

Product Catalog 2016



**Viscometer/Rheometer • Core Flow • Foam Loop • Lubricity Tester • Consistometer
Curing Chamber • Filtration • UCA • Linear Swell Meter • Sagging Tester
Acidizing/Fracturing Fluids • Tensiometer • Drilling Simulation**

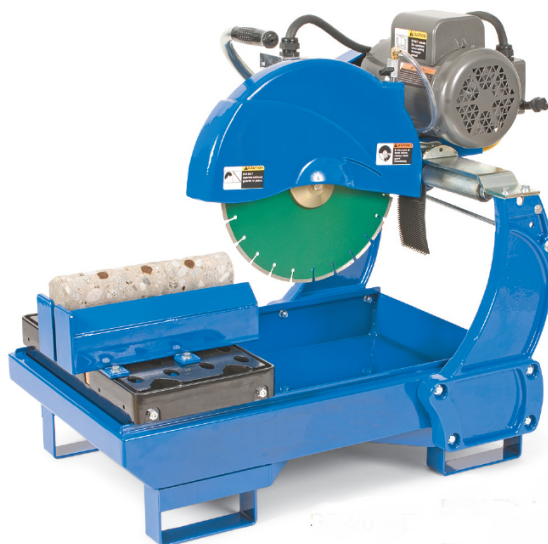
M1502 Wet Cutting Core Saw

The precision-built saws are designed for rapid and accurate sawing of exploratory core specimens. Hard rock samples along with other dense material can be cut using the saw's 14-inch segmented diamond blade.

The adjustable height of the cutting head accommodates specimen sizes between 1 inch and 5 inches in diameter.

Features

- Stay level blade guard gives 180° coverage at all times
- Blade shaft is built with sealed, permanently lubricated, heavy duty bearings
- Cast-aluminum structural components & jig welded steel frame assembly
- Convenient ON/OFF switch for operator safety
- Recoil spring return cutting head
- Cast aluminum blade guard with stainless steel water tubes that will not bend or rust
- Adjustable water supply for maximum blade protection
- Thermally protected 3 HP Baldor motor on electric saw
- Submersible electric water pump
- One-year limited warranty



Specifications

Power:	3 HP, 230V
Amperage:	12.5 Amp
Blade Capacity:	14 in.
Max Core Length:	12 in.
Max Core Diameter:	5 in.
Min Core Diameter:	1 in.
Weight:	172 lbs.
Dimensions:	29 in. Height 23 in. Width 35 in. Length

M1741 Aging Cell

Grace Instrument aging cells were designed to be used with the Grace Instrument M1740/M1750 Roller Ovens, in the aging and testing of drilling fluids or muds. It allows samples to be maintained in a liquid state while subjected to a temperature higher than the boiling point of water due to pressure.

Most drilling fluid properties are formulated through a base liquid and additives that must be dissolved or mechanically distributed within the base liquid to form a uniform, homogeneous fluid. As a result, properties of the fluid may contain one or more of the following:

- Water-soluble (dispersible) polymers or resins
- Clays or other insoluble but dispersible fine solids
- Soluble salts

The fluids are mixed or sheared for an appropriate amount of time to achieve a homogeneous composition and afterwards set aside to age. The process of aging depends on conditions that may vary from static to dynamic and from ambient to highly elevated temperatures.

Features

- Available in 3 premium metals: stainless steel (grade 303 or grade 316) or hastelloy construction.
- High temperature testing, even through prolonged salinity.
- Designed for pressurizing fluid samples
- Meets API Recommended Practice 13 B-1/ 13B-2.



Specifications

Capacity:	500 mL, 260 ml
Max Temperature:	500°F (260°C)
Max Pressure:	2000 PSI (13.8 Mpa)
Material Options:	303 Stainless Steel, 316 Stainless Steel, C-276 Hastelloy

Roller Ovens M1740/M1750

Grace Instrument M1740 and M1750 Roller Ovens provide high temperature environments and agitation for aging fluid samples for laboratory use.

Ease of use

Grace Instrument Roller Ovens have two size option (4-roll M1740 and 5-roll M1750) to meet different capacity requirements.

Aging Cell Capacity

Model	Roller No.	260 ml Cell	500 ml Cell
M1740	4	6	3
M1750	5	12	8

Corrosion resistant materials applied on rollers and oven enclosure to ensure enduring machine quality. A digital temperature controller and an extra temperature limit controller give safe and reliable high-temperature running up to 500° F. Delayed start, delayed stop, and immediate start can be set by a programmable timer. A voltage selector installed allowing machine to operate at 115VAC or 230VAC.

Features

- *Stainless steel enclosure and rollers*
- *Digital temperature controller and limit temperature controller*
- *K type thermocouple connection installed on front panel for data log*
- *Evenly distributed heat by inside air circulation*



Specifications

M1740

Dimensions: 22"W x 25"D x 26"H
 Weight: 155 lbs
 Temperature Range: Ambient to 500°F
 Heater Power: 1000 W
 Power Supply: 110-230V, 50/60 Hz

M1750

Dimensions: 26"W x 31"D x 26"H
 Weight: 170 lbs
 Temperature Range: Ambient to 500°F
 Heater Power: 1000W Heater
 Power Supply: 110-230V, 50/60 Hz

HPHT Lubricity Testing

The M2170 HPHT Dynamic Lubricity Tester offers a computer-controlled test environment which can realistically simulate downhole conditions of temperature and pressure while allowing the user to HPHT lubricity testing on solid to solid surfaces with liquid or particulate lubricants.

Fully customizable, completely user controlled

The M2170 HPHT Lubricity Tester tests the lubricity of a sample fluid by axially rotating a rubbing shoe while a metal or core sample is pressed against it. As the rubbing shoe wears away the surface of the sample, the rotating torque and upward force yield the friction factor and lubricity.

The M2170 is the only lubricity tester currently available in the USA that is designed to test lubricity performance on different types of drilling fluids such as oil-based, water-based, and synthetic-based drilling fluids at high-pressure and high-temperature conditions.

Under dynamic testing operations, the instrument is capable of producing dependable test results that simulate highly realistic conditions, which can be used to evaluate proper mud systems, drill string design techniques, or determine optimal lubricant additives. The data is collected through custom PC software and is completely user-controlled. Analysis from this data helps the operator predict, improve, or minimize the role of drill fluid techniques within oilfield operations.



Lubricity Tester Specifications:

Temperature Range:	Amb. to 500 °F
Working Pressure:	2,000 psi
Max Torque:	42.5 pound inch (4.8 N m)
Max Power Requirement:	1,800 watts
Heater Power:	1,200 watts
Power Supply:	120/240 V, 50/60 Hz
Sample Volume:	400 mL
Filtrate Volume:	50 mL
Shear Bob Speed:	0 to 2,000 rpm

Operational Features:

- Fully customizable test parameters
- Automatic pressure & temperature control
- Automatic data collection
- Paddle assembly is durable for extensive testing
- Measures fluid resistivity of various lubricants
- In accordance with API Recommended Practice 10B-2
- Maximum Speed up to 2,000 rpm
- Design of cooling jacket allows rapid cooling of test cells, lessening setup time between finishing one test & beginning a new one

HPHT Lubricity, Dynamic Filtration, and Drilling Simulation Multifunction Tester

The M2200 HPHT Lubricity, Dynamic Filtration, and Drilling Simulator provides multiple test functions in one compact unit, offering a computer-controlled test environment which can realistically simulate high pressure high temperature downhole conditions while allowing the user to perform multiple test functions, saving money, training and research time, and the laboratory space that multiple test devices would otherwise require.

The **M2200** is engineered for laboratory HPHT testing of fluid lubricity, filtration, and the simulation of a downhole drilling environment.

- fully-customizable test parameters
- automatic pressure & temperature control
- automatic data collection

Real HPHT Dynamic Lubricity Test

The M2200 is the only HPHT lubricity tester currently available in the USA that is designed for evaluating dynamic lubricity performance on different types of drilling fluid, such as oil based drilling fluid, water based drilling fluid, synthetic based drilling fluid and all oil based drilling fluid, at high pressure and high temperature reservoir conditions that are completely user-controlled. Besides, chemical additives can be blended into the drilling fluid to evaluate the change in the lubricity performance. Refer to Fig. 1.

The M2200 tests the lubricity of the drilling fluid by axially rotating a rubbing shoe while a metal or core sample is pressed against it. Rotating torque and upward force yields the friction factor and lubricity. The user can also test customized geometries and materials by replacing the shoe component, such as drilling string and casing materials. From this information, the user can recommend proper mud systems, determine optimum lubricant concentrations, develop new lubricant additives, predict drill string loads, minimize torque and drag, and improve drill string design techniques.

Differential Sticking Test

A differential sticking test can be performed whereafter the filter cake has been deposited, the load is applied and then the rubbing shoe is rotated. The torque required to move the rubbing shoe is measured.

Lubricity and Differential Sticking Test Specifications:

Temperature Range:	Amb. to 500 °F
Working Pressure:	2,000 psi
Max Torque:	42.5 pound inch (4.8 N m)
Max Power Requirement:	1,800 watts
Heater Power:	1,200 watts
Power Supply:	120/240 V, 50/60 Hz
Sample Volume:	400 mL
Filtrate Volume:	50 mL
Shear Bob Speed:	0 to 2,000 rpm
Coefficient of Friction (COF) Accuracy:	+/- 0.01 (when COF < 0.15)



U.S. Patent: 9,194,784

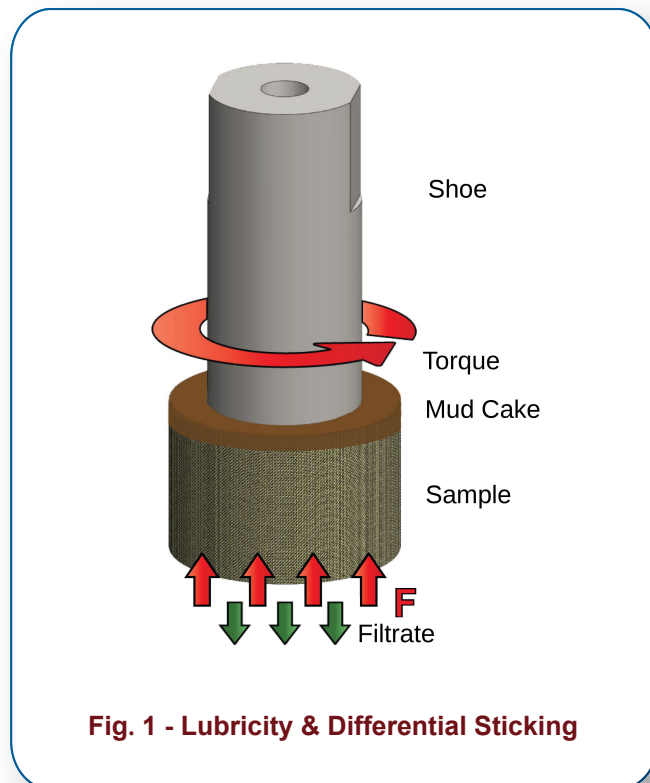


Fig. 1 - Lubricity & Differential Sticking

Dynamic HPHT Filtration Test

The M2200 includes a pressurized, temperature-controlled environment containing a filtrate medium which realistically simulates a downhole well bore (refer to Fig. 2). It is available in a variety of porosities and permeabilities to simulate reservoir formations. When the simulation chamber is filled with drilling fluid under either static condition or re-circulation condition, a shear bob simulates the drilling string centrally or off-centrally rotating inside of the filtrate medium to produce a shear inside of the filtrate medium. The filter cake deposit becomes visible on the interior of the filtrate medium as the fluid is sheared, and the resulting build-up can be examined following the completion of the test. An optional mud circulation pump is available at reduced temperature and pressure conditions.

Dynamic HPHT Filtration Test Specifications:

Temperature Range:	Amb. to 500 °F
Working Pressure:	2,000 psi
Max Differential Pressure:	500+ psi (or by core strength)
Max Power Requirement:	1,800 watts
Heater Power:	1,200 watts
Power Supply:	120/240 V, 50/60
Sample Volume:	400 mL
Filtrate Volume:	50 mL
Shear Bob Speed:	0 to 2,000 rpm

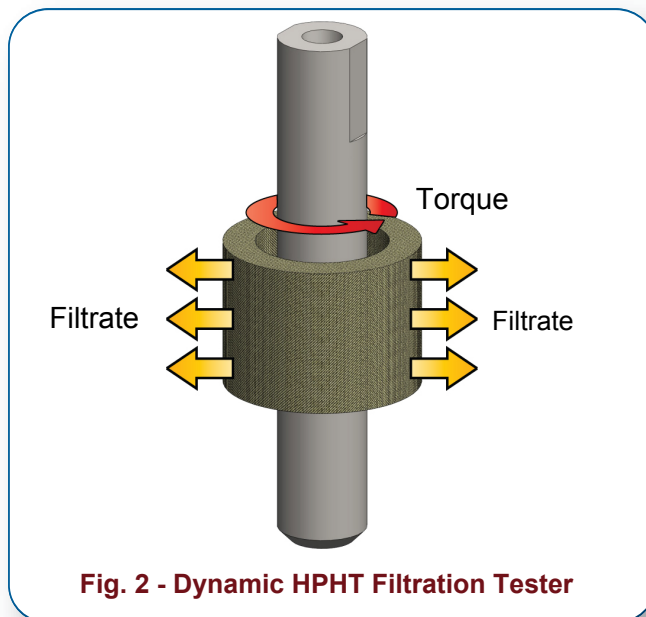


Fig. 2 - Dynamic HPHT Filtration Tester

Particle Plugging Test

Lost circulation is the uncontrolled flow of whole drilling fluid into a formation with no return to surface, especially within those formations that are inherently fractured, cavernous, or have high permeability. Lost circulation also occurs when improper drilling operations damage the mud cake as drilling fluid invades and further damages the formation.

The M2200 includes a specialized filtrate medium with an artificial fissure that can be used to perform particle plugging tests, which determine the effectiveness of additives to help prevent lost circulation in the filtrate medium (see Fig. 3). Particle plugging tests also determine the effectiveness of bridging materials. M2200 simulates an off-centric drilling string rotating and damaging the filter cake, and thus, measures the performance of bridging materials on improvement of fluid loss.

