

Epsilon[®] technology corp

Extensometers for materials testing



Extensometer Catalog

Version 110.16



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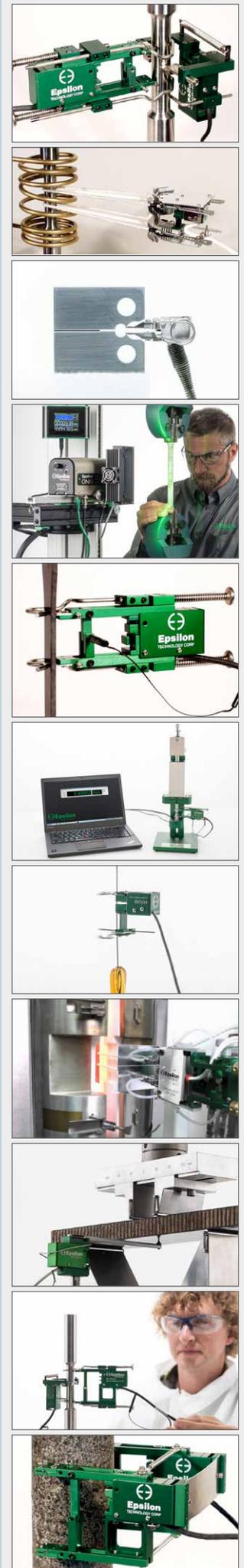
OUR COMPANY

Strain measurement for materials testing is our sole business at Epsilon.

At Epsilon, we specialize in strain measurement for materials testing. For three decades we have dedicated our efforts to developing top-quality extensometers and calibrators. Located in scenic Jackson, Wyoming, our state-of-the-art facility is where we design and manufacture extensometers for testing all kinds of materials: metals, composites, plastics, ceramics, elastomers, geomaterials, and biomaterials. From fine wire to large rebar, there are models for tension, compression, bend, shear, torsion, bi-axial, and fracture mechanics testing. Most of our extensometers are capable of cyclic fatigue testing over a range of frequencies and operating in strain control.

Why Choose Epsilon?

- **Focused on Extensometers:** With an exclusive focus on designing and manufacturing extensometers and calibrators, Epsilon has established itself as a leading choice for testing laboratories across the globe. We have customers in over 76 countries, reflecting the trust and confidence placed in our solutions.
- **Broad Product Line:** We offer 36 different extensometer models with thousands of variations, providing an optimized solution for almost any test method and ensuring the perfect fit for your specific needs.
- **Reputation for Quality:** Quality is at the core of everything we do. Our manufacturing team is committed to rigorous quality and we check every unit before it ships. Epsilon is ISO 9001 certified and ISO/IEC 17025 accredited, including our traceable laser interferometer calibrator – reasons that customers around the world trust Epsilon. Explore our scope of accreditation and quality system certificates here.
- **Expertise in Materials Testing and Extensometers:** At Epsilon, our team of degreed engineers includes experts with advanced degrees and industry experience in materials testing. We have 30+ years of experience designing and manufacturing extensometers.
- **Responsive—talk to our experts anytime:** When you reach out to Epsilon, you can expect prompt, personalized assistance from a degreed engineer well-versed in materials testing and extensometers. Whether you need help selecting an extensometer or need help troubleshooting a problem, our experts are readily available to provide guidance. If you need a repair, our service is timely and reliable.



Compatibility

Interfacing Epsilon extensometers to test equipment.

All of Epsilon's strain gaged transducers employ a full Wheatstone bridge design. They are powered by an excitation voltage, typically between 5 and 10 VDC. The output of the extensometer is proportional to the excitation. For this reason the calibrated output is often expressed as a mV/V value. An extensometer with a full scale span of 2.345 mV/V will have a full scale output of 23.450 mV if the excitation is 10V. This span data is provided by Epsilon on each extensometer test certificate.

All strain gaged sensors must be connected to some external electronics to provide readings. The electronics provide the excitation and normally amplifies the sensor's output to a high level DC voltage. This resultant voltage is used for readout or control of the test machine. In digital systems the voltage output is converted via data acquisition hardware into engineering units of strain. In instances where a chart recorder or X-Y recorder is used, the output is set to easily yield a specified strain/cm on the graph.

When any new device like an extensometer is first used, the sensor must be calibrated with the electronics to ensure proper configuration. There are several ways to accomplish this. Generally the process is very straightforward. If your extensometer will be connected to an available strain channel in your test controller, Epsilon can normally supply the unit with the correct connector to plug directly in. For external data acquisition systems, a strain gaged signal conditioning module capable of providing the excitation is required. Often this is part of the data acquisition system. For systems that require high level inputs or for use with chart recorders and X-Y plotters, Epsilon offers optional signal conditioning electronics.

CALIBRATING EXTENSOMETERS WITH EXISTING ELECTRONICS

Required for any extensometer you buy, this process can be performed many ways, most of which are quite simple. The most common options are as follows:

Using the Epsilon Shunt Calibration System

As detailed on the Epsilon Shunt Calibration System page (p. 124), shunt calibration is a very quick and easy way to set your electronics, regardless of brand. Shunt calibration allows you to transfer Epsilon's calibration to on-site electronics using a two point calibration line fit. The Epsilon Shunt Calibration System is included with all Epsilon strain-gaged extensometers and can also be retrofitted to older extensometers at Epsilon's factory.

