

Accurate Four-Ball Testing for Wear and Extreme Pressure!

Four-Ball Wear Tester

(020-001-003)

The Falex Four-Ball Wear Tester determines the relative wear-preventive properties of lubricating fluids and greases in sliding and rolling applications. It is the only test machine proven through cooperative inter-laboratory testing to meet requirements of ASTM D2266 and D4172.

The machine compares lubricants using the average size of the scar diameters worn on three, lubricant-covered, 1/2 inch diameter steel balls that are clamped together, with a fourth ball seated within the cavity.

Features:

- » ½ HP motor that drives the rotating ball at 1,200 rpm
- » Loads up to 60 kg. [with lever arm and weight hager]
- » Temperature system which controls the initial temperature set point (ambient to 171° C) and displays the lubricant temperature during the test.
- » Timer system that controls the test duration from 1 sec. to 999 hours
- » Speed indicator and controller

Variable Drive Four-Ball Wear Tester

(019-001-320)

Features:

- » 1 HP variable speed motor and a standard operating range of 60-3,600 rpm, with optional systems for rotational speeds up to 10,000 rpm
- » Pneumatic load system for loads up to 180 kg, with regulator and display
- » Digital friction measurement system to display test friction force (up to 1,000 g) with load cell and air bearing assembly
- » Speed indicator and controller
- » Optional system for controlling the atmosphere in the test cup



Four-Ball Extreme Pressure (EP) Tester

(018-001-012)

Developed by the Shell Oil Company in the 1940's, the Four-Ball EP Tester measures lubricant extreme pressure properties. It is available in two configurations for ASTM and IP Standard Test Method. The machine tests High Hertzian contact in in pure sliding, or pure rolling, motion to determine load-carrying properties of a lubricant at high test loads. Lubricants are compared using the average size of the scar diameters worn on three, lubricant-covered, 1/2 inch diameter steel balls that are clamped together with a fourth ball seated within the cavity. The fourth ball rotates for the test. The machine features scar diameters worn on the three lower clamped balls.

- » Determines LWI (Load-Wear Index) to quantify the wear protection at increasing loads
- » Determines LNSL (Last Non-Seizure Load) to indicate the transition from elastohydrodynamic to boundary lubrication and metal to metal contact.
- » Determines WP (Weld Point (WP)
- » Available for ASTM, IP and CEC L test systems

The EP Wear Tester comes in a standard system for ASTM and IP standard test methods and a high-performance system with data acquisition. (018-001-013)



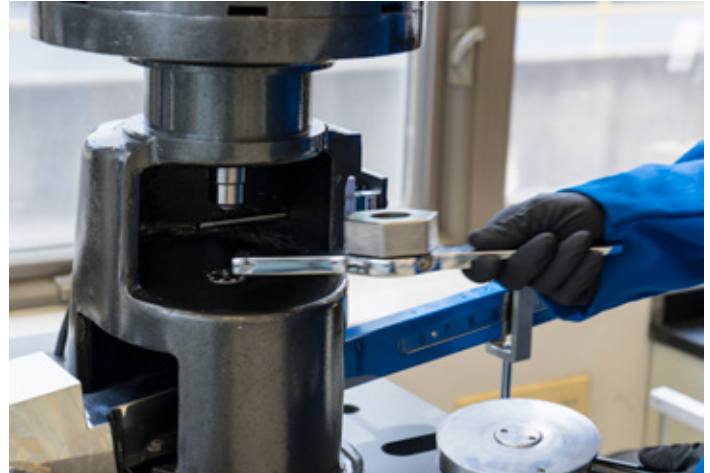
Technical Specifications

Four-Ball Wear Tester

Load	180 kg. max (019-001-320) Dead weight and mechanical lever, 50 kg. max (020-001-003)
Speed	60 to 3600 rpm continuously variable 1 to 3,600 rpm with speed conversion options (019-001-320) 1,200 rpm (020-001-003)
Temperature Control	Control from ambient to 200°C; Auto start-up upon reaching test temperature
Test Duration	Programmable Timer (1 second to 999 hours)
Friction Measurement	Load Cell Assembly and Display of Test Friction Force (019-001-320) N/A (020-001-003)
Environments	Dry or lubricated (fluids, greases, dry film)
Space Requirements	66 in (H) x 36 in (D) x 32 in (W) (168 cm x 91 cm x 81 cm)
Utility Requirements	220V, 60Cycles (50 Cycle optional), Single Phase, 10 Amps 80 psig clean dry air (Model F-1519)
Shipping Information	750 lb. (341 kg); 43 in x 36 in x 75 in (109 cm x 91 cm x 191 cm)