Particle Plugging Test Specifications:

Temperature Range:	Amb. to 500 °F
Working Pressure:	2,000 psi
Max Differential Pressure:	Determined by core strength
Max Power Requirement:	1,800 watts
Heater Power:	1,200 watts
Power Supply:	120/240 V, 50/60 Hz
Sample Volume:	400 mL
Max Filtrate Volume:	50 mL
Shear Bob Speed:	0 to 2,000 rpm

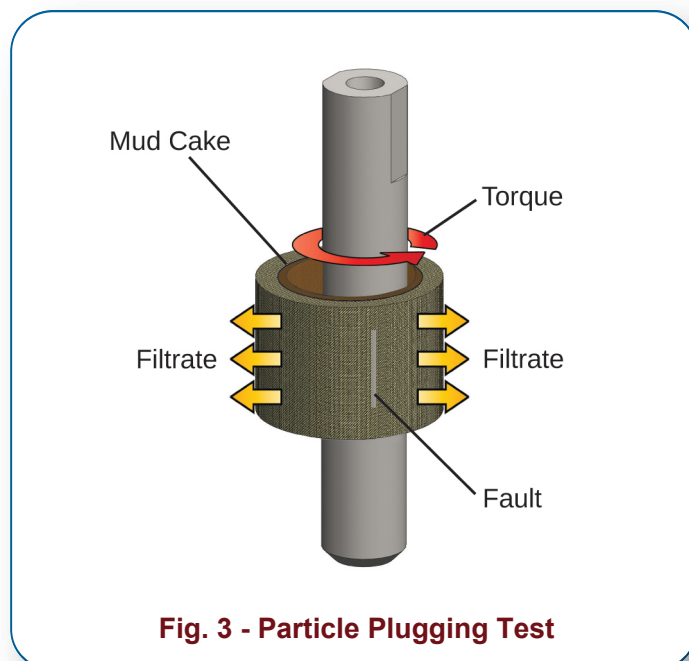


Fig. 3 - Particle Plugging Test

Real HPHT Drilling Simulation System

The M2200 can be also used to simulate drilling operations and optimize mud systems to reduce overall drilling costs. (Refer to Fig. 4.) The M2200 hardware includes an ultra-realistic well-bore simulation chamber, which allows the user to test the penetration rate on actual core samples using a real drill bit (shown in Fig. 5).

The core sample options can be different types, such as sandstone, limestone, ceramic, etc., allowing the user to select for the matching rock parameters of the reservoir to be drilled. The penetration rate is measured through linear transducers. The pressure and temperature of the simulation chamber are controlled by custom M2200 PC software, which monitors and records test results in real time. Filtration during the drilling process is measured and recorded as well.

Drilling Simulator Specifications:

Temperature Range: Amb. to 500 °F
 Working Pressure: 2,000 psi
 Max Differential Pressure: 500+ psi (or by core strength)
 Max Power Requirement: 1,800 watts
 Heater Power: 1,200 watts
 Power Supply: 120/240 V, 50/60 Hz
 Sample Volume: 400 mL
 Filtrate Volume: 50 mL
 Shear Bob Speed: 0 to 2,000 rpm

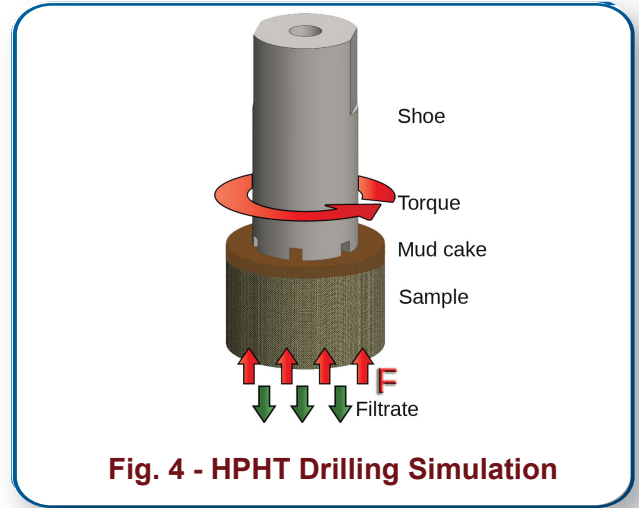


Fig. 4 - HPHT Drilling Simulation



Fig. 5 - A real drill bit is used to simulate drilling

M2200 PC Software

The M2200 instrument includes custom software called M2200 PC (refer to Fig 6), which gives the user the ability to create test sequences with these parameters:

- Temperature
- Pressure
- Differential pressure
- Shear rate

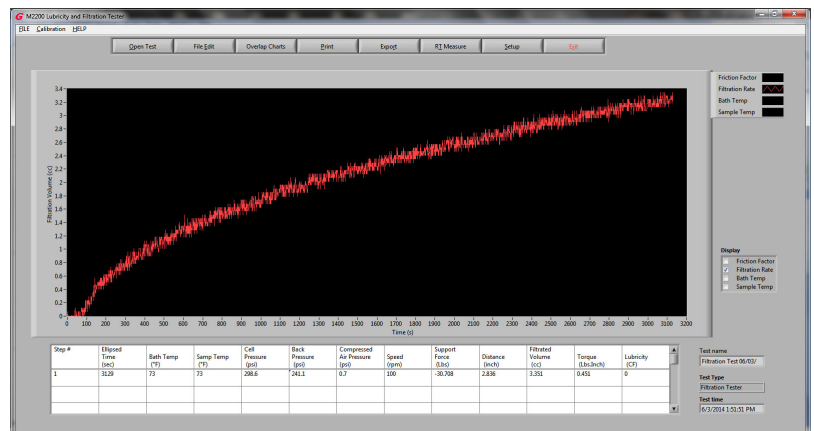


Fig. 6 - M2200 PC software

M3080 Variable Speed Mixer

The M3080 Variable Speed Mixer is specifically designed to meet oil industry testing requirements. It functions as a mixer for cement and other shear-sensitive dry or fluid materials and complies with all existing API guidelines. *In addition, when testing cement, wide variations in shear rate are avoided as the M3080 holds the speed constant for 15 seconds (as specified by API Spec 10, Sec. 5) without operator attention, so that the cement can be added slowly.*

Customizable Speed Sequences

Users can create custom speed and timing sequences using the M3080 Variable Speed Mixer controls. This allows the creation of mixing sequences which are exactly configured to meet the requirements of your test fluids and cements. Then, once created, these customized sequences can be run automatically, at the touch of a button. Alternatively, two constant speed ranges, 4,000 rpm and 12,000 rpm for cement, and 500 rpm and 1,000 rpm for fracturing fluids, are also available automatically, allowing the user to choose an API speed while adding cement.

Lightweight But Durable

The robust design features a steel structure with a stainless-steel mixing container. This allows the M3080 to operate under harsh conditions and endure rigorous test schedules with a minimum of maintenance.



Operational Features

- Durable stainless steel mixing blades that can withstand abrasive action
- Two preset mixing speeds
- Variable speeds
- Complies with all API standards
- Microprocessor-controlled speeds allow operator to set customized speed acceleration rate
- User-friendly LCD display of rpm and time
- Rotational speed is maintained at set point with microprocessor
- Timing relays automatically control mixing at the required rpm
- No variation in thickening time tests due to changes in shear rate
- Operator can quickly select API speeds while adding cement to mixer.

Mechanical Specifications:

Cement Speed Ranges:	4,000 rpm & 12,000 rpm
Frac Fluid Speed Ranges:	500 rpm & 1,000 rpm
Dimensions / Footprint:	26" H x 16" W x 11" D
Weight:	35 lbs
Construction:	Stainless steel

Utility Requirements:

Electrical Supply Voltage:	115 VAC to 220 VAC (can operate with 1.25 KVA power supply)
Line Frequency:	50 to 60 Hz

Durable, Reliable, and Affordable

The M3400 is a 9-speed Couette coaxial cylinder rotational viscometer and incorporates years of customer feedback into its design. The M3400 features a steel framework and robust electronics and is engineered to meet the various fluid rheology measuring needs of our customers, from on-site oilfield personnel doing single-speed tests in harsh environments to laboratory researchers doing advanced rheology tests. The innovative design and rugged construction of the M3400 Viscometer makes it versatile and portable--at home, in the field or in the laboratory.

Hassle-Free Speed Change

Currently, industry standard viscometers shift through different rotational speeds with a control knob that requires some finesse to operate. The M3400 takes all of that hassle away with a control pad, allowing any speed at any time.

One Touch Start Tests

The M3400 comes pre-programmed with the popular test sequences: 10-second gel strength and 10-minute gel strength. With the touch of a button, the manual shifting of speeds in these processes are eliminated. This results in more repeatable test results.



Specifications

Bob size:	(B1, B2, B3 bob)
Sample Size:	35-190 ml (depending on size of bob, cup, sleeve)
Speed:	600, 300, 200, 100, 60, 30, 6, 3, 0.1 rpm
Shear Rate:	0.17 to 1021 S ⁻¹
Temperature:	Ambient
Pressure:	Atmospheric pressure
Viscosity:	0.5 to 10,000,000 Centipoise
Shear Stress:	1.02 to 61,200 dyne/cm ²
Resolution:	1 dyne/cm ²
Accuracy:	±0.5% of torque span or better
Dimensions:	16.5" H x 5" W x 8" D
Weight:	10 lbs
Voltage:	100 VAC to 240 VAC, 50/60 Hz

Bob Specifications:

ROTOR-BOB	R1 B1	R2 B1	R3 B1	R1 B2	R1 B3
BASIC DATA					
Rotor Radius, R _r , cm	1.8415	1.7588	2.5866	1.8415	1.8415
Bob Radius, R _b , cm	1.7245	1.7245	1.7245	1.2276	0.8622
Bob Height, L, cm	3.800	3.800	3.800	3.800	3.800
Shear Gap, in Annulus, cm	0.1170	0.0343	0.8261	0.6139	0.9793
Radii Ratio, R _r / R _b	0.9365	0.9805	0.667	0.666	0.468
Maximum Use Temperature, °C	93	93	93	93	93
Minimum Use Temperature, °C	0	0	0	0	0
Overall Instrument Constant, K	300.0	94.18	1355	2672	7620
Standard F1 Torsion Spring					
$\eta = Kf\theta/N$					

M3400 keypad and dial reading



Durable, Reliable, and Affordable Digital Power

The Grace Instrument M3600 Viscometer is a torque, coaxial cylinder, rotational viscometer and incorporates years of customer feedback into its design. The M3600 features a steel framework and robust electronics, and is engineered to meet the various fluid rheology measuring needs of our customers, from on-site oilfield personnel doing single-speed tests in harsh environments to laboratory researchers doing advanced rheology tests. The innovative design and rugged construction of the M3600 Viscometer makes it versatile and portable, at home in the field or in the laboratory.

Software to cover all tests, from general viscosity to specialty

The included *M3600Frac™* software is designed for measuring fracturing fluids, while *M3600DAQ™* is designed for general viscosity measurement and mud testing.

Two Operational Modes - Stand-alone or Integrated with PC

The M3600 Automatic Viscometer can be used as a stand-alone unit, enabling users to create test sequences and record test data without the use of external equipment. It can also be connected to a Microsoft Windows PC operating our custom software for advanced test operations, test results analysis, and to export test data in spreadsheet format.



M3600 has two operating modes:

1) Stand-alone Mode:

- Perform standard API tests by pressing two keys - Press 5, 6, or 7 to bring up a selection of pre-programmed tests, then press the key for the test you want.
- Quickly create multiple custom test steps and save the results of your tests.
- Review your test results quickly and easily.

2) PC Interface Mode:

- Interface M3600 with PC using *M3600DAQ™* or *M3600Frac™* software for advanced rheology test setup, control, display and data management.
- Microsoft Windows-based software
- Export data into Microsoft Excel
- Customize charts for data relationships

Specifications

Bob size:	(B1, B2, B5 bob)
Sample Size:	35-190 ml (depending on size of bob, cup, sleeve)
Speed:	0.01 to 600 rpm continuous
Shear Rate:	0.0038 to 1020 S ⁻¹
Temperature:	Ambient (20 °F w/chiller) to 212 °F
Pressure:	Atmospheric pressure
Viscosity:	0.5 to 27,000,000 Centipoise
Torque:	7 μN.m to 14 mN.m
Shear Stress:	2 to 3,600 dyne/cm ²
Resolution:	1 dyne/cm ²
Accuracy:	±0.5% of torque span or better

Mechanical Specifications:

Dimensions / Footprint: 16" tall x 5" wide x 8" deep
Weight: 12.5 lbs

Electrical Supply:

Viscometer Voltage: 90 VAC to 240 VAC
Heater cup Voltage: 120 VAC or 240 VAC

M3600 geometries conform to API test specifications.

Patented viscometer with unique, durable design The M3900 In-Line Viscometer is a U.S. patented viscometer intended for use with a wide variety of fluids, with a special emphasis on fracturing fluid.

Single rotating element submerged in test fluid—no dynamic seal

The only moving component in contact with test fluid is the rotating bob. This patented design ensures reliability of test results over a longer period of time than any competing model can provide, without the use of any dynamic seal.

Easy breakdown for cleaning and maintenance

Access to all internal components is accomplished by a one-action dismount, providing fast access for maintenance and cleaning, maximizing performance and minimizing maintenance.



U.S. Patent: 8,850,874

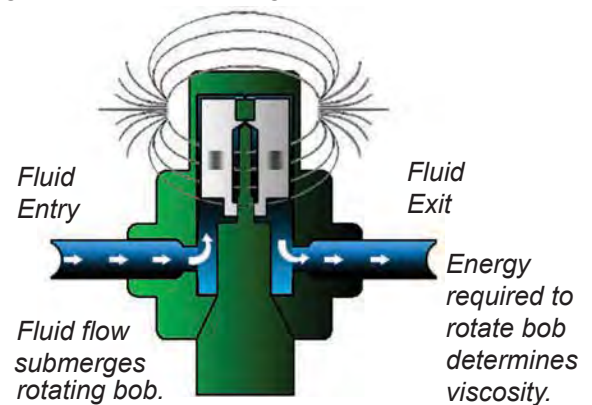
Features

- Compliant with API 13 and API 39
- Viscosity measurement unaffected by fluid flow
- Computer-controlled speed, viscosity measurement & calibration
- Multiple data export formats
- M3900 PC Control / Data Acquisition software included

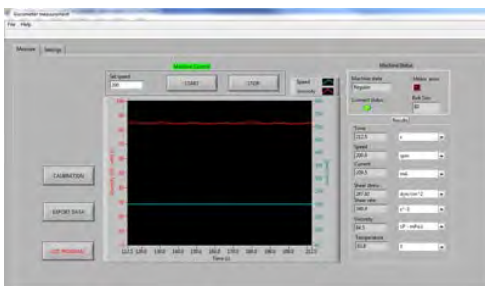
Specifications

Viscosity Range: 5 cP to 300 cP - mPa.s
 Speed Range: 3 and 6 rpm; 6 to 600 rpm continuous
 Pressure Range: Up to 2000 psi
 Output: 0 to 5 VDC analog or RS485 Modbus
 Dimensions: 12" Height x 4.5" Width

Magnetic field causes magnet inside bob to rotate.



No dynamic seal - the bob is the only moving part! Simple & fast cleaning and maintenance



M3900 PC Control / Data Acquisition software (included):



M3900 Control Box (included) controls programming, and also reads viscosity.