With signal conditioning electronics from Epsilon

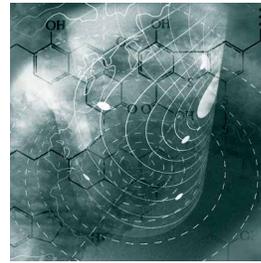
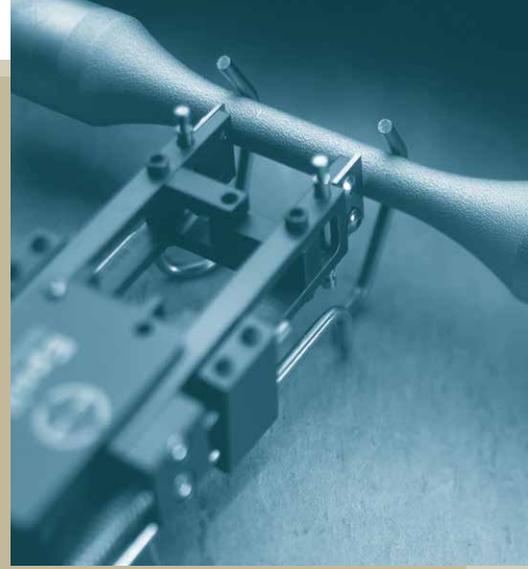
All extensometers purchased with electronics from Epsilon are shipped as fully calibrated systems. The output from the system is set to exact values (typically $\pm 10\text{VDC}$), and is noted on the test certificate. No further calibration is required. Periodic recalibration can be performed by Epsilon.

With an extensometer calibrator from Epsilon

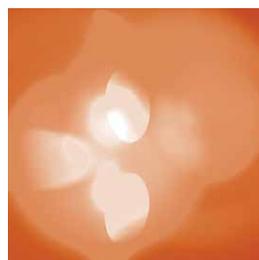
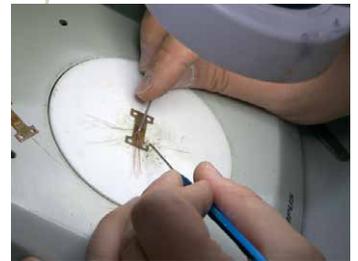
Epsilon's digital electronic calibrators are the easiest to use units available. These calibrators provide an ideal way to perform calibrations if you have many extensometers. They allow you to check many data points along the curve for the highest accuracy. The 3590VHR calibrator meets the accuracy and resolution requirements for ASTM E83 Class B-1 for 6 mm gauge length and greater extensometers and ISO 9513 Class 0,5 over the full measuring range of the calibrator. Periodic recalibration of the calibrator can be performed by a third party calibration service or by sending the unit to Epsilon Technology.

By calibration services such as the equipment manufacturer or independent calibration service

Epsilon's extensometers can be calibrated with test controls by any third party calibration service with the capability of calibrating extensometers. Many customers have their entire test machine re-calibrated annually by the service department of the manufacturer. This includes the load cell, extensometers and any other installed sensors. Most calibration services will have no difficulty calibrating Epsilon's extensometers.



bend
interfacing
calibration
torque



Performance Features

OUTSTANDING PERFORMANCE FEATURES IN EVERY MODEL

- Rugged construction withstands constant handling and mounting
- Most models may be left on through specimen failure
- Light weight to minimize specimen influence
- Most models operate in both tension and compression
- Most models are capable of being used in cyclic tests
- Low operating force, normally less than 40g, with many under 20g
- Easy to attach to specimens, with quick attach kits for most models
- Immersible in many non-conductive fluids
- Initial gauge length accurately established
- All come with foam lined case

Backed by many years of experience

Over forty years of experience in materials testing and extensometer design combine to provide the best performing extensometers in the industry. Epsilon's experienced staff combined with our factory direct sales structure means if you have questions, you can speak with an expert to help resolve your issue. Our extensometers are the result of design refinements based on the experiences and inputs from customers over many years.

Full one year warranty on every extensometer

The warranty covers defects in materials or workmanship for a full year, excluding normal wear and damage from excessive force. Each unit is produced under stringent quality standards and is fully tested and calibrated. Certain items such as knife edges wear under normal circumstances and a spare pair is included. Should your extensometer require repair, Epsilon maintains a policy of quick response to keep your test lab running.

High accuracy, exceeding requirements of ASTM, ISO, and many other test standards

All of Epsilon's extensometers are designed for very high accuracy, with performance significantly better than required by various testing standards. Epsilon's extensometers adhere to the highest requirements of ASTM E83 and ISO 9513, where applicable. For all other units, linearities of better than 0.15% of full scale measuring range are commonly achieved.

All units ship with an ISO 17025 accredited test certificate. Each extensometer is individually calibrated using traceable electronics, with relevant data provided on the test certificate.

