, flat or conforming blocks) to be loaded on either side of a pin or ring specimen, carried on the spindle. Load is applied by means of a servo controlled pneumatic bellows, with force transducer feedback, acting on a double lever mechanism. The force on the lever mechanism is reacted by the two specimen carriers.

The complete assembly is carried on a trunnion bearing on the crossbeam and is torque reaction mounted with frictional torque measured by a force transducer. A heater bath is provided for controlling sample fluid temperature. A displacement transducer is provided to measure the relative movement of the two specimen carriers, thus giving a measure of the aggregate wear of the two fixed specimens and the rotating specimen.

**TE 92/9 LVFA Test Assembly**

The TE 92/9 allows small-scale LVFA friction material test samples to be mounted in a test bath of similar construction to the TE 92/6.
TE 92/10 Vane Pump Adapter

The TE 92/10 provides mounting for a three-vane rotating specimen carrier in contact with a fixed flat disc, with the same geometry as devices produced by other manufacturers. Alternative tooling allows the same specimens to be run with the disc rotating and the vanes fixed. In this case, the vanes are independently electrically insulated allowing electrical contact potential measurements to be made between each vane and the rotating disc.

TE 92/11 Suzuki Test Adapter

The TE 92/11 is a modified version on the TE 92/6/CDS adapter, incorporating tooling for carrying
thrust washer samples and with a shaft mounting collet for carrying cylindrical tube specimens with precision ground ends. The test bath incorporates a central lubricant feed and a capacitance probe for on-line wear measurement.

TE 92/12 Three Station Ring on Liner Adapter

Instead of running up and down the liner, the ring samples are run around the internal circumference of a section of liner in either continuous rotation, allowing high sliding speeds to be achieved, or oscillating motion.

![Diagram of TE 92/12 Three Station Ring on Liner Adapter]

The adapter incorporates a fixed section of liner, which forms the specimen bath wall, and a rotating ring sample carrier. Lubricant may be dripped down the wall of the liner section, which is heated with a band heater.
The ring sample carrier has three locations for mounting ring samples. Each ring sample is carried in a lever arm with a pivot point at one end and a roller bearing at the other, the latter engaging with a 45 degree cone, mounted on spline shaft. Applying an axial load to the carrier, results in equal radial load between ring samples and liner.

The ring samples, which provide a straight line contact equivalent to a ring of infinite diameter, are carried in two dimensional spherical seats, allowing self-aligning action.
This adapter uses one half of a standard size 51208 68 mm O/D 40 mm I/D thrust bearing, with the balls running between the normal bearing race and a flat disc. A cage is provided to retain the balls.
TE 92/14 Precision Low Load Adapter

The precision low load adapter comprises a fixed cross beam, with pneumatic bellows and an integral air bearing, allowing precision low load tests to be run at loads down to 1 N. The maximum load is 1000 N. **This adapter is not available on TE 92HP.**

TE 92/15 Electro-chemical Cell & Potentiostat

The electro-chemical test cell allows tests to be run with three rotating ball on disc/pin on disc configurations. It includes a precision low load adapter (1 to 1,000 N) with pneumatic bellows and air bearing, Faraday cage, temperature controlled fluid circulator and precision shaft slip-
rings. A silver/silver chloride reference electrode and a platinum mesh counter electrode are included. The disc specimen is used as a working electrode in a typical three electrode system. The disc is carried on a clamp assembly, designed to avoid crevice corrosion. Electrical contact is made with the disc by means of a spring loaded, gold plated, pin.

The potentiostat, which is triggered by COMPEND, is a Gamry Instruments Reference 600 Potentiostat/Galvanostat/ZRA and is supplied with licenses for the following software:

- DC105 DC Corrosion
- CPT110 Critical Pitting Temperature
- EN120 Electrochemical Noise Experiment
Gamry Echem Analyst software is used to process the data and provide Tafel fit calculation to yield polarisation resistance $R_p$, Tafel Constants $\beta_a$ and $\beta_c$, wear corrosion rate C ($C_o$ and $C_w$), together with the Open circuit potential $E_{oc}$, and current $i_{oc}$, from the OCP experiment.