Simple Operation and Dependable Measurement

The Grace Instrument M4050 HPHT Filter Press is designed to measure the effectiveness of a material being tested through pressurization. The M4050 HPHT Filter Press unit can be pressurized to 1,800 psig on the cell and 750 psig on the back pressure receiver. The maximum operating temperature is 350°F.

The M4050 HPHT Filter Press is available in various component configurations to allow for greater flexibility in choosing the system and options that suit each individual need. Single or double opening cells accept different filter media.



Operational Features

- *Threaded cell and set screw cell available*
- *Single and double opening cells available*
- *Pressurization method includes CO2 Cartridges, bottled Nitrogen, or an in-house (user provided) source.*
- *Filter media includes the API standard Filter Paper, Ceramic Discs of several calculated porosities, and various mesh-sized screens.*

Specifications:

Rated Working Pressure:	1,800 psig
Maximum Temperature:	350°F
Power Supply:	110/220 VAC 50/60 Hz
Sample Volume:	175 ml
Heater Power:	400 Watts
Filtering Area:	3.5 in ²
Back Pressure Receiver Volume:	15 ml



M4075 Filter Press Testing

The Grace Instrument M4075 Filter Press API is a Low Pressure Low Temperature (LPLT) Filter Press that provides an easy, effective way to evaluate the filtration properties of a drilling fluid and cement slurry.

This instrument consists of a pressure cell, frame, pressure source, filter medium, and a graduated cylinder. It conforms to API specifications, and is suitable for both field and lab use.



Operational Features

- *Stainless steel test cell*
- *Built-in pressure regulator*
- *Suitable for field and lab use*
- *Conforms to API specifications*

Specifications:

Working Pressure:	100 psig
Filtering Area:	7.1 in ²

The only HPHT dynamic linear swell meter currently made in the USA

The M4600 HPHT Dynamic Linear Swell Meter is the only LSM in the USA capable of high-pressure, high-temperature dynamic test operations.

The M4600 is engineered specifically to achieve highly repeatable test results

The patented design of the M4600 hardware allows core samples to expand in only one direction, making test results extremely repeatable.

The Grace Instrument M4600 HPHT Linear Swell Meter is an automated, dual core, high pressure and high temperature linear swell meter (up to 2,000 psi and 500 °F). It is engineered to measure the volumetric expansion (or contraction) of a core/wafer sample under simulated downhole conditions while saturating it with a drilling fluid sample.

The Grace Instrument M4600 HPHT Linear Swell Meter provides the most repeatable test results on the market today. The patent-pending design allows core samples to expand in only one direction, making test results very repeatable.

Measurement specifications:

Sample Size:	75 mL
Pressure Range:	Atm to 2,000 psi
Core/Wafer Diameter:	1.00 inch
Core/Wafer Length:	0.4 to 1.00 inch
Maximum Linear Displacement:	±0.6 inches
Linear Resolution:	0.1% of full scale range
Temperature:	Ambient to 500 °F

Mechanical specifications:

Height:	21" tall
Width:	20" wide
Depth:	14" deep

Construction: 304/316 stainless steel wetted material

Utility requirements:

Electrical Supply Voltage:	120 VAC or 240 VAC
Line Frequency:	50 to 60 Hz
Power Consumption:	500 VA
Pressure Supply: Nitrogen:	Atm - 1,000 psi

Linear Swell Meter



The **M4600** is engineered for laboratory HPHT testing of solids and fluids interactions

- PC interface
- digital data
- easy to operate
- safe operation
- test flexibility
- repeatable results
- low maintenance
- automatic data collection

Core/Wafer Compactor



Patented design & detailed engineering lead to highly consistent data

The Grace Instrument M5600 HPHT Rheometer is a true Couette, coaxial cylinder, rotational, high pressure and temperature rheometer (up to 2,000 psi and 500 °F). Due to the patented design, The M5600 HPHT Rheometer provides direct reading inside the pressure vessel and employs no bob shaft bearings., which means lower maintenance costs and allowing for continuous testing of highly corrosive samples.

True rheology measurement under pressure

The M5600 hardware design incorporates a direct drive between the bob shaft and the torque transducer, which eliminates momentum of inertia errors associated with magnetically coupled torque transducers. This, due to the elimination of bob shaft bearings, allows the torque transducer to respond quickly and consistently to changing bob shaft torque.

Viscoelastic option available for G', G" and phase angle testing

The M5600 HPHT Rheometer does not employ magnetic coupling, and instead takes direct measurements inside the pressure vessel, providing true measurement in a pressurized environment. This allows us to offer the M5600 dynamic option, which enables the user to perform true G' and G" viscoelasticity tests under pressure, without having to pre-test using fluids with known G'/G" values.



M5600 HPHT Rheometer shown in carbon block bath

Measurement Specifications

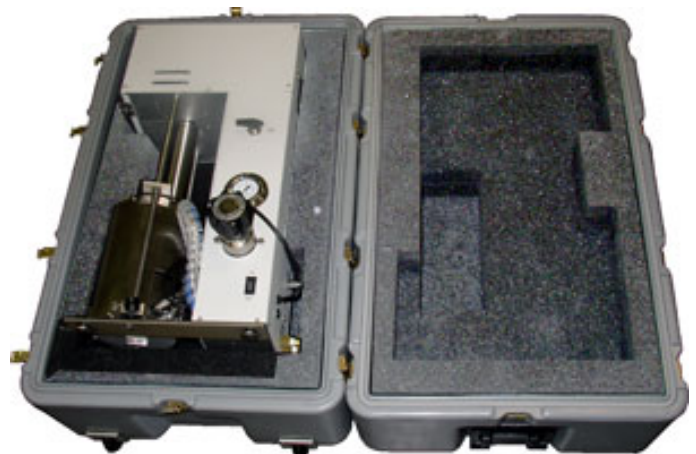
Bob Size:	B1, B2, B5 bob
Sample Size:	32 – 78 mL (depending on size of bob)
Speed Range:	0.0001 – 1,100 rpm continuous
Shear Rate Range:	0.00004 – 1870 Sec ⁻¹
Frequency Range:	0.01 – 5 Hz (optimized at 0.2 to 3 Hz)
Amplitude Range:	0.1% – 500% (optimized at 0.2% to 500%)
Temperature Range:	Ambient to 500 °F
Pressure Range:	Atm to 2,000 psi
Viscosity Range:	0.5 – 5,000,000 Centipoise
Torque Range:	14 μN.m to 100 mN.m
Shear Stress Range:	1 to 15,000 dyne/cm ²
Resolution:	0.01% of full scale range or better
Repeatability:	±0.05% of full scale range or better

Mechanical Specifications:

Dimensions/Footprint:	25.5" tall x 8.5" wide x 12.5" deep
Weight:	61 lbs (with carbon block heating bath)

Utility Requirements:

Electrical Supply Voltage:	120 VAC or 240 VAC
Compressed Nitrogen:	2,000 psi



Optional carrying case with extendable handle and wheels for easy portability

Oscillatory Testing

Standard rotational testing measures fluid viscosity under a constant shear rate (constant speed), which indicates only apparent viscosity, or how thick a fluid is. On the other hand, almost all drilling muds, fracturing fluids and cements have some "gelly" strength that enables them to suspend solid particles. This ability to suspend solids is very important to many oil field operations.

The M5600 HPHT Rheometer oscillatory testing option provides the capability to measure how "gelly" a sample is, in addition to how thick the sample is, by providing G', G'', and other data. This vastly increases the researcher's ability to predict the behaviors of these fluids, such as capacity for carrying solids (weight material sag, drill cuttings transport, proppant transfer, etc.). Oscillatory testing mode also completely removes measurement errors due to sample climbing.

Available Oil Bath Option

The M5600 is also available in an oil bath. The oil bath allows for cooling options and an operator can connect tubing to supply water for cooling capabilities.

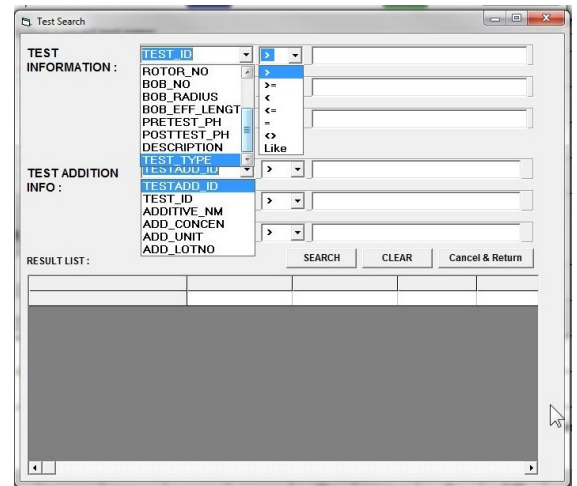


M5600 Rheometer is shown with oil bath option

Cutting-edge database software enables customized search and data comparison

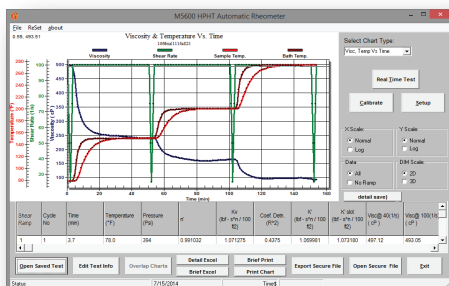
The application software, M5600 PC, includes powerful database tools for searching, categorizing, and comparing test results. The search criteria can include any test result parameter, including additives, descriptions, or other details. M5600 PC also allows you to overlap as many test charts as you like. Each test chart will display with customized graphics to differentiate it from other tests. M5600 PC software is:

- Customizable charts and real-time data are displayed during testing
- Data can be instantly exported into any spreadsheet
- Tests are simple to set up and run
- Customizable charts and real-time data are displayed during tests
- Using the drop-down menu saved tests can be searched by any specified test parameter, including: test name, fluid ID, additive, researcher name, rotor number, bob number, bob radius, and more.

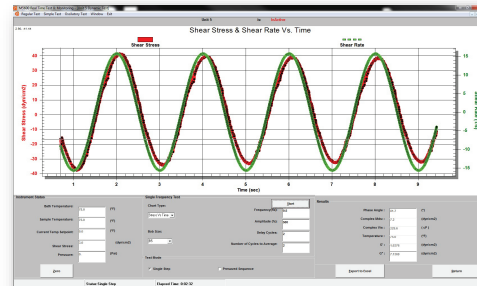


Test search dialog box with drop-down menus

M5600 PC Software - Standard Test



M5600 PC Software - Oscillatory Test



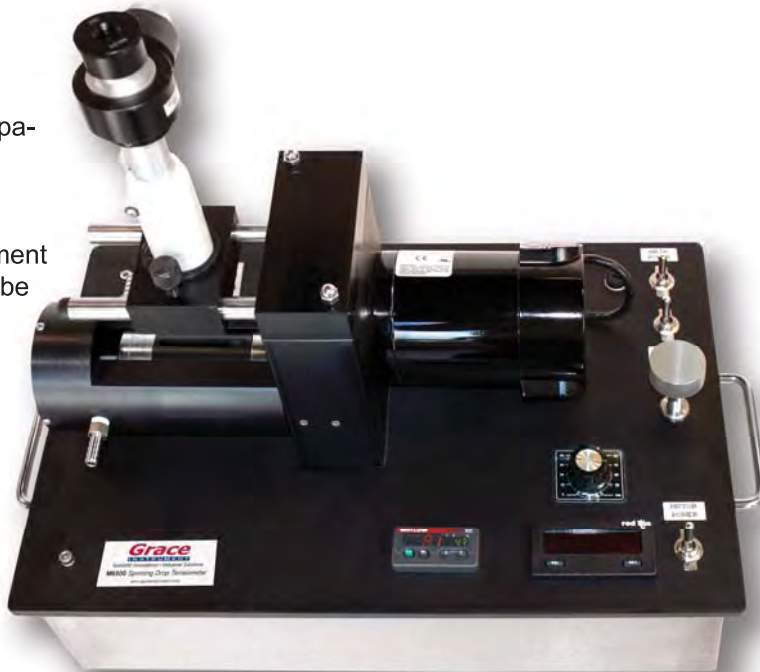
High-resolution microscope for enhanced accuracy

The M6500 microscope magnifies up to 25x and enables a numerical display resolution of 0.0001 mm, giving the researcher the greatest measurement accuracy of any comparable device.

Light-weight and easy to handle

The M6500 weighs only 24 lbs. and includes a level-adjustment control as well as handles on two sides so that the unit can be picked up and manipulated to reposition the test droplet.

The M6500 Spinning Drop Tensiometer was developed for measuring interfacial tension, surface tension, and absorption rate between two different fluids. Engineered with the researcher in mind, the M6500 is built to be dependable, accurate, and easy to operate. Responsive temperature controls and optimum synchronization of the instrument allow the sample to be observed over a long period of time under constant conditions.



- RTD temperature transducer - accurate temperature reading
- PID temperature controller - stable at target temperature
- Accurate speed controller ensures high image synchronization
- High accuracy of reading with stroboscope illumination
- Optional chilling sleeve for low-temperature applications

Measurement range:

Temperature Range: Ambient (45 °F w/chiller) to 212 °F
 Speed Range: 0 to 11,000 rpm continuous
 Surface Tension Measurement Range: 10^{-6} to 10^2 mN/m
 Capillary Diameter: 2.0mm
 Microscope Magnification: 25x
 LCD Display Resolution: 0.0001mm

Digital camera option:

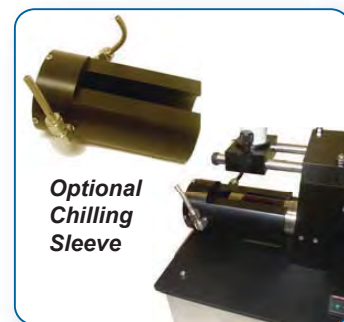
Live Resolution: 2.0 MP
 Optical Format: 1/3"
 Focusable Lens: 16mm (adds approx. 3" to unit height)

Mechanical specifications:

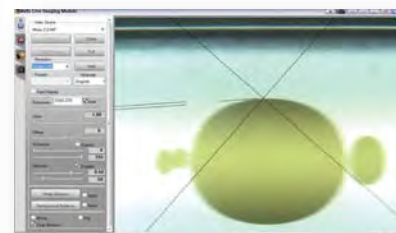
Dimensions/Footprint: 19.5" wide x 11.5" deep x 19" tall
 Weight: 24 lbs.
 Voltage: 120V or 240V with transformer



LCD numerical display



Optional Chilling Sleeve



Optional digital camera with image processing software

M7150 Stirred Fluid Loss Tester is Fast-cooling, Durable, and Easy to Handle

The M7150 Stirred Fluid Loss Tester provides a reliable means to determine the fluid loss properties of muds and slurries under HPHT conditions. It pre-conditions and tests cement slurry in the same cell, removing the necessity of manually transferring heated slurry to another cell vessel, thus reducing operator contact with and danger to extremely hot slurry. The apparatus is designed to be safe, reliable, economic and easy to use.