Highest quality and the best value

Epsilon's entire line of extensometers were engineered for high performance during even the most demanding materials testing applications. They have the ruggedness needed for high volume testing labs, proven through years of customer use.

Epsilon extensometers are sold factory direct. Coupled with our innovative design, the result is substantial cost savings to your company, with world class performing products.

Unique dual flexure design combined with overtravel stops for ruggedness

Nearly all models use a dual flexure design, which protects the extensometer from undesired motions. This design isolates the sensing element from side forces and accelerations in dynamic tests. Nearly all out-of-plane errors are eliminated.

All standard axial extensometers may be left on through specimen failure

Integral mechanical stops protect the extensometer from damage when specimen failure occurs. The stops also prevent damage from mishandling.

Replaceable parts for added life and versatility

All models have easily replaceable knife edges (where applicable). An additional set is included in the spare parts kit. The standard knife edges are made from hardened tool steel for long life. The modular design of the extensometers allows easy replacement of damaged components.

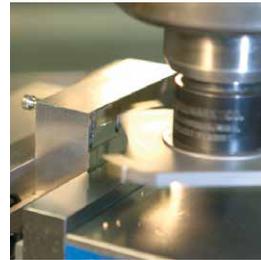
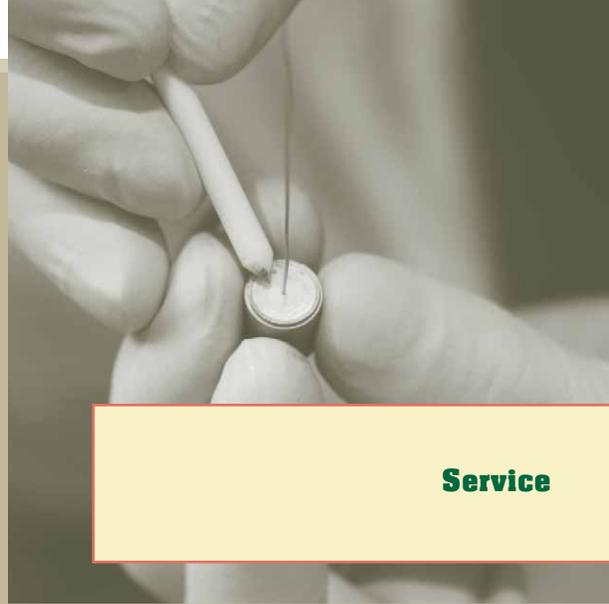
PERIODIC TABLE OF THE ELEMENTS											
IV			V			VI					
A	B	A	B	A	B	A	B	A	B	A	B
RH ₁			RH ₂			RH ₂			RH ₂		
RO ₂			R ₂ O ₃			RO ₃			RO ₃		
5	4	6	5	7	6	2	15.999				
C 12.01115			N 14.0067			O 15.999			S 32.06		
3	4	14	5	15	6	8	32.06				
Si 28.086			P 30.9738			S 32.06			Cr 51.996		
2	22	2	23	11	24						
Ti 47.90			V 50.942			Cr 51.996			Se 78.96		
31	4	32	5	33	6	18	78.96				
Ge 72.59			As 74.9216			Se 78.96			Mo 95.94		
2	40	2	41	12	42						
Zr 91.22			Nb 92.906			Mo 95.94			Mn 54.938		
49	4	50	5	51	6	18	54.938				
Sn 118.69			Sb 121.75			Te 127.6			Ni 58.71		
2	72	2	73	11	74						
Hf 178.49			Ta 180.948			W 183.84			Cu 63.546		
1	81	82	5	83	6	18	63.546				
Pb 207.19			Bi 208.980			Po 209			Au 196.967		
37	4	82	5	83	6	18	196.967				
101											

We are all about service at Epsilon.

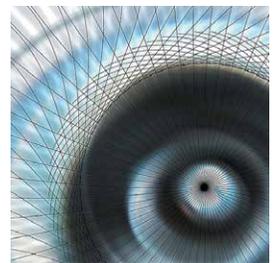
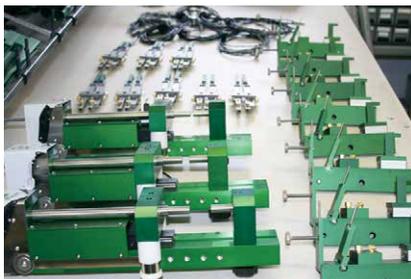
Each extensometer comes with a full, one year warranty. The warranty covers defects in materials or workmanship for a full year, excluding normal wear and damage from excessive applied force. Each unit is produced under stringent quality standards and is fully tested and calibrated before leaving the factory.

Certain items such as knife edges and ceramic rods wear under normal use, and a spare set is included. The modular design of the extensometers allows for easy replacement of damaged parts. Should your extensometer require repair, Epsilon maintains a policy of quick response to keep your test lab running.

Epsilon Technology takes pride in ensuring that our experts are available to speak with customers. If you have an issue you wish to discuss, please contact us with your questions.



fully tested
one year warranty
stringent standards
highest quality



Frequently Asked Questions

Can Epsilon extensometers be left on through specimen failure?