Four-Ball EP Tester



Load	1000 kg max, applied using a lever arm and dead weight loading system
Speed	200-1800 rpm
Motion	Sliding Rolling (with optional rolling 4-ball race)
Space Requirements	72 x 60 x 65 in [L x D x H] 183 x 152 x 165 cm
Power	220 Volts, 60 Hz, Single Phase, 15 Amps. 50 Hz optional
Shipping Information	900 lb / 408 kg 56 x 36 x 65 in / 142 x 91 x 165 cm [L x W x H]

Four-Ball Wear Tester Options

Standard Four-Ball Wear Tester (020-001-003) includes:

- » ½ HP Single Speed Motor, 1,200 rpm
- » Mechanical Loading System (Lever Arm and Weight Hanger, 60 kg. max load)
- » Test Duration Timer
- » Temperature Controller System (Heater Assembly w/automatic test start - 171° C max)
- » Ball Assembly and Fixtures (Ball cup with Thermocouple, Ball Chuck, Ball Cup tightening base, Ball Cup Disk Adapter, 0-25lb-in Torque Wrench, Heater Assembly)
- » Emergency Stop Switch

Variable Drive Four-Ball Wear Tester (019-001-320) includes:

- » 1 HP Variable Speed Motor (60 to 3,600 rpm) w/speed indicator and controller
- » Pneumatic Loading System
- » Test Duration Timer
- » Friction Measurement System (includes load cell and air-bearing assemblies)
- » Temperature Controller System (Heater Assembly (200° C max) w/automatic test start)
- » Ball Assembly and Fixtures (Ball cup with Thermocouple, Ball Chuck, Ball Cup tightening base, Ball Cup Disk Adapter, 0-25lb-in Torque Wrench, Heater Assembly)
- » Emergency Stop Switch

Accessories

Standard Four-Ball Wear Cup Assembly (019-105-004) - fig 1

Standard Test Cup, Disk, Clamp Ring, Lock Nut and Thermocouple

Clamp Ring Lock (006-105-007) - fig. 2

Clamp Ring (006-099-201) - fig. 3

Cup Disk (019-010-002) - fig. 4

Disk Adapter (019-108-003) - fig (5)

Uses three ¼ inch diameter by 1/16 inch thick disk specimens (F-1519-56) in place of lower balls for alternate material combinations.

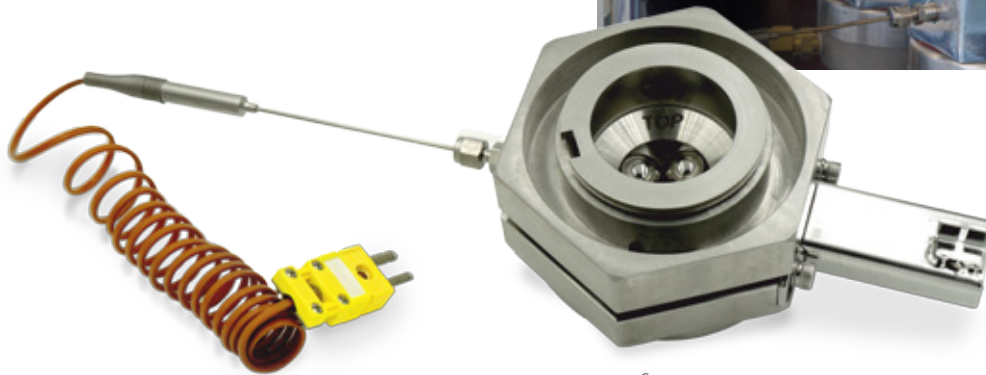
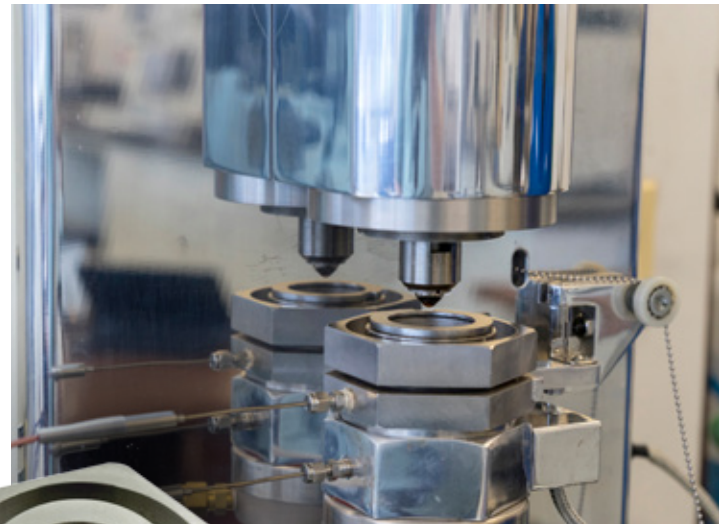