The M7150 simulates down-hole conditions where slurry dehydration might occur. Cement slurry is poured into a pressure vessel and heated by a heating jacket. A PID temperature controller controls the applied temperature as the slurry is stirred with a rotating paddle at 150 rpm according to API Specifications. Back pressure is applied to the back pressure receiver, where the filtrate is collected after it is forced through a filter medium. The fluid-loss rate is determined by the volume of filtrate collected per unit of time.



Operational Features:

- *Innovative designed cooling jacket rapidly cools testing cell to quickly start next test.*
- *New designed cell cap is interchangeable with older cells.*
- *Innovative designed paddle assembly is durable for extensive testing and easy to maintain.*
- *Heating jacket can be locked at 30° inclined angle for the easy installation and extraction of test cell.*
- *Programmable temperature controller increases the cell temperature at desired rate.*
- *Apparatus is in accordance with API Recommended Practice 10B-2.*
- *No need to transfer hot slurry.*

Specifications:

Maximum temperature: 400°F (204°C)
Maximum Pressure: 2,000 PSI (13.8 Mpa)
Heater power: 800 W.
Compact size: 27" H X 22" W X 18" D
Digital Temperature Controller w/ 1.0° resolution

Requirements:

Power Supply: 120VAC, 60HZ, 18 Amp
Nitrogen Supply: 2000 PSI - 2500 PSI
(13.8 MPa – 17.2 Mpa)
Water Supply for cooling: 40 PSI

Simple and Dependable Testing

The M7200 conditions slurry while the slurry is subjected to desired temperature under atmospheric pressure. The slurry is placed in API standard brass cups that rotates at 150 rpm. Slurry conditioning always plays an important role in well cement testing, and M7200 is capable of preparing cement slurry for the testing of thickening time, free water content, fluid loss, viscosity, rheological properties and various other properties

M7200 atmospheric consistometer saves operating time with slurry in two sample cups that running at the same time. The easy-reading dial on each cup gives quick and clear response that shows the current consistency of the slurry.

Dual thermocouples monitor the bath temperature to provide extra protection and prevent from hazardous situation. Pre-installed copper cooling coil cools down the temperature of bath quickly at the end of the test so that time between tests reduces significantly.

The hardware design makes M7200 easy to set up, use and clean. All hardware components are created in accordance with API recommendations.



Operational Features

- *Reliable over temperature protection*
- *Easy to use PID temperature controller*
- *Efficient operation with dual rotating cups*
- *Stainless steel bath*
- *Time saver, fast cooling with cooling coil*
- *API compliant instrument design*

Specifications:

Temperature Range:	Up to 200 °F
Pressure Range:	Atm. pressure
Heat Power:	1,500W
Power Supply:	115/220 VAC, 50/60 Hz
Slurry Cup Rotation:	150 rpm
Compliance:	API Spec 10A / ISO 10426-1
Weight:	63 lbs.
Height:	25"
Width:	15"
Depth:	18"

Designed for Fast and Easy Operation via PC Control

The M7250 measures slurry consistency and thickening time while the slurry is subjected to simulated down hole conditions. The slurry is placed in a temperature and pressure-controlled cell and tested under the conditions that are specified by the user through the PC software. The software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.

Robust Components Provide Exacting Measurements

The Grace Instrument M7250 Consistometer features a rotating slurry cup that turns at speeds up to 250 rpm and a stationary paddle-style sensor. The magnetically-driven cup rotates and the slurry flows against the paddle. The torque applied to the paddle as the slurry cup revolves is used to determine the slurry consistency.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

The Grace Instrument M7250 Consistometer enables the operator to perform accurate, dependable test operations with minimal preparation time. The hardware design makes the instrument easy to set up, use and clean. All hardware components are created in accordance with API recommendations.



Operational Features

- *Automatic PC-controlled temperature and pressure*
- *Automatic 5 channel data logging with easy export*
- *Time saver, fast automatic cooling*
- *Space saver, small footprint enclosure*
- *Credible measurement by improved potentiometer mechanism design*
- *Reliable over temperature/pressure/consistency protection*
- *MS Windows compatible PC software*
- *Reliable over temperature/pressure/consistency/time protection*
- *PC software capable of controlling up to 8 units*

Specifications:

Temperature Range:	Amb. to 400 °F
Pressure Range:	25,000 psi
Thickening Time Range::	0 - 100 Bc (Bearden Units)
Heater Power:	3,000W
Power Supply:	240 V, 50/60 Hz
Slurry Cup Rotation:	150 rpm
Pressure Medium:	White mineral oil
Compliance:	API Spec 10A / ISO 10426-1
Height:	53"
Width:	26"
Depth:	26"

Designed for Super-Fast, Easy Operation via PC Control

The Grace Instrument M7260 Consistometer was developed with laboratory efficiency in mind, enabling the operator to perform accurate, dependable test operations with minimal preparation time. The innovative hardware design makes the instrument easy to set up, easy to use and easy to clean. The custom PC software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly with efficiency.

The Consistometer is supplied with a magnetic drive for the rotational drive of the slurry cup as standard equipment. The M7260 measures slurry consistency while the slurry is subjected to simulated a wide range of downhole conditions of temperature and pressure up to 40,000 psi (275MPa) and 600° F (315° C)

Robust Components Provide Exacting Measurements

The Grace Instrument M7260 Consistometer features a rotating slurry cup that turns at speeds up to 150 rpm and a stationary paddle-style sensor. User-specified conditions of temperature and pressure are applied to the test chamber as the magnetically-driven cup rotates and the slurry flows against the paddle. The torque applied to the paddle as the slurry cup revolves is used to determine the slurry consistency.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

All hardware components are created in accordance with API recommendations. The cement sample is placed in a temperature and pressure-controlled cell and tested under the curing conditions that are specified by the user through the PC software.

Operational Features

- Automatically conditions slurry
- Computer-controlled data logging
- Control panel optimized for ease of use
- Constant temperature control system
- Designed for maximum accuracy and operator safety
- Innovative data analysis algorithms
- Comparison of current test data with historical test data
- Data analysis software compatible with MS Windows 8/8.1



Specifications:

Temperature Range:	Amb. to 600°F
Pressure Range:	Atm. to 40,000 psi
Thickening Time Range:	0 - 100 Bc (Bearden Units)
Heater Power:	4,000W
Power Supply:	240 V, 50/60 Hz
Slurry Cup Rotation:	150 rpm
Pressure Medium:	White mineral oil
Compliance:	API Spec 10A / ISO10426-1
Dimensions/Footprint:	65" Height 33" Width 31" Depth
Weight:	800 lbs.

Designed for Super-Fast, Easy Operation via PC Control

The Grace Instrument M7270 Dual Cell Consistometer was developed with laboratory efficiency in mind, enabling the operator to perform accurate, dependable test operations with minimal preparation time. The innovative hardware design makes the instrument easy to set up, easy to use and easy to clean. The custom PC software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.

The M7270 measures slurry consistency while the slurry is subjected to simulated a wide range of downhole conditions of temperature and pressure up to 25,000 psi (172MPa) and 400°F (204° C). This instrument can simultaneously perform two independent tests.

Robust Components Provide Exact Measurements

The Grace Instrument M7270 Dual Cell Consistometer features the rotating slurry cup that turns at speeds up to 150 rpm and a stationary paddle-style sensor. User-specified conditions of temperature and pressure are applied to the test chamber as the magnetically-driven cup rotates and the slurry flows against the paddle. The torque applied to the paddle as the slurry cup revolves is used to determine the slurry consistency.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

All hardware components are created in accordance with API recommendations. The cement sample is placed in a temperature and pressure-controlled cell and tested under the curing conditions that are specified by the user through the PC software.

Operational Features

- Automatically conditions slurry
- Computer-controlled data logging
- Control panel optimized for ease of use
- Constant temperature control system
- Designed for maximum accuracy and operator safety
- Innovative data analysis algorithms
- Data analysis software compatible with Microsoft™ Windows® 8/8.1



Specifications:

Temperature Range:	Amb. to 400°F
Pressure Range:	Atm. to 25,000 psi
Thickening Time Range:	0 - 100 Bc (Bearden Units)
Heater Power:	6,000W
Power Supply:	240 V, 50/60 Hz
Slurry Cup Rotation:	150 rpm
Pressure Medium:	White mineral oil
Compliance:	API Spec 10A / ISO10426-1
Dimensions:	46" H x 44" W x 31" D

Designed for Super-Fast, Easy Operation via PC Control

The Grace Instrument M7280 HPHT Dual Cell Consistometer was developed with laboratory efficiency in mind, enabling the operator to perform accurate, dependable test operations with minimal preparation time. The innovative hardware design makes the instrument easy to set up, easy to use and easy to clean. The custom PC software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.

The M7280 measures slurry consistency while the slurry is subjected to simulated a wide range of downhole conditions of temperature and pressure up to 40,000 psi (275MPa) and 600° F (315° C). This instrument can simultaneously perform two independent tests.

Robust Components Provide Exacting Measurements

The Grace Instrument M7280 HPHT Dual Cell Consistometer features the rotating slurry cup that turns at speeds up to 150 rpm and a stationary paddle-style sensor. User-specified conditions of temperature and pressure are applied to the test chamber as the magnetically-driven cup rotates and the slurry flows against the paddle. The torque applied to the paddle as the slurry cup revolves is used to determine the slurry consistency.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

All hardware components are created in accordance with API recommendations. The cement sample is placed in a temperature and pressure-controlled cell and tested under the curing conditions that are specified by the user through the PC software.

Operational Features

- *Automatically conditions slurry*
- *Computer-controlled data logging*
- *Control panel optimized for ease of use*
- *Constant temperature control system*
- *Designed for maximum accuracy and operator safety*
- *Innovative data analysis algorithms*
- *Comparison of current test data with historical test data*
- *Data analysis software compatible with Microsoft™ Windows® 8/8.1*



Specifications:

Temperature Range:	Amb. to 600°F
Pressure Range:	Atm. to 40,000 psi
Thickening Time Range:	0 - 100 Bc (Bearden Units)
Heater Power:	8,000W
Power Supply:	240 V, 50/60 Hz
Slurry Cup Rotation:	150 rpm
Pressure Medium:	White mineral oil
Compliance:	API Spec 10A / ISO10426-1
Dimensions:	65" H x 50" W x 31" D

Innovative Technology Provides Efficiency & Dependability

The Grace Instrument M7350 Ultrasonic Cement Analyzer is used to perform compressive, non-destructive strength tests on cement slurries under controlled conditions of temperature and pressure.

In these tests, the M7350 Ultrasonic Cement Analyzer transmits an ultrasonic pulse through a cement slurry sample. By measuring the length of time required for the pulse to travel through the sample, the M7350 PC software determines the compressive strength of the cement.

As the cement hardens, the pulse transit time becomes shorter, allowing the system software to calculate changes in the compressive strength of the cement sample over time. This data is then collected into a customized database for comprehensive analysis, including comparison with data from previous tests. This data can also be easily exported in spreadsheet format.

Compact, Lightweight Design With Powerful Capability

Understanding and predicting the likely changes to the strength of oil well cement during curing is tremendously important in maintaining the integrity of a well. By enabling the researcher to construct test sequences, analyze completed test results, and compare those results with previous results, the M7350 delivers a powerful analytic tool in one compact package.



Operational Features

- *Lightweight pressure vessel capable of up to 10,000 psi, while being easy to clean up and maintain*
- *Test sequences can be amended during test operations*
- *Touch-screen controls enhance ease-of-use.*
- *Pressure and temperature are monitored and regulated automatically*
- *Continuous measurement of cement sample under conditions of temperature and pressure*
- *Analysis software is MS Windows-compatible*
- *Reliable over temperature/pressure/consistency/time protection*
- *PC software capable of controlling up to 8 units*

Specifications:

Temperature Range:	Amb. to 400 °F
Pressure Range:	Atm. to 10,000 psi
Operating Temperature:	32 - 105 °F
Operating Humidity:	0 - 95% non-condensing
Compressed Air:	50 - 100 psi
Chiller/Cooling Water:	5 - 80 psi
Heater Power:	1,500W
Voltage:	120 - 240VAC
Current:	15A, 50 or 60 Hz
Height:	15"
Width:	14"
Depth:	22"

Compact, Lightweight Design with Powerful Capability

The Grace Instrument M7370 Automatic Pressure Control Twin Cell Ultrasonic Cement Analyzer (UCA) is used to perform compressive, non-destructive strength tests on cement slurries under controlled conditions of temperature and pressure. The user can choose to operate either one or both cells, depending on the requirement. In these tests, the M7370 Automatic Pressure Control Twin Cell UCA transmits an ultrasonic pulse through a cement slurry sample. By measuring the length of time required for the pulse to travel through the sample, the M7370 PC software determines the compressive strength of the cement.

As the cement hardens, the pulse transit time becomes shorter, allowing the M7370 PC software to calculate changes in the compressive strength of the cement sample over time. This data is then collected into a customized database for comprehensive analysis, including comparison with data from previous tests. This data can also be easily exported in spreadsheet format.

Innovative Technology Provides Efficiency & Dependability

Understanding and predicting the likely expansion or contraction of oil well cement during curing is tremendously important in maintaining the integrity of a well. By enabling the researcher to construct test sequences, analyze completed test results, and compare those results with previous results, the M7370 Automatic Pressure Control Twin Cell UCA delivers a powerful analytic tool in one compact package.

Operational Features

- *Pressure and temperature are monitored and regulated automatically*
- *Continuous measurement of cement sample under conditions of temperature and pressure*
- *No sample contamination by pressurization media*
- *Test sequences can be amended during test operations*
- *Easy-to-use, lightweight pressure vessel capable of up to 10,000 psi.*



Specifications:

Temperature Range:	Amb. to 400°F
Pressure Range:	Atm. to 10,000 psi
Chiller/Cooling Water:	5 - 80 psi
Compressed Air:	50 - 100 psi
Power Supply:	240 V, 50/60 Hz
Dimensions:	27" H x 18" W x 21" D
Weight:	100 lbs.
Heater:	3000W

Affordable, dependable cement curing apparatus

The Grace Instrument M7450 Curing Chamber is specifically designed to cure standard two-inch cement cube samples for compressive strength testing in accordance with API and ISO standards for oilfield cements. The user is able to specify conditions of temperature and pressure in order to simulate a wide variety of downhole conditions during the curing process.

Test sequences can be created to monitor sample behavior under changing environmental conditions, as well.

A slurry mold design that saves time...and resources

The slurry mold has been designed to allow smooth insertion of the thermocouple. This enables the operator to start tests more quickly.

The curing chamber system design further ensures operator safety by optimizing tube routing and protecting components from high temperatures. The panel button and handle configuration has been designed so that instrument operations are both easy and safe.