Yes. All Epsilon standard extensometers are designed to withstand remaining on the sample through specimen failure. On certain materials, such as high strength metals, knife edges will wear out faster if the extensometer is left on through failure. A spare set of knife edges is included.

Will the extensometer be compatible with my existing electronics?

All extensometers in this catalog can easily be shipped with the mating connector already installed, so you can plug right in to your existing electronics. We stock connectors for every common brand of test machine.

The majority of Epsilon's extensometers are strain gaged transducers which may be connected to most brands of materials testing controls. If your controls have the signal conditioning module for a strain gaged extensometer, we can supply the unit with the necessary connector to plug in directly. If you are using a data acquisition board to acquire test data, the extensometers can almost always be interfaced properly. Some of our extensometers use capacitive sensing technology and these include the required electronics.

If your controls are designed for LVDT type extensometers only, we can provide the electronics to work with our extensometers. Available electronics are covered in this catalog. This is also ideal for older test machines, which may not have any extensometer electronics, allowing the output to run a chart recorder or plotter, or interface to a data acquisition board.

The Epsilon Shunt Calibration System helps make calibrating the electronics for the extensometer quick and easy. This also allows you to send your extensometer back to Epsilon for periodic recalibration. For further details on shunt calibration see page 124.

What electronics are needed?

Most of our extensometers are strain gage based sensors. They use a full Wheatstone bridge design. Functionally they require the same signal conditioning electronics used for any strain gaged transducer (load cell, pressure sensors, etc.). If you do not already have the electronics, Epsilon has signal conditioners available.

How do I decide what measuring range I need?

The selection of extensometer measuring range can depend on several factors including resolution of the signal conditioner, desired dynamic performance, space constraints, desired calibration class, ergonomics of the extensometer, and hanging weight on the specimen. The general rule is that for optimum performance in the elastic region (i.e., Young's modulus and yield strength measurements) a measuring range of 5% to 20% is typical. If there is a need to record strain at failure using the extensometer, the measuring range selected should provide sufficient travel including overage for outliers. Strain ranges of 20% to 50% are typical for many metallic materials, with more ductile materials requiring 50% to 100% strain range. Composites typically need no more than 10% to 20% strain range for measuring strain at failure.

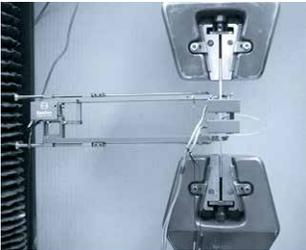
Generally speaking, Epsilon's extensometers will meet the higher levels of accuracy requirements in today's standards, such as ASTM E83. You can thus be assured that reasonably accurate measurements at the low end of the range can still be made.

Why do I need an extensometer when I can get strain from crosshead displacement?

Measuring crosshead extension during a test does not just measure strain in a defined region of a test sample. It also measures machine deflection, load cell deflection, grip deflection, deflection of the part of the test sample outside the reduced section, and possible grip slippage. Strain is defined as the change in length divided by the initial length (gauge length). There is no defined initial length without an extensometer, and the change in length is not correctly measured due to the other deflections included in crosshead displacement.

What our customers have to say about us.

“ I use Epsilon extensometers because they are rugged, well built and economical. I find their versatility to be their most appealing aspect.



Model 3542-2 inch extensometer with a Model 3575AVG r-Value extensometer in use determining deep drawing sheet metal properties.

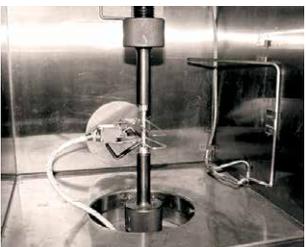
We interface them with several data acquisition systems as well as testing machines. We use them in traditional testing modes to non-traditional, stand alone applications. It's the versatility of these instruments that makes Epsilon extensometers a perfect fit for our test laboratory.”

RICK PEARSON
ANDERSON LABORATORIES, INC.

“ Epsilon's products, technical support and service on repairs are very easy. We have never before experienced such a well organized company. We are in Austria, but it is much faster and easier to buy high temp extensometers via the US instead of from nearer European companies! The technical support is very good, since every question is answered in less than 24 hours! Other companies take weeks to answer – if they answer at all.”

MARTIN RIEDLER
Department Product Engineering
MONTANUNIVERSITÄT LEOBEN, AUSTRIA

“ ... I have been doing testing for over 15 years and have used Epsilon extensometers for more than seven years (3542 series). Your extensometers represent the best value for their cost in the industry. ... Since, we can “leave” the extensometer until break in most



Model 3555 high temperature extensometer being used at 550 °F in the determination of mechanical properties of an aluminum alloy used in an engine head application.

applications (because of the robust design), we can get invaluable information on the material evaluated. ... The response time in getting a new unit is by far the shortest in the industry.”

BRUNO BELANGER
President and CEO
BCOMTESTING, INC.

“ At Laborator Dinamic we are using your Epsilon extensometers for modernizing different kinds of Universal Testing Machines or on new machines. ... I really appreciate your product's simple and clever embedding solutions with high quality and technical performances.”