fig 1



fig 2



fig 3



fig 4

Four-Ball EP Tester Options

Falex Four-Ball Extreme Pressure Tester
(018-001-1012) includes:

- » Two-speed Motor and Test Spindle
- » Dead Weight Load System and Weights
- » Timer and Test Shut-Off
- » Ball Cup Assembly
- » Test Stand
- » Test Cup Table Fixture
- » Torque Wrench
- » Upper Ball Chuck

Accessories

Standard Four-Ball EP Cup Assembly
(018-099-002) - fig. 6

- Ball Cup (018-015-002) - fig. 7
- Ball Cup Nut (018-016-001) - fig. 8
- Ball Clamp Ring (018-010-004) - fig. 9
- Cup Disk (018-010-003) - fig. 10
- Ball Chuck (020-099-028) - fig. 11
- Disk Fixture (020-200-001) - fig. 12

For punching $\frac{1}{4}$ in diameter by $\frac{1}{16}$ in thick disks in place of lower balls for alternate material combinations.

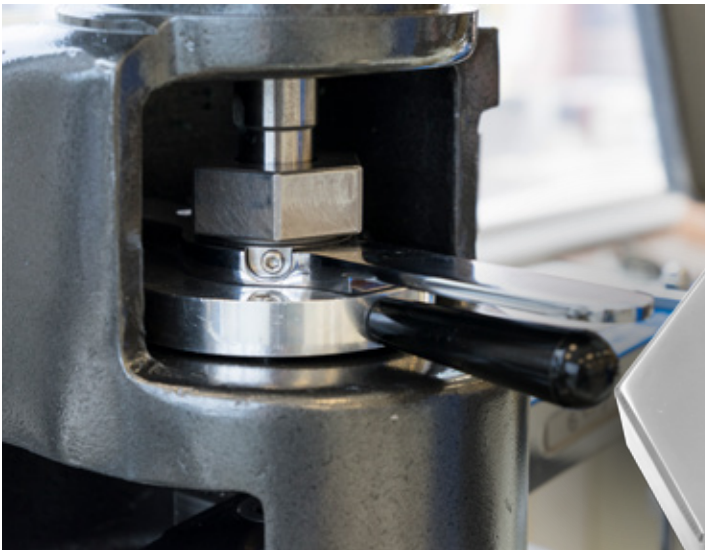


fig 6



fig 7

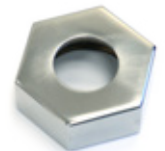


fig 8

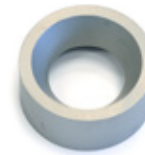


fig 9



fig 10



fig 11



Falex Scar Measurement System

(For both the Four-Ball Wear & EP Testers)

Digital Scar Measurement System with CCD Camera (100-200-023)

Includes a CCD camera and digital display of ball scar and capability of measurement on screen to 0.001mm. System includes ball cup stand with single ball holder and CCD camera with USB port for recording scar diameters to Falex computerized data acquisition system or host computer. An optional adapter allows for reading the ball scars without removal from the ball cup.