Operational Features

- *Hardware specifications conform to API standards*
- *Test sequences can be created or edited by users to perform testing under a wide variety of simulated downhole conditions*
- *Slurry mold design allows quick thermocouple insertion and withdrawal*
- *Control panel and handles optimized for easy and safe operation*

Specifications:

Temperature Range:	Amb. to 700 °F
Pressure Range:	3,600 psi
Operating Temperature:	32 - 105 °F
Operating Humidity:	0 - 95% non-condensing
Compressed Air:	50-145 psi max
Heater Power:	9,000W
Voltage:	120 - 240VAC
Current:	30A, 50 or 60 Hz
Weight:	500 lbs
Height:	46"
Width:	30"
Depth:	28"

Patented design prevents sample contamination

The Grace Instrument M7500 Ultra HPHT Rheometer employs a unique, patented design which entirely prevents contact between sample fluid within the main test chamber and pressurization fluid, which is injected into interlocking isolated chambers above the test chamber. No other rheometer on the market today can make this claim.

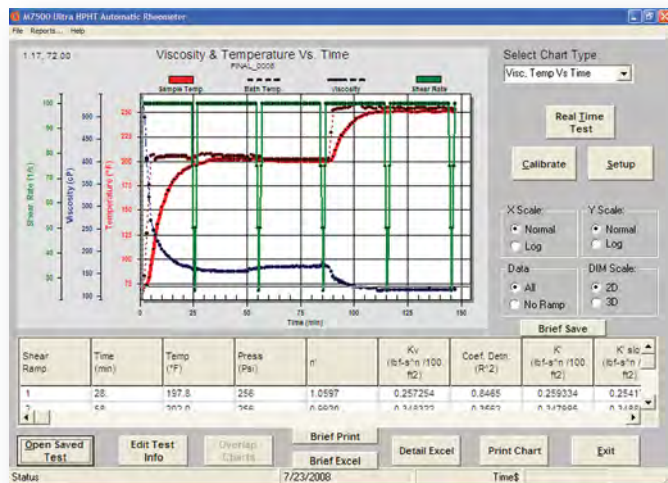
Optional components add multiple test functions while saving time, money, and laboratory space

Hardware modules are available which add specific functionality to the M7500, including cement testing, pressure-volume testing, linear swell testing, and more. These modules take the place of stand-alone equipment and can be integrated into the standard M7500 training program, saving training costs and laboratory space. This feature alone enables the M7500 Ultra HPHT Rheometer to provide an excellent ROI.



The Grace Instrument M7500 Ultra HPHT Rheometer is a coaxial cylinder, rotational, high pressure and high temperature rheometer. It measures various rheological properties of fluids (including API HPHT tests) under a range of pressures and temperatures, up to 30,000 psi and 600 °F.

M7500DAQ PC software:



Measurement range (B1, B5 bob):

- Sample Size: 132 mL
- Speed: 0.01 to 600 rpm continuous
- Shear Rate: 0.0082 to 1020 S⁻¹
- Temperature: Ambient (20 °F w/chiller) to 600 °F
- Pressure: Atm to 30,000 psi
- Viscosity: 0.5 to 5,000,000 Centipoise
- Torque: 7 μN.m to 10 mN.m
- Shear Stress: 2 to 1,600 dyne/cm²
- Resolution: 0.3% of full scale range or better
- Repeatability: ±1% of torque span or better

Mechanical specifications:

- Dimensions / Footprint: 22" tall x 12" wide x 24" deep (tower)
15.5" tall x 14" wide x 25" deep (cab)
- Weight: 250 lbs

M7500 geometries conform to API test specifications.

One Device + Multiple Modules = Multiple Test Functions

The **Grace Instrument M7500 Ultra HPHT Rheometer** offers an ultra-high-pressure, high-temperature test environment that provides automatic, highly-repetitive tests. It does all this at a competitive price and even fits on a desktop.

The **M7500** is also designed to accommodate a wide variety of testing requirements via optional functionality modules. These are comprised of both hardware and software components and are either replacements for **M7500** components or modifications of the **M7500** itself. Some can be added to an existing **M7500** unit, and some require a customized **M7500** hardware configuration.

Each added module potentially replaces stand-alone testing apparatus. This increases lab efficiency by reducing setup, cleanup and maintenance times. It saves space by consolidating diverse test functions into one instrument, and saves training and operation time by reducing the number of different devices and software applications that must be learned and managed.

Here are some of the features available:



Cement Cell Module:

The **M7500** can be used to test fluids such as well cements which are highly vulnerable to contamination with pressurization fluid. The patented design of the **M7500 Cement Cell** reduces contact between test sample and pressurization fluid to a bare minimum.



PVT Pycnometer Module:

The **M7500PVT** pycnometer module provides a means for testing liquid density changes under simulated downhole conditions, such as those found in deep oil or geothermal wells. The **M7500PVT** module is also designed to test solid samples such as cements, cores, or other solids.



LSM Linear Swell Meter Module:

The **M7500LSM** linear swell meter module provides a high pressure and temperature environment for single-core swell tests, with pressures up to 30,000 psi and temperatures up to 600 °F.



M7800 Ultra HPHT Hematite Rheometer:

The **M7800** design modifies the **M7500** cell tower hardware to enable test pressures of up to 40,000 psi. It also eliminates any contact between the test samples and the magnets, allowing for testing magnetically-sensitive fluids that cannot be reliably tested using standard industry hardware. (For more information, please see the **M7800 Ultra HPHT Hematite Rheometer** product page in this brochure.)

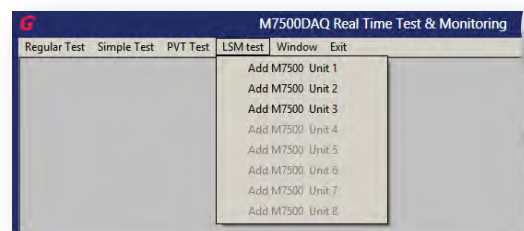


M8500 Ultra HPHT Dynamic Sagging Tester:

The **M8500** is a modification of the **M7500** hardware to allow the cell tower to be tilted up to 80° and includes three sample collection cells for sag testing. The optional rheometer module will allow the **M8500** to be configured to run viscosity tests and can accommodate any **M7500** test module. (For more information, please see the **M8500 Ultra HPHT Dynamic Sagging Tester** product page in this brochure.)



M7500DAQ™ software PVT test



M7500DAQ™ software Real-time test selection

Designed for Safety, Efficiency, and Compatibility

The Grace Instrument M7530 Corrosion Tester was developed with laboratory safety, efficiency and compatibility in mind. The instrument features a rotating cup which contains up to 3 coupons that turns in various speeds up to 250 rpm through mag-drive mechanism. Programmed acceleration-deceleration motion ensures fully contact between coupons and acid. The innovative hardware design makes the module easy to set up, easy to use and easy to clean. Double-seal design prevents acid leakage from sample cup into pressure chamber.

Simple Setup, Easy Operation via PC Control

User-specified conditions of temperature and pressure are applied to the test chamber under the precise automatic control. The custom PC software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.



Operational Features

- *Double seal design prevents acid contact with hydraulic oil*
- *Corrosion coupons tested in separate cells*
- *Automatic pressure, temperature, and rotating speed control*
- *Fully customized testing sequence in PC software*
- *Optimized control panel for ease of use*
- *Dual thermocouples with limit temperature control*
- *Optional consistency measurement module available*

Specifications:

Temperature Range:	Amb. to 400 °F	Dimensions	
Pressure Range:	Atm. to 20,000 psi	Height:	53"
Heater Power:	3,000W	Width:	26"
Power Supply:	240V, 50/60 Hz	Depth:	26"
Sample Cup Rotation:	0-250rpm		
Pressure Medium:	White mineral oil		

Designed for Fast and Easy Operation via PC Control

The M7540 measures slurry consistency, thickening time and static gel strength while the slurry is subjected to simulated down hole conditions. The slurry is placed in a temperature and pressure-controlled cell and tested under the conditions that are specified by the user through the PC software. The software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.

Robust Components Provide Exacting Measurements

The Grace Instrument M7540 Consistometer/SGS Tester features a rotating paddle that turns at speeds up to 250 rpm. The paddle is driven by a servo through a magnet coupling. The torque read by the servo is used to determine the slurry consistency or static gel strength.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

The Grace Instrument M7540 Consistometer/SGS Tester enables the operator to perform accurate, dependable test operations with minimal preparation time. The hardware design makes the instrument easy to set up, use and clean. All hardware components are created in accordance with API recommendations.



Operational Features

- Automatic PC-controlled temperature and pressure
- Bench-top configuration with touch screen for easy operation
- Automatic 6 channel data logging with easy export
- Time saver, fast automatic cooling
- Credible measurement by super accurate servo
- Reliable over temperature/pressure/consistency/time protection
- PC software capable of controlling up to 8 units

Specifications:

Temperature Range:	Up to 400 °F
Pressure Range:	Up to 20,000 psi
Heater Power:	1,500W
Power Supply:	110/240 V, 50/60 Hz
Slurry Cup Rotation:	0 - 250 rpm
Static Gel Speed:	0.2 deg/min.
Pressure Medium:	White mineral oil
Compliance:	API Spec 10A / ISO 10426-1
Height:	27 in.
Width:	18 in.
Depth:	21 in.

Designed for Fast and Easy Operation via PC Control

The M7550 measures slurry consistency, thickening time and static gel strength while the slurry is subjected to simulated down hole conditions. The slurry is placed in a temperature and pressure-controlled cell and tested under the conditions that are specified by the user through the PC software. The software included with each unit allows the user to construct test sequences, run tests, and interpret test results quickly and efficiently.

Robust Components Provide Exacting Measurements

The Grace Instrument M7550 Consistometer/SGS Tester features a rotating paddle that turns at speeds up to 250 rpm. The paddle is driven by a servo through a magnet coupling. The torques read by the servo or potentiometer are used to determine the static gel strength or consistency.

Simple Set-Up, Easy Operation, Reliable & Repeatable Testing

The Grace Instrument M7550 Consistometer/SGS Tester enables the operator to perform accurate, dependable test operations with minimal preparation time. The hardware design makes the instrument easy to set up, use and clean. All hardware components are created in accordance with API recommendations.



Operational Features

- *No exposed moving/rotating parts*
- *Automatic PC-controlled temperature and pressure*
- *Touch screen installed for direct reading and easy operation*
- *Automatic 6 channel data logging with easy export*
- *Time saver, fast automatic cooling*
- *Credible measurement by super accurate servo*
- *Reliable over temperature/pressure/consistency/time protection*
- *PC software capable of controlling up to 8 units*

Specifications:

Temperature Range:	Up to 600 °F
Pressure Range:	Up to 30,000 psi
Heater Power:	3,000 W
Power Supply:	240 V, 50/60 Hz
Slurry Cup Rotation:	0 - 250 rpm
Pressure Medium:	White mineral oil
Compliance:	API Specification 10B-2/ISO 10426-2
Weight:	650 lbs.
Height:	64"
Width:	34"
Depth:	33"

Designed to completely isolate magnet from testing sample

The U.S. patented design allows separation of magnet from testing samples, and is especially suitable for hematite types of mud and liquid samples reactive to magnets.

Engineered for ultra-high pressure testing & easy operation

The M7800 HPHT Hematite Rheometer can apply pressure to the pressure chamber as high as 40,000 psi, giving the researcher a pressure environment range greater than any competing instrument, while providing easy operation and simple maintenance.

The Grace Instrument M7800 Ultra HPHT Hematite Rheometer is intended for use in rheological testing of magnetically-sensitive fluids such as those containing hematite.

Unlike the standard operation of a rheometer which operates via magnetic coupling, the M7800 is configured to keep the magnets completely separated from the tested fluid. This helps ensure that test results are free of magnetically-induced errors.

The M7800 is built with a thick-walled steel pressure cell, surrounded by a fail-safe steel containment vessel, to ensure operator safety.

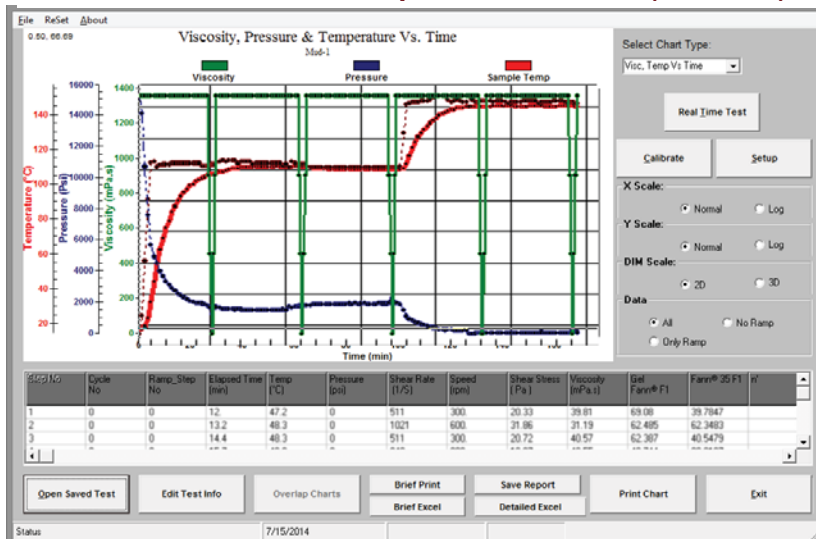


M7800 cell tower & M7500 control unit



M7800 pressure cell
U.S. Patent: 8,813,542

M7800DAQ control/data acquisition software (included)



Measurement Range (B1, B5 bob):

- Sample Size: Approx. 132 mL (depending on size of bob)
- Speed: 0.01 to 600 rpm continuous
- Shear Rate: 0.0082 to 1020 S⁻¹
- Temperature: Ambient (20 °F w/chiller) to 600 °F
- Pressure: Atm to 40,000 psi
- Viscosity: 0.5 to 5,000,000 Centipoise
- Torque: 7 μN.m to 10 mN.m
- Shear Stress: 2 to 10,000 dyne/cm²
- Resolution: 0.3% of full scale range or better
- Repeatability: ±1% of torque span or better

Mechanical Specifications:

- Dimensions / Footprint: 22" tall x 12 wide x 24" deep (tower)
20" tall x 14" wide x 25" deep (cab)

Electrical Supply:

- Voltages: 120 VAC or 240 VAC

Patented design prevents contamination of test sample by pressurization fluid

Contact with pressurization fluid can compromise the integrity of sag test results. The M8500 Ultra HPHT Dynamic Sagging Tester prevents any contact between the test sample and the pressureization fluid, because the innovative design, in particular the accumulator piston, prevents the test sample from contact with any other fluid, from pressure chamber to pycnometer.

Highest pressure and temperature rating

The 8500 offers the highest pressure and temperature rating of any HPHT sagging tester available in the USA, providing the researcher with a very realistic and robust test environment.