![Graph of Tafel Plot](image)

Test sequences are provided for experiments in accordance with ASTM G199 “Standard Guide for determining Synergism Between Wear and Corrosion”. **This adapter is not available on TE 92HP.**
TE 92/16 Rolling Contact Fatigue Adapter (Roller Thrust Bearing)

This adapter is essentially similar to TE 92/13, but uses one half of a standard size 81208 TN roller thrust bearing, loaded against a flat lower disc sample, of chosen material. The standard bearing cage is used to locate the rollers, with the cage centred by a spindle mounted deep groove ball bearing.

TE 92/HT 600°C Enclosure for Dry Pin on Disc Tests

The TE 92/HT 600°C incorporates an electrically heated furnace. To ensure that heat conduction to the test spindle bearings is minimised, the TE 92 machine must be manufactured with a longer test spindle and therefore larger frame. This option is thus not available as a retrofit item on existing standard machines and must be specified at the time of order. The adapter is suitable for dry tests in three rotating pin on fixed disc mode only. The available track radius is less than for the TE 92/6 assemblies because of space limitations in the furnace. This adapter is not available on TE 92HP.
TE 92/O Oscillating Drive Adapter

The TE 92/O Oscillating Drive Adapter allows for conversion of the TE 92 to oscillating motion instead of continuous rotation. The angle of oscillation can be set between 0 and 90° with limits on the maximum frequency at large angles. Oscillation motion is useful for wear and friction testing under pin on disc and thrust washer contact conditions. The reversal of motion can result in different wear mechanisms, particularly if wear or abrasive particles are involved. The drive comprises a crank mechanism connecting the motor output shaft to the test spindle. The clutch and pulley assembly of the TE 92 are removed and hubs with locations for the crank arm are mounted on the two shafts. The motor hub has a number of screwed locations for the driving pin to give a range of oscillating angles. A clamping arrangement is provided for the torque arm on the TE 92/6 Heated Reservoir to ensure that the torque transducer monitors the bi-directional friction torques during these tests.

As an alternative to mechanical oscillation, the vector drive can be set to produce oscillating motion at limited frequencies.

This adapter is not available on TE 92HP.

TE 92/LS Lubricant Re-circulating System

The TE 92/LS uses an anodised aluminium bath with inlet, outlet and thermocouple ports. The bath is mounted on a laboratory heater/stirrer unit. A magnetic paddle is placed inside the bath to ensure that the liquid is heated evenly. The temperature of the liquid is monitored by the
thermocouple mounted in the lid and the value is read from a free-standing temperature display unit. The temperature set-point is selected manually on the heater unit.

There are two integrated peristaltic pumps, one to pump liquid from the bath to a test adapter and one to scavenge the fluid from the test adapter and return it back to the bath.

**TE 92/CAL Calibration System**

The TE 92/CAL provides facilities to calibrate Load, Torque and Temperature.

Load is calibrated by means of a calibration arm assembly that is secured to the machine base. The load force transducer is removed from the Load Actuator Assembly and mounted on the calibration assembly. Calibration masses are provided.

Torque is calibrated by removing the force transducer from its mounting and securing it to horizontal fixing locations on the machine base. Calibration masses are then applied directly to the transducer using a weight hanger.

Temperature is calibrated by placing one of the thermocouple sensors in iced water and boiling water. Means of generating ice is not provided.

**TE 92/SCOPE High Resolution Microscope Assembly**

The TE 92/SCOPE enables rapid measurement of the wear scar on the test balls from a sliding four ball test (EP or Wear) without having to removing the balls from the TE 92/3 test adapter. The sliding four-ball test adapter fits onto the base of the microscope assembly. The microscope
is located on angled holder which is set to the standard contact angle of the balls in the machine. This means that the microscope is normal to the centre of the wear scar. The microscope has a rack and pinion focusing system and the wear scar is illuminated by the internal light source. Each ball may be viewed in turn by rotating the test adapter by hand. Two interchangeable eye pieces are provided with internal graticules as follows:

Range 2 mm with 0.01 mm divisions

Range 4 mm with 0.02 mm divisions

The wear scar is measured in one direction and then the eyepiece is twisted 90° to read the second value.
## Adapter Selection for Standard Tests

**TE 92 with TE 92/1, TE 92/2 and TE 92/3**

- ASTM D2266 Wear Preventive Characteristics of Lubricating Greases
- ASTM D4172 Wear Preventive Characteristics of Lubricating Fluid
- ASTM D2596 Extreme Pressure Properties of Lubricating Greases
- ASTM D2783 Extreme Pressure Properties of Lubricating Fluid
- ASTM D5183 Determination of the Coefficient of Friction of Lubricants
- IP 239 Extreme Pressure Properties: Friction and Wear Test for Lubricants
- DIN 51350/1-5 Testing Lubricants: Testing in the Shell Four-Ball Tester

**TE 92 with TE 92/2 and TE 92/4**

- IP 300 Rolling Contact Fatigue Tests for Fluids

**TE 92 with TE 92/2 and TE 92/5**

- DIN 51350/6 Testing of Shear Stability of Lubricating Oils Containing Polymers
- CEC L-45-T-93 Viscosity Shear Stability of Transmission Lubricants (Taper Roller Bearing Rig)

**TE 92 with TE 92/6**

- ASTM G99 Wear Testing with a Pin-on-Disc Apparatus
- DIN 50324 Measuring Friction and Wear: Model Experiments on Sliding Friction in Solids (Ball on Disc System)
- ISO/DIS 7148-2 Testing of the Tribological Behaviour of Bearing Materials
## TECHNICAL SPECIFICATION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TE 92</th>
<th>TE 92HS</th>
<th>TE 92HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotational Speed</td>
<td>30 to 3,000 rpm</td>
<td>30 to 3,000 rpm</td>
<td>2 to 2,000 rpm and 0.735 to 735 rpm</td>
</tr>
<tr>
<td>Spindle Bearing Load</td>
<td>10,000 N @ 3,000 rpm</td>
<td>10,000 N @ 3,000 rpm</td>
<td>10,000 N @ 2,000 rpm</td>
</tr>
<tr>
<td>Maximum Spindle Speed</td>
<td>6,000 rpm</td>
<td>6,000 rpm</td>
<td>6,000 rpm</td>
</tr>
<tr>
<td>Maximum Gearbox Speed</td>
<td>N/A</td>
<td>N/A</td>
<td>2,000 rpm</td>
</tr>
<tr>
<td>Torque Capacity</td>
<td>14 Nm @ 30 to 1500 rpm</td>
<td>14 Nm @ 30 to 1500 rpm</td>
<td>37.5 Nm @ 1,000 rpm</td>
</tr>
<tr>
<td>Motor</td>
<td>2.2 kW ac @ 1500 rpm</td>
<td>2.2 kW ac @ 1500 rpm</td>
<td>4 kW ac @ 1500 rpm</td>
</tr>
<tr>
<td>Heater Block Power</td>
<td>550 W</td>
<td>50% overload for 30 seconds</td>
<td>50% overload for 30 seconds</td>
</tr>
<tr>
<td>Temperature Sensor</td>
<td>k-type thermocouple</td>
<td>piezo-electric</td>
<td>k-type thermocouple</td>
</tr>
<tr>
<td>Vibration Sensor</td>
<td>Phoenix Tribology USB micro-controller interface</td>
<td>COMPEND 2020</td>
<td>COMPEND 2020</td>
</tr>
<tr>
<td>Interface</td>
<td>COMPEND 2020</td>
<td>COMPEND 2020</td>
<td>COMPEND 2020</td>
</tr>
<tr>
<td>Software</td>
<td>COMPEND 2020</td>
<td>COMPEND 2020</td>
<td>COMPEND 2020</td>
</tr>
</tbody>
</table>

### Controlled Parameters

- Rotational Speed
- Temperature
- Load
- Test Duration

### Recorded Parameters

- Rotational Speed
- Friction Torque
- Temperatures
- Number of Revolutions
- Test Duration
- Sliding Speed
- Friction Coefficient
- Sliding Distance

