

PCS Instruments HFR2 High Frequency Reciprocating Rig

Overview

The HFR2 is a computer-controlled reciprocating friction and wear test system which provides a fast, repeatable assessment of the performance of fuels and lubricants. It is particularly suitable for wear testing relatively poor lubricants like diesel fuels and for boundary friction measurements of engine oils, greases and other compounds. Developed in consultation with a major fuel additive manufacturer and the Tribology Section of Imperial College, London, there are currently over 320 systems in use in more than 30 countries world-wide.

Key features

- Standard test for diesel fuel lubricity
- Fast, repeatable friction and wear measurement
- Independently proven repeatability and reproducibility
- Fully automated, computer controlled test sequence
- Easy to calibrate
- Compact, quiet bench top system

Current HFR2 applications include:

- Evaluation of new diesel and gasoline additives
- Determination of optimum additive dose rates for raw fuels
- Quality assurance of outgoing products and incoming materials to ensure conformity with specifications
- Boundary friction coefficient measurements for automobile fuel economy modelling

Operating principles

The system is entirely controlled by an IBM PC-compatible computer via a custom electronic interface. Once the test specimens have been loaded the test sequence is completely automatic, with all test parameters set by the simple menu-driven control software. The software heats the specimens up to the test temperature then starts the test, controlling frequency, stroke length and temperature within very close limits. It also times the test and logs friction coefficient, temperature and specimen contact resistance at user defined intervals.

The mechanical unit uses an electromagnetic drive to oscillate the upper test ball against a fixed lower plate. The digital control system and the absence of bearings and sliding components in the mechanical unit ensures absolute repeatability of stroke length and frequency. Accurate and repeatable loading is ensured by using dead-weights applied to a counterbalanced arm. Platinum RTD temperature probes are used for the specimen and safety cut-out temperature measurements.

Data logging

Collected data is displayed in graph form as the test proceeds. It is continuously updated, saved on disc (in a standard text file format) and can be easily recalled and printed. Wear scar dimensions and operator's comments may also be recorded to provide a complete hard copy record of each test.

Wear assessment

Wear on the standard 6 mm upper specimen ball is easily assessed by measuring the diameter of the wear scar. PCS Instruments can supply a suitably adapted microscope with a 1 μm resolution micrometer stage for this purpose.

Calibration

The system can be completely re-calibrated by the user in about 10 minutes using the supplied calibration kit. The only additional requirement is a reference thermometer or Platinum RTD simulator.

Safety

The control software monitors the temperature of a safety probe permanently mounted in the heater block and if this exceeds a user-set limit the system will shut down. Furthermore, a hardware “watchdog” circuit continuously checks the operation of both the computer and software and if either should fail for any reason, the system will again shut down automatically.

Quality

All components of the system are manufactured by sub-contractors certified to BS EN ISO 9002.

System Components

The standard HFR2 system comprises:

- Mechanical test unit with upper and lower specimen holders for standard specimens (6mm ball and 10mm disc).
- Control and data acquisition system. Controls stroke length, reciprocation frequency, temperature and test duration. Logs all test measurements to spreadsheet compatible file for printout, storage and analysis. Includes IBM-PC compatible computer system and all interface hardware between PC and test unit.
- Calibration kit.
- User manual.
- Tool set (tweezers, allen keys etc.).

Options

- Colour ink jet printer for results print-out.
- Spare upper and lower specimen holders enabling faster turn round between tests.
- Microscope with adapter for upper specimen holder and 1 μ m resolution wear scar measuring micrometer.
- Standard upper and lower specimens.
- Specimens to individual customer specifications.
- AUTOHFR software upgrade which allows multiple temperature steps and ramps during a single test. Widely used for lubricant boundary friction measurements.

Specifications

Mechanical Unit

Frequency	20 to 200 Hz.
Stroke length	20 µm to 2 mm.
Load	0 to 1 kg with supplied weights.
Temperature	Ambient to 120°C as standard, optional high power heaters to 400°C.
Wear resolution	10 ⁻⁶ mm ³ (8x10 ⁻⁹ g) with standard specimens.

Control System

Type	PC-based digital controller.
Software	Custom Windows software.
Functions	Controls stroke length, reciprocation frequency, temperature and test duration. Allows recall and printout of test data as required.
Safety checks	Safety RTD for over temperature, watchdog circuit shuts system down in case of PC or software failure.
Data Logging	Logs friction coefficient, temperature and % film at user defined intervals.
File Format	ASCII tab delimited text. Easily imported into any spreadsheet application.
Electrical Supply	100/120/230/240VAC, 50/60Hz, 400VA. (Specify when ordering).

Weight

Mechanical unit	25 kg (55 lb)
Electronics unit	10 kg (22 lb)
PC	15 kg (28 lb) (typical)

Dimensions

Mechanical unit	H	225 mm	(9 in)
	W	150 mm	(6 in)
	D	340 mm	(13.5 in)
Electronics unit plus PC	H	600 mm	(24 in)
	W	550 mm	(22 in)
	D	400 mm	(16 in)