Ordering Information

EP or Wear Tester (WT)	Product Name	Description
<i>Equipment Components</i>		
WT	Falex Four-Ball Wear Tester	See page 1-2
WT	Falex Variable Drive Four-Ball Wear Tester	See page 1-2
EP	Falex Four-Ball Extreme Pressure Tester	See Page 1-2
<i>Options and Accessories</i>		
EP	Four Ball Wear Testing Kit	Includes precision test load assembly and Wear Test Cup
EP	KRL Mechanical Shear Stability Adapter Assembly	Determines shear loss of polymer containing multi-viscosity gear oils used in heavy duty manual transmissions and differentials. For CEC L-45-A-99
EP	Ball Cup Assembly	See Page 4, fig. 6
EP	Ball Cup Assembly with Thermocouple	See Page 4, fig. 12
<i>Options and Accessories (continued)</i>		
Both	#28 Ball Chuck	Holds upper rotating ½ inch diameter ball during testing, page 4, fig. 11
EP	Disk Adapter	See page 3, fig. 5
Both	Disk Fixture	See page 4, fig. 12
EP	Thermocouple Assembly	
EP	Rolling Four-Ball Cup Assembly	Accommodates lower rolling specimen race for testing under rolling conditions. Includes one lower specimen race (F-1518-9B). Purchase of F-1518-9, Pitting Detection Device, is strongly recommended.
WT	Standard Ball Cup Assembly	See Page 3
WT	Rolling Four-Ball Cup Assembly	Includes Rolling Ball Cup, Lock Nut and Thermocouple
WT	Rolling Four-Ball Specimen Race	Rolling Test Specimen evaluating materials under rolling conditions. Requires F-1519-5A.
WT	Thermocouple	Ball cup thermocouple
WT	Disk Adapter	Uses three ¾ in diameter by 1/16 in thick disk specimens (F-1519-56) in place of lower balls for alternate material combinations.
WT	Four-Ball Wear Load Calibrator	Includes Calibration load cell and meter for the pneumatic load system on model F-1519.
<i>Scar Measurements</i>		
Both	Digital Scar Measurement System with CCD Camera	See Page 4
<i>Test Specimens</i>		
EP	Falex Test Specimen Balls	AISI E 52100 steel. 500/box. Balls conform to ASTM D2596 and, D2783.
EP	Bearing Test Specimen	for KRL Test CEC L-45-T-93
Both	Rolling Four-Ball Specimen Race	Replacement lower specimen race for evaluating materials under rolling conditions.

EP = Falex EP Test Machine WT = Falex Wear Test Machine

Falex Corporation follows a policy of continuous product improvement. Specifications are subject to change without notice.

Standard Test Methods

Four-Ball Wear Testers Used In Standard Test Methods

ASTM D2266	Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)
ASTM D4172	Standard Test Method of Wear Preventive Characteristics of Lubricating Fluids (Four-Ball Method)
ASTM D5183	Standard Test Method for Determination of the Coefficient of Friction of Lubricants Using the Four-Ball Wear Test Machine
IP 300	Rolling Contact Fatigue Tests for Fluids in a Modified Four-Ball Machine

* High Performance EP Tester or Falex Four-Ball

** Test results allow prediction of in-service permanent viscosity loss. Requires High Performance EP Tester with accessory kit or Falex Four-Ball

Four-Ball EP Tester Used In Standard Test Methods

ASTM D2266	Standard Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)*
ASTM D2596	Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)
ASTM D2783	Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Four-Ball Method)
ASTM D4172	Standard Test Method for Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method)*
CEC L-45-A-99 (KRL)	Viscosity Shear Stability of Transmission Lubricants**
IP 239	Determination of Extreme Pressure and Anti-Wear Properties of Lubricating Fluids and Greases (Four-Ball Method)
DIN 51350-1	Testing of lubricants; testing in the Shell-Four-Ball tester, general working principles
DIN 51350-2	Testing of lubricants; testing in the Shell-Four-Ball tester, determination of welding load of fluid lubricants
DIN 51350-4	Testing of lubricants; testing by the Shell-Four-Ball tester; determination of welding load of consistent lubricants
DIN 51350-6	Determination of shear stability of polymer-containing lubricating oils by the Shell Four-Ball Tester

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