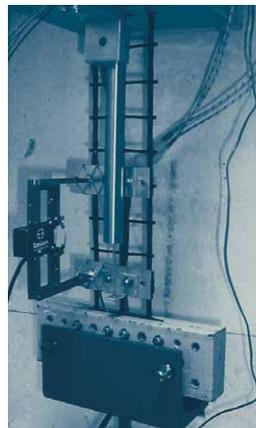


Model 3542 axial extensometer mounted on round tensile sample.

JOHN DINA
LABORATOR DINAMIC, ROMANIA

“ ... With the fastest repairs completed in less than two weeks (from the moment it was dispatched overseas from our factory to the moment it was received again). Our previous extensometer supplier never managed a turnaround in less than eight weeks. For a front line piece of equipment that is entirely unacceptable.”

MIKE DAVIES
CYTEC, UNITED KINGDOM



Polyethylene geogrid undergoing pullout testing in TRI's Compact Connection Device using a specially designed Model 3542 extensometer.

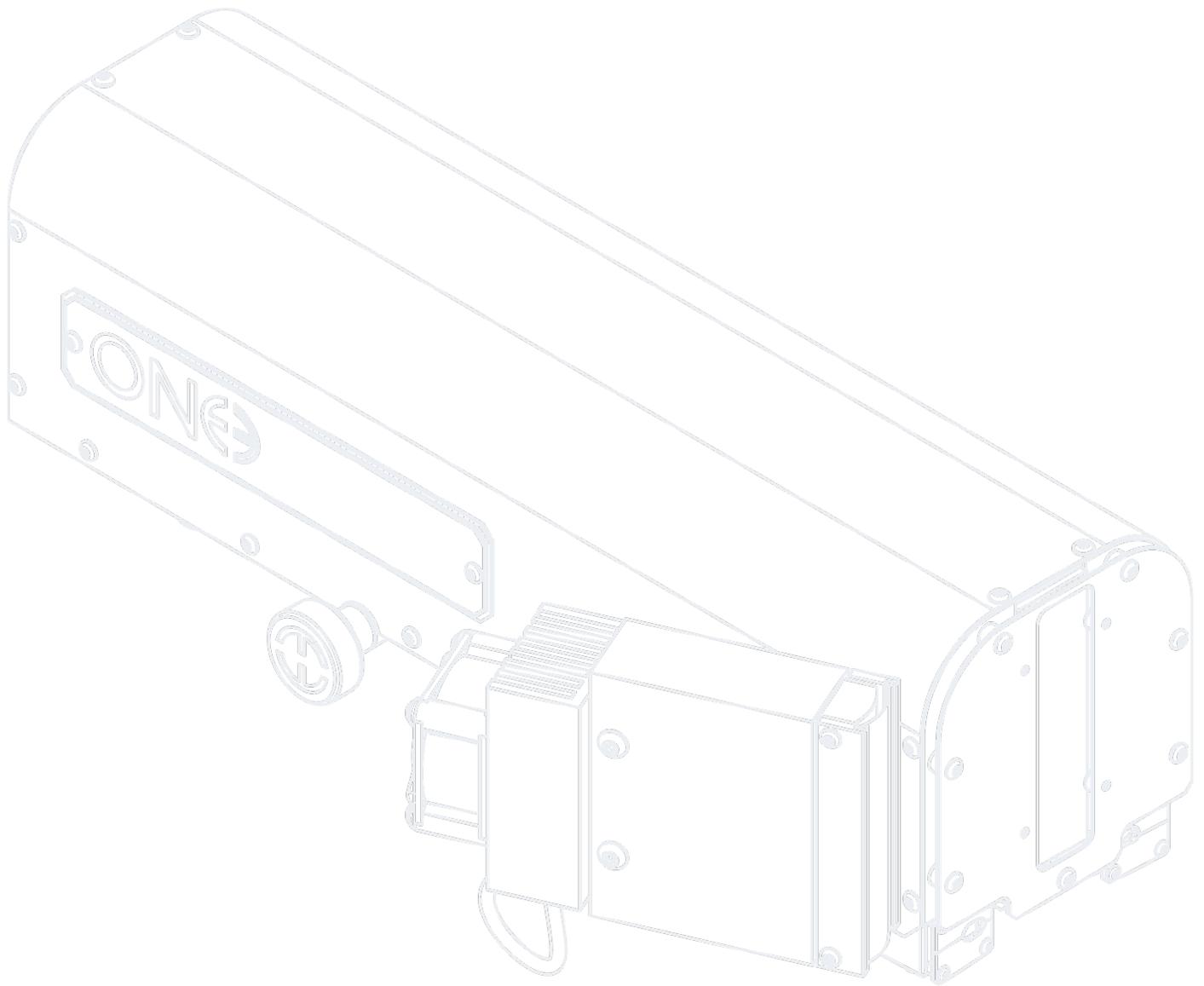
“ We use Epsilon extensometers for their high quality, stability and ruggedness. When we do eventually damage an extensometer, Epsilon has, without fail, offered excellence of service we would like from all of our vendors. Epsilon has provided custom engineering support to maximize reliability after many cycles of specimen ruptures.”