Multifunction options are available, adding many capabilities

The M8500 is available with optional Ultra HPHT Fluid Rheometer, HPHT Cement Rheometer, and/or PVT and LSM Tester modules, with more being developed. These options allow a laboratory to significantly expand the scope and variety of fluid performance testing, without having to purchase, operate and maintain multiple instruments.

The Grace Instrument M 500 Ultra High Pressure, High Temperature Dynamic Sagging Tester is designed for evaluating barite sagging and other weight material sag under simulated drilling conditions.

A sample of drilling fluid is subjected to an adjustable temperature, pressure, rotor (pipe) speed and borehole angle for a set period of time. Small amounts of the from a defined collection site within the testing cell while maintaining temperature, pressure, and shear conditions. Other qualitative and quantitative analysis can also be performed.



M8500 Sag Tester shown with M7500 Ultra HPHT Rheometer

U.S. Patent: 7,845,212
International Patent: CN 101614648 B

Measurement range:

- Total Sample Size: Approx. 500 ml
- Sag Sample Vol.: 7.5 mL (x 3 chambers)
- Shear Rate: 0.004 to 202 sec⁻¹
- Speed Range: 0.01 to 600 rpm cont.
- Temperature Range: Amb. (20 °F w/chiller) to 600 °F
- Pressure Range: Atm to 20,000 psi
- Borehole Angle: 0 to 80°

Mechanical specifications:

- Dimensions: 30" tall x 12.5" wide x 25" deep (tower)
20" tall x 14" wide x 25" deep (cab)
- Weight: 278 lbs

Electrical supply:

- Viscometer Voltage: 120 VAC (or 240 VAC with transformer)
- Frequency: 50 or 60 Hz

Example of Sag Test Results:

Table 1: M8500 Dynamic Sag Tester Results for 11.00 lb/gal, oil-based fluid with API Barite weight material		
Initial Mud Density	lb/gal	11.00
Borehole Angle	degrees	80
Temperature	°F	300
Pressure	psi	20,000
RPM	rpm	100
Annulus	inch	0.375
Shear Rate	S ⁻¹	33.71
Sag Density after 1 hour	lb/gal	13.14
Density Difference	lb/gal	2.14
Relative Density Increase	%	19.45

Streamlined workflow allows for multiple test operations without draining confining fluid between tests

Designed to maximize efficiency, the M9100 hardware design allows for multiple test operations without draining confining fluid, enabling the researcher to conduct multiple tests without multiple set-up and clean-up times.

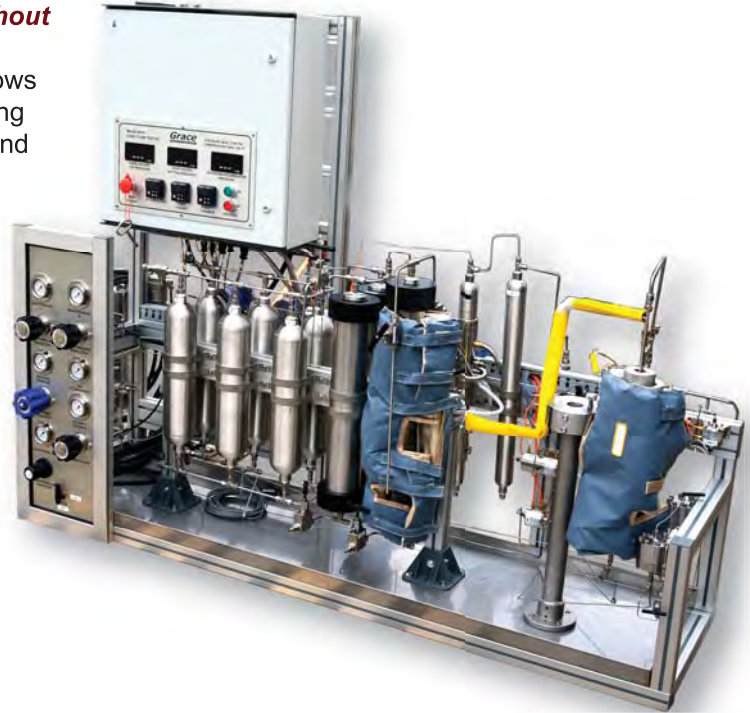
Complete automatic valve and fluid control

The M9100 software is customized to your specifications to allow for maximum automation of the test process, including digital control of valves, fluid injection, and many other test operations and parameters.

Available options

The M9100 Automatic Core Flow Tester is completely customizable. Here are only some of the possible customizing options:

- Optional automatic gas porosity and permeability measurement
- Optional automatic core loading
- Optional heating band or convection oven temperature control
- Optional fluid pre-heating prior to contact with the core sample



Customized to fit your test requirements



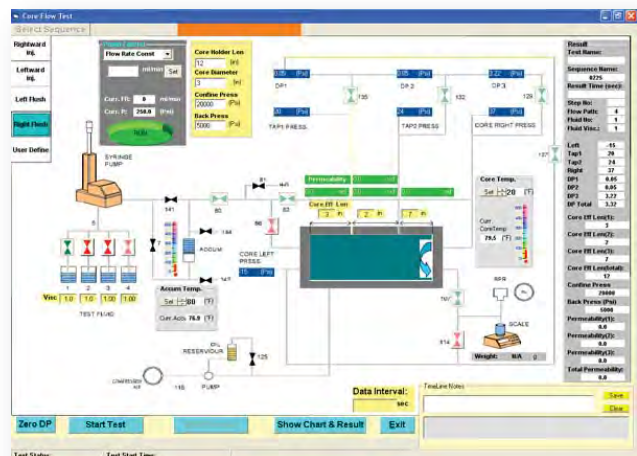
Specifications:

Operating Temperature:	Amb. to 392 °F
Confining Pressure:	Atm to 15,000 psi
Working Pressure:	Atm to 10,000 psi
Back Pressure:	Atm to 10,000 psi
Accumulator Capacity:	1L sample capacity
Fluid Injection Rate:	0 to 80 ml/min (depends on pump)
Core Dimensions:	1"/1.5" diam. by 6" to 24" length
Footprint:	28" tall x 70" wide x 26" deep
Weight:	250 lbs.

- Standard core injection with optional cross-face
- Includes application software & operation manual

M9100 Core Flow software:

- Tests controlled and data collected by computer
- Data can be exported into spreadsheet as .csv file



The 9000 series of products are all highly customizable, so all specifications should be regarded as approximate, depending on individual customer requirements.

M9104 Automated Core Plugging Machine

Grace Instrument's M9104 Automated Core Plugging Machine uses a heavy diamond-tooled drill press and pressure feed to drill quickly into various rock densities. It also has a uniquely designed coring bit that is specifically engineered to accommodate multiple core samples sizes. The user can control the pressure through an automatic, variable force, constant pressure feed. The constant pressure feed uses a hydraulic (water pump) actuator, which enables the coring bit to drill faster into softer rocks samples but automatically drill slower into harder, or denser, rock samples. However, even at a lower rate of penetration, the coring bit's operation is still smooth due to a rapid retractable position that removes the coring bit from the rock so that the plug is retrievable.

Coring operations are usually conducted with either water or oil, however, the user has the option to substitute with liquid nitrogen when working with loose materials. A core clamping assembly is mounted onto the pan table where an XY table allows the pan to be properly positioned before plugging.

The drill press is also able to drill vertically due to the head of the drill press being able to move at various angles.

Features

- *Coring bit internal diameter 1.5"*
- *Maximum coring depth 5 inches & 12 inches*
- *Drip pan dimensions L x W x H is 1340 x 380 x 340 mm*
- *Coring position is any position from -45° to +45°*
- *Pan position X: ±1000 mm, Y: ±125 mm*
- *Compatible coolants vary from water, oil, or liquid nitrogen*
- *Drill speed is 550, 1120, 1680 RPM*
- *Electrical 230 VAC 1 phase, 50 or 60 Hz, 11.5 A*
- *Air 150 psi*

Specifications

Core Bit Internal Diameter: 1.5 inches
Maximum Core Depth: 5 inches & 12 inches
Drill Speed: 550 rpm, 1120 rpm, 1680 rpm
Max Air: 150 psi
Pan Positions: X= ±1000 mm ; Y= ±125 mm
Compatible Coolants: Water, Oil, Liquid Nitrogen
Electrical Requirements: 230 VAC, 50 or 60 Hz, 11.5 Amp

M9106 Automated Saturator

The Grace Instrument's M9106 Automated Saturator is a computer controlled saturator used for performing a sequence of vacuum and saturation cycles on both plug and full diameter core samples (option) in an automated mode.

This apparatus uses a vacuum to remove trapped air and a high pressure liquid pump to make sure the core samples are completely saturated.

Designed for Simple Operation and Minimal Maintenance

The Windows®-based program permits the operator to open or close the valves, start and stop the high pressure pump, the vacuum pump, and run automatic saturation cycles. Operator involvement is minimal and the robust machine requires a minimal amount of maintenance.



Operational Features:

- Automatic pressure and valve control system
- Wetted materials of construction are SS-316 Stainless Steel
- Control console incorporating PC

Specifications:

Maximum saturation pressure:	2,000 psi
Core cell diameter:	6"
Core cell length:	10"
Wetted Material:	SS-316 Stainless Steel
Saturating fluid:	Water, brine, oil or other fluids
Power Requirement:	110-220 VAC, 50 or 60 Hz

*Other specifications can be done by customized request.

The **Grace Instrument M9110 Electrical Resistivity System** at Ambient Condition is designed to perform measurement of rock electrical resistivity for both fully and partially brine saturated core samples and brine electrical resistivity at ambient condition. Formation factor, cementation exponent m , resistivity index and Archie saturation exponent n can be derived from measurement results and helpful for the calibration of well logs.

Key Benefits:

- Measure fully and partially saturated core samples with large frequency range.
- A dip conductivity probe to measure brine resistivity.
- Jack mechanism uses compressed air to clamp the sample onto the electrode platens.
- Electrical switch box for toggling the electrical core holder to LCR meter without disconnecting wires.

Key Feature:

- Enables bench top measurements for formation factor and resistivity index at ambient condition.
- Standard core holder offers two and four electrodes design.
- Two electrodes are also clamped around the circumference of the core sample.
- Core holder is provided with a plastic box to minimize core saturation changes.

The **M9110** is engineered for laboratory testing of resistivity and formation factor of core sample at ambient conditions.

- LCD display
- digital data
- easy to operate
- safe operation
- low maintenance
- test flexibility
- repeatable results

Specification:

Core diameter:	1" and 1.5"	Core length:	up to 3"
Pressure range:	atmospheric	Temperature:	room temperature
Test frequency:	12 Hz to 100 kHz	Test mode:	R/Q, C/D, C/R, L/Q
Resistivity measurement:	2 and 4 electrodes	Accuracy:	0.05% basic measurement

M9111 Filtration Assemblies

Filtration Assemblies are designed for high pressure liquid chromatography (HPLC), particulate, and microbiological contamination filtrations.

Sintered glass support provides even, flat support structure for membrane filters. They are available in 47-mm or 90-mm filter sizes. Filtering flasks are also available, but sold separately.

Features

- *Coarse fritted glass support base*
- *Graduated glass funnel with 300ml or 1,000ml capacity*
- *Anodized aluminum clamp*
- *#8 silicone stopper with 9/16-inch hole*



Specifications

Size:	90 mm
Diameter:	90 mm
Filter Sizes:	47mm/ 300ml capacity 90mm/ 1,000ml capacity

M9115 Electrical Resistivity System at Overburden Condition

Grace Instrument Model 9115 is designed to perform measurement of rock electrical resistivity at overburden conditions. It measures rock resistivity for both fully and partially brine saturated core samples and brine electrical resistivity at overburden condition.

M9115 includes a hydrostatic electrical core holder, with hand pump for confining pressure generation, a confining and pore pressure control panel for core desaturation.

The resistivity measurement is based on two and four electrode method. Water wet ceramic is used to retain the gas and let the brine going out of the core sample. A burette is used to measure the brine expelled from the core to determine core saturation.



Specifications:

Core diameter:	1" and 1.5"
Core length:	Up to 3"
Resistivity measurement:	2 and 4 electrodes
Pressure:	Up to 10,000 psi
Temperature:	Room condition

**Other specifications can be done by customized request.*

M9117 Capillary Pressure and Resistivity System

The Grace Instrument M9117 Capillary Pressure and Resistivity System is designed to examine capillary curves (both positive and negative) and check the electrical resistivity index as a determination of core sample saturation at reservoir conditions.

The system also includes a core holder made of hydrophobic and hydrophilic ceramics and uses electronodes patterns for resistivity measurement. An automatic pumping system measures fluid control, while a resistivity cell has been installed for resistivity measurement.

Saturation and cementation exponents ("n" and "m", respectively) as well as the formation factor can be calculated during testing.



Features

- Calculates Saturation exponent "n"
- Calculates Cementation exponent "m"
- Core holder of Hydrophilic and hydrophobic ceramics used for resistivity measurement
- Resistivity cell used for brine resistivity measurement
- Automated pumping system used for fluid control
- Temperature-controlled bath houses entire instrument

Specifications

Max confining pressure:	10,000 psi (700 bar)
Max pore pressure:	10,000 psi (700 bar)
Working Temperature:	up to 302°F (150°C)
Capillary pressure range:	145 psi (± 10 bar)
Core length:	up to 3 inches
Core Diameter:	1.5 inches (other sizes available upon request)
Power Supply:	220 VAC, 50/60 Hz
Brine wetted material:	Stainless Steel (with optional Hastelloy)

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The Grace Instrument M9140 Porosimeter is used to measure the effective porosity of a core sample precisely. The effective porosity is the percentage of all the interconnected pore space to the whole core sample. The effective porosity is of great importance in considering the suitability of rocks or sediments of oil or gas reservoirs.

M9140 Core Porosimeter is based on Boyle's Law to calculate the volume through pressure change during the expansion of helium or nitrogen.

Efficient & Dependable Design

A Microsoft Excel® spreadsheet is provided to calculate the porosity using the pressure reading on the digital display. The instrument measures core samples with diameter up to 1.5 inches and length up to 3 inches. Other sample holder sizes are also available.



Operational Features

- Prevents over pressurization
- Calibration block included in the package
- Pressure and pressure sensor accuracy
- Spreadsheet
- Compact size and easy to maintain
- Precise pressure transducer provides accurate pressure measurement
- Vacuum pump is optional for the evacuation of the core sample

Specifications:

Core diameter:	up to 1.5"
Core length:	up to 3"
Electrical requirement:	110/220 VAC
Nitrogen/Helium requirement:	200 psi minimum
Pressure sensor accuracy:	0.1% FSO
Power:	110-220 VAC 50/60 Hz
Dimensions:	12" H x 16" W x 12" D
Weight:	30 lbs

*Other specifications can be done upon customer's request.