### TE 92/1 Low Load Actuator Assembly
- Load Range: 20 to 1,000 N
- Compatible

### TE 92/2 High Load Actuator Assembly
- Load Range: 200 to 10,000 N
- Compatible

### TE 92/3 Sliding Four Ball Test Assembly
- Ball Size: 12.7 mm (0.5”)
- Temperature Sensor: k-type thermocouple
- Compatible

### TE 92/3/1 Electro-magnetic Clutch
- Maximum Clutch Speed: 1,800 rpm
- 1,800 rpm
- N/A

### TE 92/4 Rolling Four Ball Test Assembly
- Ball Size: 12.7 mm (0.5”)
- Temperature Sensor: k-type thermocouple
- Compatible

### TE 92/5 Shear Test Adapter DIN 51350-6
- Bearing: SKF 32008 X/Q
- Temperature Sensor: k-type thermocouple
- Sump Capacity: 35 litres
- Heater Power: 3 kW
- Pump Flow: 9 litre/minute at zero head
- Compatible

### TE 92/6 Shaft Hub & Heated Reservoir
- Compatible
Reservoir Capacity: 500 ml
Heater Power: 550 W
Temperature Sensor: k-type thermocouple
Maximum Temperature: 200°C

**Three Rotating Pin on Disc**
Track Radius: 10 to 35 mm
Pin Size: 8 mm diameter x 15 mm long
Number of Pins: One, Two or Three
Disc Size: 75 mm diameter

**Thrust Washer Test Adapters**
Thrust Washer: Compatible

**TE 92/6/CDS Reservoir with Displacement Sensor**
Reservoir Capacity: 500 ml
Heater Power: 550 kW
Temperature Sensor: k-type thermocouple
Maximum Temperature: 200°C
Resolution: 0.2 microns

**TE 92/7 Rolling Contact Fatigue Adapter**
Contact Configuration: Cone on ball race - pure rolling
Rolling Bearing: SKF 7206 cage and lower race
Balls: silicon nitride
Maximum Contact Stress: 5.5 GPa
Maximum Speed: 3,000 rpm (TE 92)
10,000 rpm (TE 92HS)
Maximum Temperature: 200°C

**TE 92/8 Pin on Vee Block/Block on Ring**
Contact Configuration: Pin on vee block
Pin on Vee Specimens: Standard Falex specimens
Ring Specimen: Max dia 35 mm x max width 10 mm
Maximum Load: 20,000 N
Rotational Speed: 60 to 1,840 rpm (direct drive)
60 to 3,000 rpm (direct drive)
Torque Capacity: 7.4 Nm @ 60 to 1,840 rpm (direct drive)
4.5 Nm @ 3,000 rpm (direct drive)
Heater Bath Temperature: 200 °C

**TE 92/9 LVFA Adapter**
Contact Configuration: Thrust Washer (LVFA small)
Maximum Load: 1,000 N
Heater Bath Temperature: 200 °C

**TE 92/10 Vane Pump Adapter**
Contact Configuration: Three Vane on Disc
Maximum Load: 1,000 N
Heater Bath Temperature: 200 °C