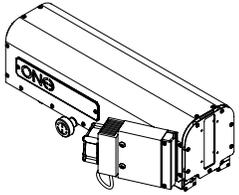
SHAWN ARNETT
TEXAS RESEARCH INSTITUTE

“ I have been really happy with all extensometers purchased from you: good quality, high precision, friendly.”

GREGORY BANAS
Senior Research Engineer
UNIVERSITY OF ILLINOIS

Visit our website at www.epsilontech.com
Contact us for your special testing requirements.

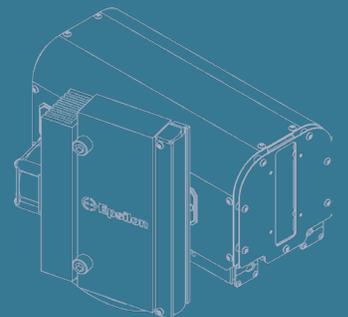
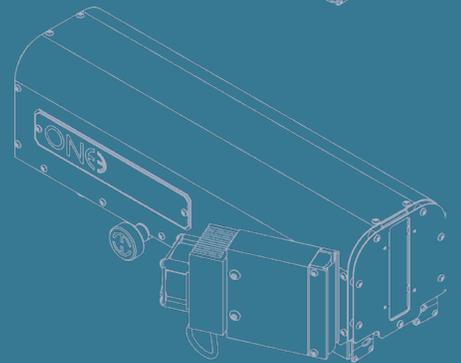
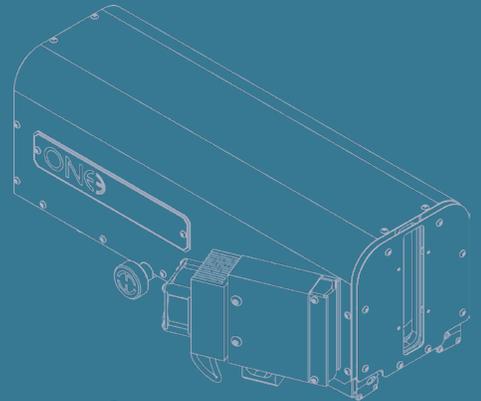




Epsilon ONE® Non-Contact Optical Extensometers

Non-Contact Extensometers

LE-05 Non-Contact Laser Extensometers



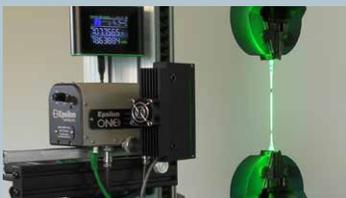
Breakthrough Performance • Easy to Use • Interfaces With Any Test Machine

Epsilon ONE high-precision optical extensometers measure axial strain with industry-leading resolution, accuracy, and speed. Innovative Instant Reset and Laser Alignment features maximize ease of use and testing throughput. $\pm 10V$ output is compatible with any testing system.

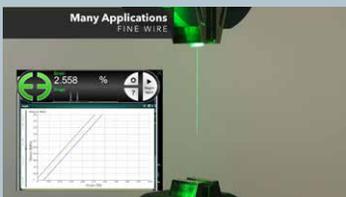
Applications



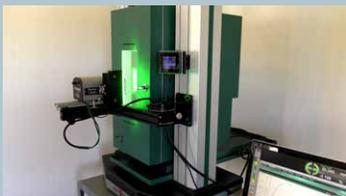
Composites, Metals, Ceramics



Plastics, Elastomers

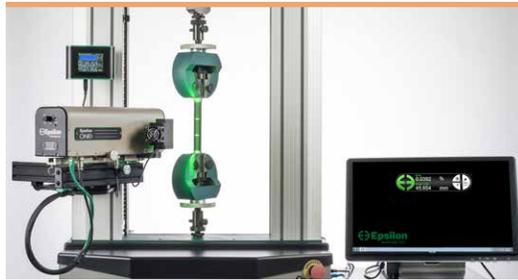


Foil, Wire, Polymer Films



Non-Contact Strain Measurement with an Environmental Chamber

Many more...



Epsilon ONE - Model ONE-78PT-System with carbon fiber composite specimen

Epsilon ONE optical non-contact extensometers perform high-accuracy, high-resolution, non-contacting axial strain and displacement measurement. These extensometers are suitable for testing high-modulus materials such as metals and composites, high-elongation materials, thin or delicate specimens, cyclic fatigue, strain controlled testing, deflectometer applications, and measuring crack opening displacements. Strain or extension is measured and output in real time.

Epsilon ONE's high resolution and ISO 0,5 / ASTM B-1 accuracy classes make it suitable for non-contact measurement of a wide range of strain values, from very small strains required to measure modulus of metals, composites, ceramics and CMCs through elastomers and everything in between.

Class-leading accuracy and resolution are achieved by Epsilon's comprehensive optical path optimization, a unification of several optical technologies and signal processing algorithms. Ultra-high camera resolution, real-time data rates up to 3000 Hz, minimization of optical error sources, and signal processing techniques provide high strain resolution and accuracy with the lowest noise. No other system on the market combines all of these technologies.