M9130 Slim Tube System

Grace Instrument's M9130 Slim Tube System is used to test dynamic miscible (or homogeneous) solutions at reservoir conditions.

Before testing gas is injected at user-controlled pressure through a slim tube which has been saturated in oil through a high pressure pump. A back pressure regulator achieves a constant pressure inside the system while the liquid waste, (or effluent) discharged from the slim tube can be observed through a capillary sight glass tube.

They are then expanded to atmospheric pressure and temperature through a back pressure regulator. An ultrasonic multiphase separator for liquid measurement as the produced gas is measured by a wet gas meter.

A recovery curve is plotted using the raw data obtained during the testing of different miscible displacement experiments. Additional components such as density meter and gas chromatograph may be added to extend the capabilities of the instrument.



Features

- *Determines miscibility at reservoir conditions*
- *Raw data obtained after testing*
- *Produced gas is measured by wet gas meter*
- *High level of automation*
- *Ultrasonic multiphase separator for liquid measurement*
- *Many add on tools extend unit capabilities*
- *Embedded gas injection pump makes safe and easy operation for user*

Specifications

Tube Length:	80 ft. (24 m.)
Tube Diameter:	1/4 in.
Material:	Stainless Steel
Porous media :	Calibrated 230 - 310 μ m silica
Approx porosity :	35 %
Approx pore volume:	100 cc
Working pressure :	10,000 psi (700 bar)
Working temp.:	Up to 150°C
Fluids:	Oil, HC gas, CO ₂ ,
Power supply :	220 VAC 50 Hz

Low Permeability Measurement Apparatus

The Grace Instrument M9190 Nanodarcy Permeameter is designed to measure the low and ultra low permeability of tight plug sized core samples from shale and other tight gas reservoirs. It uses a pulse decay procedure and high pressure nitrogen to measure permeability. Confining pressure system is included for simulating overburden pressure at reservoir condition.

The M9190 Nanodarcy Permeameter can operate at pore pressure up to 2,500 psi and confining pressure up to 10,000 psi, pulse range between 5 to 50 psid. The temperature controlled chamber is used to provide a constant temperature during testing.

Simple Operation and Dependable Measurement

The 9190 Nano-Darcy Permeameter measure the core permeability at a set pore pressure, then propagates a differential pressure pulse through the sample, M9190 software will record upstream pressure, downstream pressure, differential pressure across the sample, and time. The recorded data can then be exported in .CSV format into a spreadsheet file.

Operational Features

- *Mercury-free design*
- *Compatibility with Sour Gas*
- *Digital Display and Accurate Measurement of Gas Volume*
- *Three-volume Function Accomplished by Two-chamber Design*

Specifications:

Working Pressure:	2,500 psi.
Confining Pressure:	10,000 psi.
Temperature Control:	Forced-air flow to ± 0.5 °C
Permeability Range:	10 nanodarcy to 0.5 millidarcy
Core length:	0.125" to 3.0"
Core OD:	1", 1.5"
Pulse Range:	5-50 psi.

Highest pressure and temperature rating of any foam rheometer in the world

Today's researchers must come to grips with some of the harshest environments on earth, and the M9200 hardware is intended to address their needs by providing a test environment that is more robust and realistic than any competing instrument available today can provide.

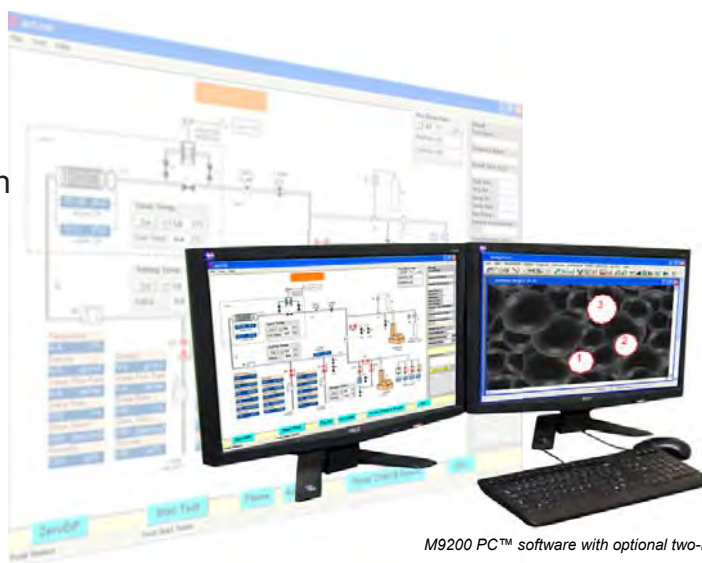
The integrated heat trace maintains a uniform temperature on all sample lines, further ensuring accurate test results.

M9200 Features:

- Single or dual gas (CO₂ and/or N₂) foam testing capabilities
- Continuous foam circulation ensures uniform foam properties
- HPHT viewing cell provides safe operation when testing acidic samples
- Direct visual assessment of foam half-life
- Computer-assisted analysis of bubble size and distribution
- Integrated heating trace maintains a uniform temperature on all sample lines
- Optional accumulator for injection of high-viscosity and/or corrosive sample fluids

Specifications:

Operating Temperature:	Ambient to 350 °F (up to 400 °F optional)
Working Pressure:	Atm to 5,000 psi
Shear Rate:	0 to 1,500 S ⁻¹
Microscope Magnification:	Up to 450x
Viewing Window Material:	Sapphire
Foam Density:	0.3 to 1.0 g/cm ³ controllable
Half-life of Foam:	0 to 72 hr
Foam Bubble Diameter:	≥1 μm
Sample Volume:	115 ml - 220 ml
Accumulator Volume:	500 ml (with optional accumulator)
Rheology Characterization:	API standard and other rheological tests



M9200 PC™ software with optional two-monitor configuration shown

The 9000 series of products are all highly customizable, so all specifications should be regarded as approximate, depending on individual customer requirements.

Straight-Tube Friction Flow Testing

The Grace Instrument M9250 Friction Flow Tester is designed to use a straight tube flow structure to evaluate the performance of a friction reducer for oilfield use. This automated system circulates test fluid through multiple tube sections of varying diameters in order to test flow rate vs. differential pressure under various diameters.

Automatic Computer-Controlled System

This system comprises a standard 30 gallon plastic tank with paddle stirrer to fully mix additives into the base fluid. The test fluid will then be pumped into the friction loop, with the flow rate set by using the mass flow meter. Differential pressure transducers are mounted on two sides of the test sections, and the differential pressure is logged into the analysis software directly.

Analytical Software Included

The friction loop system includes interactive graphics-based software which allows the user to automatically control and operate the loop system, while recording the data for pressure, flow rate, and temperature. A data graph can be generated in order to analyze the effectiveness and performance of friction reducer.



Operational Features

- *Fill Automation*
- *Coriolis mass flow meter*
- *Safety control - Over-pressure relief valve*
- *DP Transmitter (30 psi and 100 psi)*
- *Flow rate of 20 gallons per minute*
- *Mixing tank holds up to 50 gallons*
- *1/2" and 3/4" O.D., 25' straight tube length (10' test section)*
- *Real-time display of Reynolds number, flow rate, temperature, and differential pressure*

Friction Flow Loop Specifications:

Pressure Range:	Atm. up to 150 psi
Flow Rate Range:	0.5 - 15 gal/min
Fluid Temp. Range:	60°F - 90°F
Mixing Tank:	15 - 30 gallons
DP Pressure Accuracy:	0.1% of full range
Particle size limit in fluid:	Up to 0.44 inch

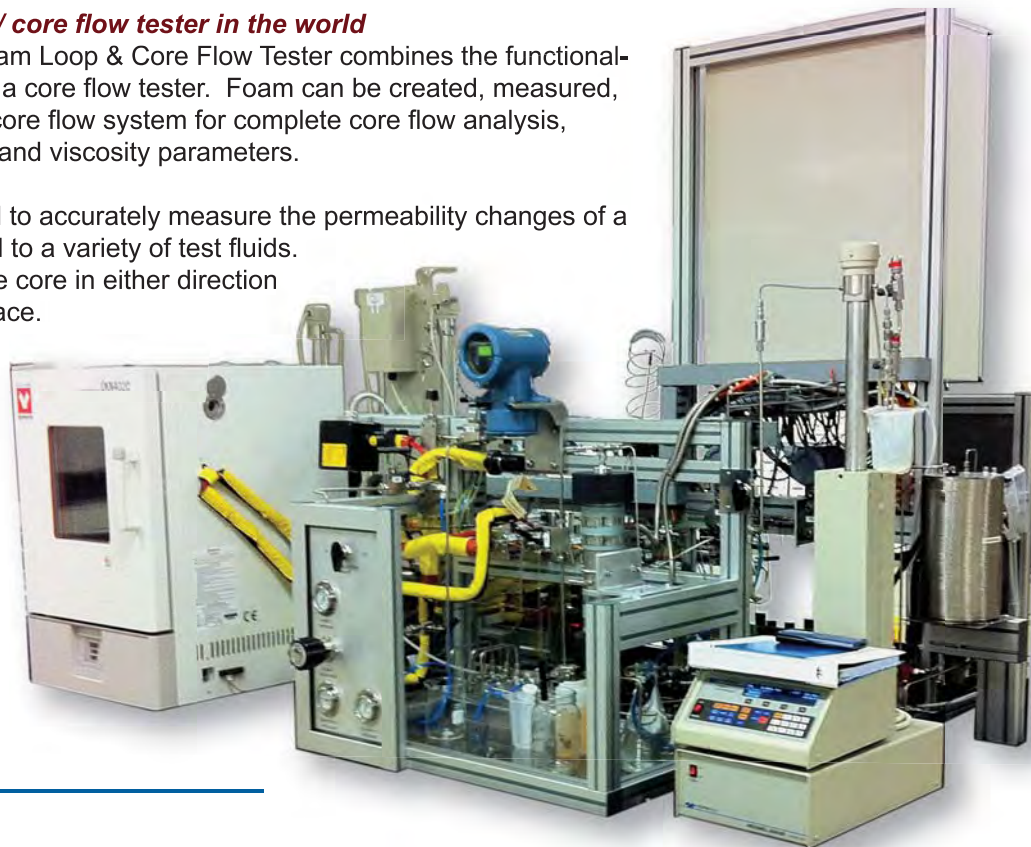
Dimensions - Height:	6 ft
Dimensions - Width:	30 ft
Dimensions - Depth:	4 ft

The only integrated foam loop / core flow tester in the world

The Grace Instrument M9300 Foam Loop & Core Flow Tester combines the functionality of a foam loop rheometer with a core flow tester. Foam can be created, measured, modified, and passed through a core flow system for complete core flow analysis, including temperature, pressure, and viscosity parameters.

The core flow system is designed to accurately measure the permeability changes of a formation sample as it is exposed to a variety of test fluids. Fluids can be injected through the core in either direction or across either end of the core face.

The system is designed to handle all types of clean treating, as well as corrosive treating fluids at temperatures of up to 350 °F. The unique design offers a complete computer-controlled automation package that allows precise monitoring and control of the different flow paths.



Features & Benefits:

- Unique design allows fluids to be injected in either direction or across either end of a core
- Accurate temperature control to 350 °F
- Accurate pressure control to 5,000 psi (41,344 kPa)
- Core holder pivots for easy visual inspection of the core
- Ability to pump solid-laden fluids
- Fully automated for ease of use

Specifications:

Foam Generation & Foam Loop System

Operating Temperature:	Ambient to 350 °F
Operating Pressure:	Atm to 5,000 psi
Flow Rate Range:	0 to 375 mL/min
Shear Rate:	0 to 1,500 S ⁻¹
Microscope Magnification:	11 to 144 X
Viewing Window Material:	Quartz
Rheology Characterization:	API standard rheological and shear history
Foam Density:	0.3 to 1.0 g/cm ³ controllable
Half-life of Foam:	0 to 72 hr
Diameter of Visible Foam Bubble:	≥1 μm

Formation Damage System

Operating Temperature:	Ambient to 350 °F
Confining Pressure:	Atm to 15,000 psi
Working Pressures:	Atm to 10,000 psi
Flow Rate:	0 to 60 mL/min
Back Pressure:	Atm to 10,000 psi

Combined Foam Loop & Formation Damage System

Operating Temperature:	Ambient to 350 °F
Operating Pressure:	Atm to 5,000 psi
Shear Rate:	0 to 1,500 S ⁻¹
Confining Pressure:	Atm to 15,000 psi
Back Pressure:	Atm to 10,000 psi

The M9300 can test a foam fluid with a viscosity of 200 mPa·s with a maximum shear rate of 1,000 S⁻¹

The 9000 series of products are all highly customizable, so all specifications should be regarded as approximate, depending on individual customer requirements.

M9400 Automatic Rotating Disc Acid Reactor

The Grace Instrument M9400 Automatic Rotating Disc Acid Reactor is designed to analysis acid stimulation performance at reservoir conditions. The M9400 is capable of handling hydrochloric, hydrofluoric and organic acids used for acid stimulation of carbonate and sandstone reservoir. The rotating reactor puts the rock sample in motion for uniform reaction with acid system.

Safe, Reliable, Hands-free Operation

Designed to maximize user safety, the M9400 features completely automatic, hands-free operation after the user loads the test samples. Additionally, steel safty shield towers enclose the pressure vessels, with a surrounding splash shield providing further protection to the user and the working environment

This M9400 features a 1-inch diameter rotating disc and a magnetic drive system all within a 10,000 psi Hastelloy pressure vessel. It also includes a temperature control, reactant fluid collector and data acquisition and control system.

During the experiment, pressure, temperature, acid displacement and test duration are all software controlled. Further, the easy to use software allows the collection of numerous reactant samples at preselected time intervals. The necessary accessories are meeting HSE required standards.



Specifications

Pressure Range:	10,000 PSI
Temperature Range:	250 Degrees C
Rotation Speed:	100 - 2,000 rpm (customer option avail.)
Material:	Hastelloy B and Hastelloy C
Reactor Cell Capability:	600ml; (customer option avail.)

Features

- *Automatic hands free operation after loading samples*
- *Steel shield tower provides further protection to test cells*
- *Automatic sampling system*
- *Proprietary design prevents debris plugging sample tubing*

Note: The 9000 series of products are all highly customizable, so all specifications should be regarded as approximate, depending on individual customer requirements.

Design details that ensure repetitive results

The M9500 includes many special design details that ensure repetitive test results. The M9500 system is guaranteed to repeat the benchmark long-term conductivity measurement of Ohio 20/40, 40/60 White Sand.

Multiple precise proppant thickness measurement per cell

By providing at least 2 high-precision proppant-gap measurements at both ends of the testing cell, the M9500 provides crucial information to monitor and validate proper loading of proppant.