**TE 92/11 Suzuki Test Adapter**
Contact Configuration: Thrust Washer
Maximum Load: 10,000 N
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heater Bath Temperature:</strong></td>
<td>200 °C</td>
</tr>
<tr>
<td><strong>TE 92/12 Three Station Ring on Liner Adapter</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Contact Configuration:</td>
<td>Line Contact</td>
</tr>
<tr>
<td>Maximum Ring Sample Load:</td>
<td>500 N</td>
</tr>
<tr>
<td>Maximum Liner Temperature:</td>
<td>200 °C</td>
</tr>
<tr>
<td><strong>TE 92/13 Rolling Contact Fatigue (Thrust Bearing)</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Thrust Bearing:</td>
<td>Size 51208</td>
</tr>
<tr>
<td>Maximum Speed:</td>
<td>6,000 rpm</td>
</tr>
<tr>
<td>Maximum Temperature:</td>
<td>200°C</td>
</tr>
<tr>
<td><strong>TE 92/14 Precision Low Load Adapter</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Load Range:</td>
<td>1 to 1,000 N</td>
</tr>
<tr>
<td><strong>TE 92/15 Electro-chemical Cell &amp; Potentiostat</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Contact Configuration:</td>
<td>Three balls rotating on fixed disc</td>
</tr>
<tr>
<td>Contact Configuration:</td>
<td>Three pins rotating on fixed disc</td>
</tr>
<tr>
<td>Potentiostat:</td>
<td>Ref 600 Potentiostat/Galvanostat/ZRA</td>
</tr>
<tr>
<td><strong>TE 92/16 Rolling Contact Fatigue (Roller Thrust Bearing)</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Thrust Bearing:</td>
<td>Size 81208 TN</td>
</tr>
<tr>
<td>Maximum Speed:</td>
<td>6,000 rpm</td>
</tr>
<tr>
<td>Maximum Temperature:</td>
<td>200°C</td>
</tr>
<tr>
<td><strong>TE 92/O Oscillating Drive Adapter</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Oscillating Motion:</td>
<td>+/-10 degrees at 25 Hz</td>
</tr>
<tr>
<td></td>
<td>+/-15 degrees at 20 Hz</td>
</tr>
<tr>
<td></td>
<td>+/-20 degrees at 18 Hz</td>
</tr>
<tr>
<td></td>
<td>+/-25 degrees at 15 Hz</td>
</tr>
<tr>
<td></td>
<td>+/-35 degrees at 10 Hz</td>
</tr>
<tr>
<td></td>
<td>+/-45 degrees at 8 Hz</td>
</tr>
<tr>
<td><strong>TE 92/HT 600°C Specimen Enclosure</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Track Radius:</td>
<td>20 mm</td>
</tr>
<tr>
<td>Pin Size:</td>
<td>8 mm diameter x 15 mm long</td>
</tr>
<tr>
<td>Disc Size:</td>
<td>55 mm</td>
</tr>
<tr>
<td>Heater:</td>
<td>60 V ac ceramic fibre heater</td>
</tr>
<tr>
<td>Heater Power:</td>
<td>1 kW</td>
</tr>
<tr>
<td>Temperature Sensor:</td>
<td>k-type thermocouple</td>
</tr>
<tr>
<td><strong>TE 92/LS Lubricant Re-circulating System</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Bath Volume:</td>
<td>1.2 litres</td>
</tr>
<tr>
<td>Peristaltic Pump Flow:</td>
<td>1 litre/minute (maximum)</td>
</tr>
<tr>
<td>Heating Power:</td>
<td>550 W</td>
</tr>
<tr>
<td>Temperature Range:</td>
<td>ambient to 100°C</td>
</tr>
<tr>
<td><strong>TE 92/SCOPE Digital Microscope Assembly</strong></td>
<td>Compatible</td>
</tr>
<tr>
<td>Magnification:</td>
<td>x 40</td>
</tr>
<tr>
<td>Graticule:</td>
<td>range 2 mm with 0.01 mm divisions</td>
</tr>
<tr>
<td></td>
<td>range 4 mm with 0.02 mm divisions</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td>220/240V, single phase, 50/60 Hz, 7.5 kW</td>
</tr>
<tr>
<td></td>
<td>220/240V, single phase, 50/60 Hz, 7.5 kW</td>
</tr>
<tr>
<td></td>
<td>380/415 V, three phase, 50/60 Hz, with neutral &amp; earth 7.5 kW</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td>4 cfm at 8 bar (120 psi)</td>
</tr>
<tr>
<td></td>
<td>4 cfm at 8 bar (120 psi)</td>
</tr>
<tr>
<td></td>
<td>4 cfm at 8 bar (120 psi)</td>
</tr>
<tr>
<td>Floor-standing machine:</td>
<td>900 mm x 600 mm deep x 2000 mm</td>
</tr>
</tbody>
</table>
Packing Specifications:

350 kg
2.2 m³, GW 550 kg