The Laser-Assist Alignment System provides an instant alignment and distance spot check. Epsilon ONE will project pre-aligned laser lines on the specimen before the test, revealing any misalignment. During the test, high precision telecentric lenses on the PT models eliminate errors due to out-of-plane movements – a common source of errors for many video extensometers. Epsilon ONE arrives factory calibrated – there are no calibration grids or gauge length bars, saving a great deal of time.

The system sets up for new specimen types in minutes and requires very little training or skill to use. The desktop user interface software and optional Touch Interface provide continuous digital readouts and status information.

Epsilon ONE was designed for the fastest specimen cycle times. Auto-start repetitive tests without any software interaction; Epsilon ONE is always running, and its Instant Reset and Automatic Mark Detection eliminate software start/stop interactions common with video extensometers.

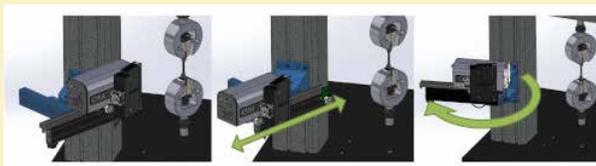
Epsilon ONE fits all types of materials testing machines. The system may be used with environmental chambers that are equipped with a window – contact Epsilon.

See Epsilon ONE extensometer videos

Features

- Always on, always ready: Unlike DIC systems, software interactions are unnecessary when running repetitive tests.
- Always real-time: Post-processing is never required, even at the highest data rates.
- Faster throughput with Instant Reset: Auto-start repetitive tests without touching the extensometer or software.
- Reliable, automatic mark detection: Robust tracking of bright or dark marks beyond 1000% strain and speeds >1500 mm/second.
- Laser Assist Alignment System: Provides an instant visual spot-check for specimen alignment and optics positioning.
- Precision Telecentric Design: Epsilon ONE's telecentric lenses prevent common sources of error. *See the Tech Note at www.epsilontech.com*
- Fully factory calibrated: Epsilon calibrates using the industry's most comprehensive process to correct for scaling, skew, lens distortion, and uneven lighting. A2LA accredited factory calibration, traceable to the SI; no grids or bars are required for calibration.
- Cleaner workspace: No need for an additional computer and monitor; the included Software User Interface has very low resource requirements and can run on the test machine's computer.
- Optional Touch Interface: Access and control the Epsilon ONE without a computer.
- Retractable high-stiffness mounting: Industry-leading ease-of-use while maintaining maximum dynamic range and vibration rejection.
- Selectable multi-line specimen marking: Automatically identify and report the region of highest strain concentration, in real time.
- Wide range of selectable filter and optical settings enable high performance with many different materials and specimens.
- Faster Testing: Save time with industry-leading 200+ Hz dynamic range and automatic gain compensation filters.
- Admin/User Modes: Define, save and reload settings for specific specimens and test methods, then lock them in User Mode.
- Real-time digital output: High-speed data stream including APIs for control and status, and examples for automation and integration.
- Better Strain Control: Built-in high speed 16-bit analog output; not susceptible to unpredictable cyclic bias errors typical of DIC systems.
- Versatile Output Modes: output $\pm 10V$ as % Strain, Length (mm), or Elongation (mm).
- Applicable for testing with many ISO and ASTM standards, including:
 - ISO 6892-1, 527-2, 527-4, 527-5
 - ASTM E8, E9, D3039, D638, A370, D3552, E646
- Turn-key: Each base package includes
 - Optics Package with laser-assist alignment system
 - Lighting Module
 - Sensor Controller
 - Mounting Interface Subassembly
 - Specimen Marking Kit
 - Cables and software
- Patented design
- Includes high quality foam lined case.

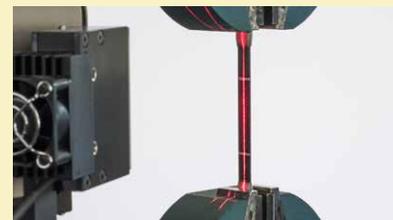
Ease of Use is Designed In



Rigid Load Frame Mounting
Linear Retraction and Swing Away features



Instant Reset
Always On, Always Real Time
Automatic Mark Detection



Laser Assist Alignment System
• Specimen alignment spot check
• Eliminates calibration grids and bars



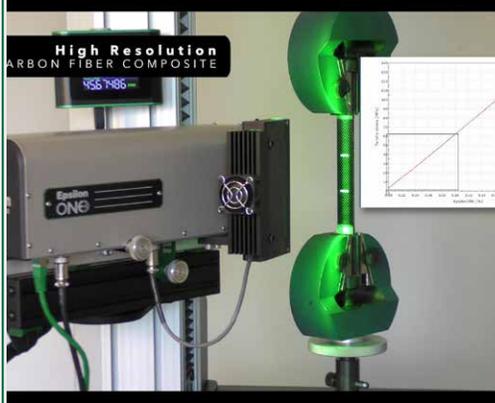
Simple User Interfaces
• Software User Interface
• Touch Interface

Epsilon ONE[®] Optical Non-Contact Extensometers, continued

ADVANTAGES

What sets Epsilon ONE[®] apart?