Years of hands-on conductivity testing experience

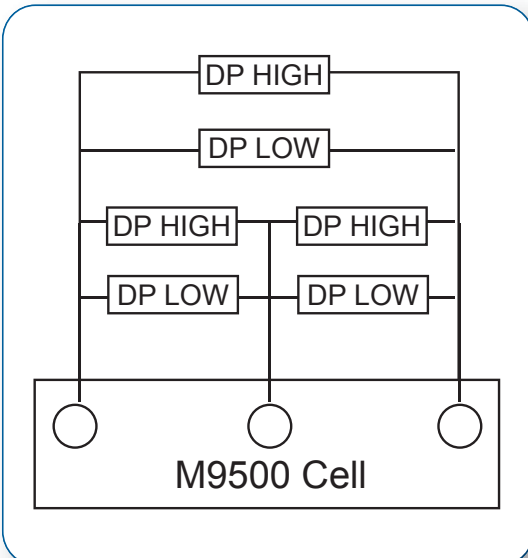
With years of hands-on operating experience, our technicians provide in-depth training to customers, including all necessary details for obtaining repetitive test results.

Multiple DPs validate accurate testing

The standard M9500 configuration includes 6 DP transducers per cell. This provides a very wide and accurate measurement range, suitable for conductivity testing from standard proppant long-term conductivity to polymer reaction with proppants. By providing at least 3 DP transducers per cell, the M9500 can easily verify the accuracy and consistency of test measurement.

Proprietary press design leads to accurate testing

Simplified and improved press design and cell loading procedures warrant easy test cell setup, while ensuring even loading of proppant sample. Additionally, the M9500 hardware can be scaled back to reduce the number of DP transducers from 12 to 6 or even 2, in order to reduce the instrument size and save laboratory space.



Specifications

Fracture Conductivity System:

Flowing Pressure:	Atm to 3,000 psi
Closure Stress:	Atm to 20,000 psi
BP Regulators:	Atm to 3,000 psi
Accum. Pressure:	Atm to 3,000 psi
Accum. Volume:	2,000 mL
ISO Standard:	Adheres to ISO Standard 13503-5

Leak-off System:

Back Pressure:	Atm to 3,000 psi
Digital Pressure Transducer:	±0.1% accuracy of full scale or better
Closure Stress:	Closure stress up to 20,000 psi
Temp. Range:	Atm to 400 °F with ±1 °F accuracy

M9500 Automatic Proppant Conductivity Tester

The M9500 can perform fracture conductivity or leak-off testing separately or they can be run together as part of a pre-programmed test sequence:

1. Fracture Conductivity Testing

The Fracture Conductivity system injects proppant fluids into multiple stacked test cells. Temperature and pressure are displayed on digital readouts as well as being displayed within M9500 PC.

- Manual bleed valves for each cell
- Blanketed reservoirs for deoxygenation of KCl brine
- Inline heaters ensure that fluid enters test cells at target temperature
- Backpressure control and electronic balances capable of measuring 0.1 g/min

2. Leak-off Testing

The Leak-off testing system enables backpressure to be maintained against rock wafers in order to test leak-off rate.

- Handles multiple stacked cells
- Individual heating elements for cells and controllers
- 316 stainless construction for all components exposed to injected brine
- Computer-controlled pump for pressurization and control

3. Flow-back Testing

The Flow-back test is run to measure the flow-back properties of a proppant using one or more test fluids.

- Measures the movement of particles in fluid
- Test fluids include silicate additives or corrosives
- Multiple cells can enable simultaneous tests
- Software can create multiple sequence steps for detailed flow-back analysis

4. Beta factor measurement (non-Darcy flow)

- Automatic calculation of Beta factor under various flow rate
- Max pressure rating: 1,000 psi
- All stainless steel for those components exposed to N₂ injection
- Automatic mass flow controller controllable range min 1-300L/min
- Automatic Beta factor calculation



Note: The model 9000 series of products are all highly customizable, so all specifications should be regarded as approximate, depending on individual customer requirements.

PVT System Provides Accurate, Repeatable Results

The Grace Instrument M9700 PVT System is designed to study the phase behavior of hydrocarbon fluids. The system is mercury-free, featuring high pressure pumps, which generate the required pressure for testing operations. Test fluid volume is monitored for expansion or contraction while under varying conditions of temperature, pressure, and volume.

These conditions are computer-controlled and are completely customizable through user-designed test sequences created with the included PC software.

Efficient & Dependable PVT System

The M9700 analyzer can be used either at a field location or in the laboratory. The PVT cell features a window through the cell wall, allowing visual observation of the sample fluid during test operations. The apparatus can perform constant mass expansion tests (i.e. CME), constant mass depletion (i.e. CMD), differential vaporization studies (i.e. DV), constant volume depletion (i.e. CVD), swelling test, separator test, dissociation point of gas hydrate, and more.

During test operations the software records test data, including pressure, total volume, retrograde liquid volume, and temperature. The instrument's hardware components blend the fluids while providing conditions of pressure and temperature. The recorded data can then be exported in .CSV format and opened in spreadsheet program to derive the PVT parameters.

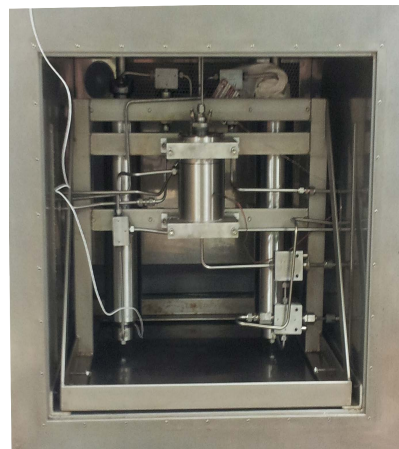
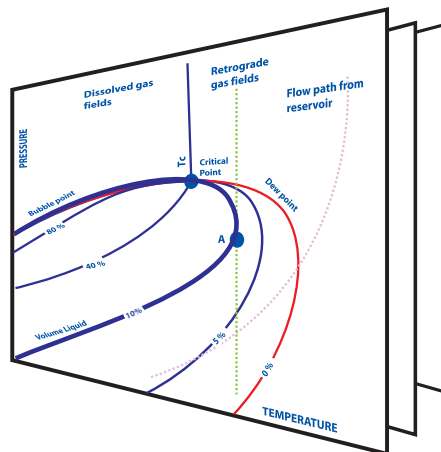


Operational Features

- Mercury-free design
- Computer-controlled data logging
- Visual observation cell
- Constant temperature control system
- Detection in both oil and gas condensate studies
- Designed for maximum accuracy and operator safety
- Innovative data analysis algorithms
- Comparison of current test data with historical test data
- System hardware and software customized to your specifications

PVT System Specifications:

Temperature Range:	Ambient to 205°C (-20°C optional)
Pressure Range:	Atm to 15,000 psi / 104 MPa
Volume Accuracy:	0.001 ml
Cell Volume:	400 ml and above
Temperature Reading:	±0.2 °C
Operating Temperature:	60 °F to 104 °F
Voltage:	220 - 240VAC
Frequency:	50 or 60 Hz



Multiple Test Options for Comprehensive PVT Testing

The M9700 gives the operator the greatest possible number of options for testing parameters. Extreme high-resolution measurement of pressure, temperature, phase, vapor, liquid volume, gas volume, and more can all be tracked accurately and repeatably by the improved computer-controlled sensors and the state-of-the-art data analysis software, which powers the entire system.

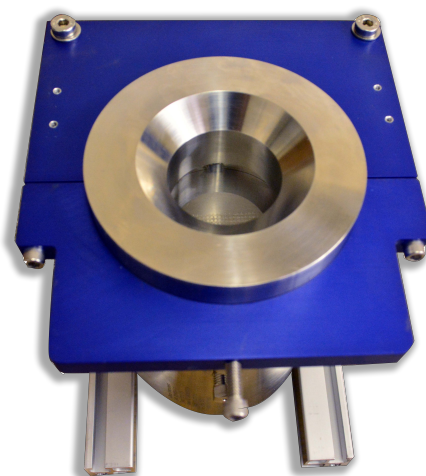
M9700 series PVT System can also be customized toward individual application, such as asphaltene control, brine crystalization control, GOR measurement, scaling control, etc.

Multiple configuration construction available

The M9700 can be modified to different configuration construction upon customer request.

Option one: The M9700 is comprised of two viewing PVT cells in different sizes. One is for oil study and the other is for gas study. The oil cell is equipped with a motorized piston controlled by jack-up system. Gas cell is controlled by high pressure hydraulic pump. Temperature control system is provided by temperature chamber.

Option two: The M9700 is comprised of only one full viewing PVT cell for oil and gas study. The M9700 is equipped with magnetic stirrer and rocking system for fast-reaching phase equilibrium. A high pressure pump is used to control piston movement inside of the PVT cell. Temperature control system is provided by heat cartridges. CCD camera system is used to record phase behavior under different reservoir conditions and detect phase interface and volume in both options.



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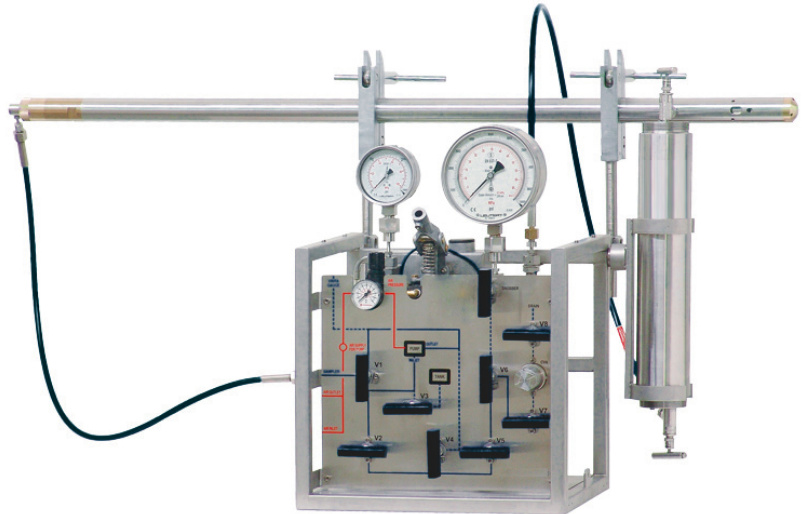
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Volume Accuracy:	0.001 ml
Cell Volume:	400 ml and above
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Voltage:	220 - 240VAC
Frequency:	50 or 60 Hz

Positive Displacement Sampler

The Grace Instrument M9705 Positive Displacement Sampler offers downhole samples within oil wells. Positive displacement operations occurs when synthetic fluid replaces the oil well fluid. The M9705 is able to provide representative fluid samples that can be transferred on site to a sample bottle, without the use of mercury, and analyzed or evaluated to determined reservoir conditions.

Data collected from the M9705 allows the operator to establish oil and gas recovery factors, oil field development programs, and sub-surface samples of water, among other things.

The innovative hardware design of the instrument makes test clean up easy and collection of data simple and reliable. Also, the omission of handling mercury greatly reduces operator risk, making the unit safe and efficient.



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Features

- *Positive displacement operation*
- *High temperature, high pressure testing*
- *No risk for contamination prior to and after sampling*
- *Able to function within hostile oil well conditions*
- *Adjustable sampling duration*
- *Mercury free transfer to bottle*
- *Confirmed sample volume of 600 cm³*
- *Maximizes operator safety & efficiency with shorter sampler*
- *Automatic locking and sealing of chamber*
- *Able to validate sample within sample chamber*

Specifications

Volume:	600 cm ³
Max Temperature:	360°F (180°C)
Max Pressure:	15,000 psi (1035 MPa)
Test Pressure:	22,500 psi (1550 MPa)
Material Options:	Seamless Stainless Steel NACE, MR-01-75 Bronze Hastelloy
Weight:	60 lbs
Dimensions:	12 ft Width 2 in Depth

M9730 Recombination Cell

The Grace Instrument M9730 Recombination Cell was designed to inject oil and gas in at a pre-determined volume, then mixed together and heated at elevated temperature and pressure conditions. The recombination cell is pressurized for a given number of hours, above the saturation pressure to produce a homogeneous, or consolidated mixture of the reservoir fluid.

The recombination cell is heated through a heating jacket for user-controlled temperature settings. A mag-drive stirrer, motorized rocking system are also built within the M9730 to correctly mix and agitate samples while subjected to HPHT conditions.

Features

- *Mercury-free apparatus used to combine liquid samples*
- *Heating jacket/mantel allows user to control temperature*
- *Volume of separator gas and separator oil are determined by user*
- *Can be transferred from recombination cell to a sample piston bottle*
- *Analyze data of GOR, oil shrinkage, and gas compressibility factor*
- *Instrument is based on a HPHT recombination cell*
- *Motorized rocking jacket, magnetic drive stirrer included for proper agitation and mixing procedures*

Specifications

Cell Volume:	2,000 cc
Max Working Pressure:	15,000 psi (1,000 bar)
Max Working Temp.:	Ambient to 350°F (175°C)
Pressure Accuracy:	0.1 % FS
Temperature Accuracy:	± 0.5 °C
Electrical Requirements:	220 VAC, 50 or 60 Hz, 1 ph

Smart Designed, Two Volume Chambers Configuration

The Grace Instrument M9740 Digital Gasometer was developed with two different volume chambers that support multiple combinations. This system widens the capacity of the apparatus by just simply using two chambers separately or in series.

Simple Operation and Dependable Measurement

A control knob on the panel and a corresponding float piston inside each chamber are linked through a set of rack and pinion mechanism for easy adjusting. Direct reading of pressure, temperature, and gas volume can be obtained from gauges, indicators and scales on the front panel of the instrument.

During a test, desired gas will flow into the volume chamber where a vacuum has been conveniently generated by the operator. Then, readings can be done when the chamber pressure is balanced around 1 atm by the piston which is moved by a rotating, pressure-adjusting knob. After the gas has fully expelled from the chamber, a new test can be started immediately.

Operational Features

- *Mercury-free design*
- *Compatibility with Sour Gas*
- *Digital Display and Accurate Measurement of Gas Volume*
- *Three-volume Function Accomplished by Two-chamber Design*

Specifications:

Total capacity:	3,000 ml
Left side capacity:	2,000 ml
Right side capacity:	1,000ml
Accuracy:	0.2% of reading
Maximum pressure:	50 inch of water / ~2 psi / 14 kPa
Scale resolution:	0.1% of full scale

GRACE INSTRUMENT ALSO MANUFACTURES THESE TESTERS:

Viscometer/Rheometer
Core Flood
Foam Loop
Lubricity Tester
Shale Swelling
Interfacial Surface Tension
Curing Chamber
Consistometer
Stimulation

Cement Analyzer
Sagging Tester
Dynamic Filtration
Formation Damage
Acidizing/Fracturing Fluid
Linear Swell Meter
Drilling Simulator
Pycnometer (PVT)
Stirred Fluid Loss



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