TE 91 PRECISION ROTARY VACUUM TRIBOMETER



Description

The TE 91 Precision Rotary Vacuum Tribometer is based on a bench mounted test chamber. A motor driven test spindle, in the form of standard rotary feedthrough, projects downwards into the chamber and carries tooling for mounting rotating test samples. A servo motor with encoder feedback provides a variable speed turn-down ratio of 100:1.



The various fixed specimen test adapters can be mounted on a mandrel projecting through the bottom of the chamber and coaxial with test spindle.



The mandrel is sealed to the chamber by means of a flexible stainless-steel bellows. The nonchamber end of the mandrel is attached to a 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 of the load applied outside the chamber.



The force applied by the actuator is adjusted by means of a precision servo pneumatic valve. A second force transducer may be mounted inside the test chamber to measure the resulting inchamber load force in order to calibrate the external load force transducer for different chamber operating pressures.

The friction torque measuring assembly incorporates a linear torsional flexure, the rotary displacement of which is sensed by means of a linear capacitance probe. The capacitance probe is subjected to an oscillating frequency and the response measured correlates with the change in capacitance as the gap between probe and target varies. As a charge as opposed to current device, the sensor is not subject to the unwanted sensor heating effects associated with equivalent strain gauge devices.



The fixed specimen tooling is electrically insulated from its surroundings and the rotating test spindle is fitted with an electrical slip ring allowing electrical contact potential measurements to be made across the specimen contact.

Bake-out heaters are provided within the test chamber to assist with out-gassing.



Control and Data Acquisition

Control and data acquisition are implemented via host PC running COMPEND 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.

Sliding Friction and Wear Tests

Sliding friction and wear tests are performed with test configurations equivalent to those specified in ASTM D2266 (sliding four ball), ASTM D3702 (thrust washer) and ASTM G99 (three in on disc).



Four Ball Adapter



Thrust Washer/Pin on Disc Adapter

Rolling Contact Fatigue Tests

Rolling contact fatigue tests may be performed using the spiral orbit ball on disc test configuration. A lubricated ball is clamped between two parallel plates with one plate fixed and one plate rotating. The ball follows a spiral track and is maintained in orbit by contact once per revolution with an instrumented guide plate.



Spiral Orbit Adapter

Instrumentation used with this adapter includes an orbit counter, piezo transducer and charge amplifier for scrub friction measurement and a high-speed data acquisition card for scrub force data capture.

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Technical Specifications

Tribometer

Load: Rotational Speed: Maximum Friction Torque: Load Actuation: Test Configurations:

Motor Type: Roughing Pump: Vacuum Pump: Interface: Software:

Test Chamber

Vacuum: Environment: Material: Surface Treatment: Viewports: Electrical Feedthrough: Coaxial Feedthrough: Thermocouple: Vacuum Transducer: Leak rate: Rotary Feedthrough: 20 to 2000 N 10 to 1700 rpm 5 Nm Pneumatic Bellows Four ball wear (ASTM D2266) Thrust washer (ASTM D3702) Three pin on disc (ASTM G99) Spiral orbit ball on disc (ASTM F2661) Servo with encoder feedback Rotary vane pump Turbomolecular Serial Link Interface Module COMPEND 2000

Down to 100 Picobar (10^{-5} Pa) Air, inert gas or vacuum 304 stainless steel Glass bead blasted Fused Silica 1 kVolts , 15 Ampere BNC through Flange Type K through Flange Cold Cathode and Pirani < 10^{-7} mbar l/s Pressure up to 10^{-7} Pa Rotary Feedthrough:

Services Electricity:

Computer Controlled Parameters

Manually Controlled Parameters

Recorded Parameters - Sliding Friction & Wear

Recorded Parameters - Rolling Contact Fatigue

Temperature up to 80°C

Rotational Speed Test Duration Load

Operating Pressure

Load Rotational Speed Friction Torque Temperature Operating Pressure Electrical Contact Potential Number of Revolutions Test Duration Sliding Speed Sliding Distance

Load Rotational Speed Scrub Force Temperature Operating Pressure Electrical Contact Potential Number of Revolutions Number of Ball Orbits Test Duration

220/240V, single phase, 50 Hz, 3 kW 110/120 V, single phase, 60 Hz, 3 kW