Resolution, Accuracy, Speed



Epsilon ONE's performance is a result of optics and algorithm technologies that combine for high resolution, data rates and accuracy:

Resolution: $<0.5 \mu\text{m}$ quasistatic, $<2.5 \mu\text{m}$ dynamic, $<0.1 \mu\text{m}$ creep; Typical RMS resolution at typical settings.

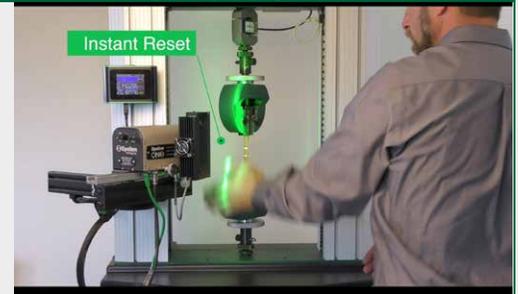
Real time data rate: 300-3000 Hz

Extensometer Accuracy Class: ISO 9513 Class 0,5 and ASTM E83 Class B-1 or better, typical, for gauge lengths $\geq 10 \text{ mm}$

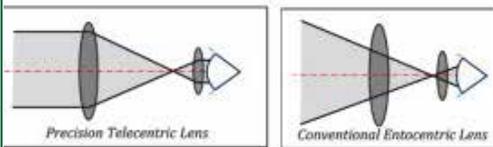
As a result, Epsilon ONE is equipped with the accuracy and fine resolution required to measure modulus, offset yield, stress-strain curves, and strain at failure for all high-modulus materials.

Always On, Always Real Time

Epsilon ONE overcomes one of the biggest barriers to widespread use of non-contact extensometers: too many steps when using them. Epsilon ONE is always running and measuring strain or searching for marks using its Automatic Mark Detection. As soon as marks are detected, Epsilon ONE is measuring strain in real time. Epsilon ONE doesn't have to be started and stopped for each specimen like most video extensometers and DIC systems, and strain output is always in real time at data rates up to 3000 Hz.



Telecentric Design



Many applications involve specimens that straighten or grips that are free to align under tensile loading. Unlike conventional lenses, telecentric lenses are insensitive to potential inaccuracies caused by these out-of-plane motions. With a telecentric lens, the image of the test specimen seen by the camera's sensor is the same size even if the specimen moves closer to the Optics Package or further away.

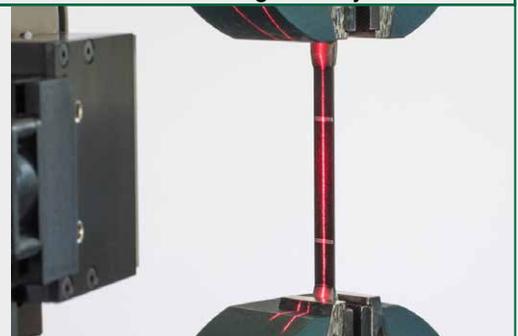
The benefit: full strain measurement accuracy is maintained even if the specimen or grips move out of the testing axis ("out of plane") during the test. Conventional entocentric lenses, which are widely used by other manufacturers of non-contact extensometers, cannot match this performance.

Laser Assist Alignment System

Setup is faster and more robust with the Laser Assist Alignment System. Epsilon ONE's built-in factory aligned lasers provide two functions:

- Spot-checking specimen alignment
- Setting distance to the specimen - eliminates the need for calibration grids or gauge length bars

Epsilon ONE is factory calibrated - just set the distance to the specimen, set your controller to take Epsilon ONE's calibrated $\pm 10\text{V}$ input, and start testing.



Optics Packages



ONE-78PT-System
Premium Precision Telecentric Optics



ONE-52PT-System
Precision Telecentric Optics



ONE-200CE-System
Conventional Entocentric Optics

Specimen Marking



Specimen marking is simple and fast. Templates and paint pens are included with every Optics Package

See Epsilon ONE extensometer videos

SPECIFICATIONS

<i>Field of View:</i>	50-500 mm. See specific optics packages; contact Epsilon for other options.
<i>Real-Time Data Rate:</i>	300-3000 Hz, >2000 Hz typical; includes image frame rate, analysis, analog output, and digital output
<i>Strain Outputs:</i>	Analog Output: $\pm 10V$, short-protected, selectable units and range; includes 2.4 m (8 ft) shielded output cable Digital Output: 16-64 bit typical over RS232; includes 1.8 m (6 ft) shielded null modem cable
<i>Resolution:</i>	<0.5 μm quasistatic, <2.5 μm dynamic, <0.1 μm creep; <i>Typical RMS resolution at typical settings. Resolution is a function of the optics and filter settings. See www.epsilontech.com for further details.</i>
<i>Extensometer Accuracy Class:</i>	ISO 9513 Class 0,5 and ASTM E83 Class B-1 or better typical at ≥ 10 mm gauge length
<i>Absolute Accuracy:</i>	PT models: $< \pm 1 \mu m$ or 0.5% of value, not exceeding $\pm 30 \mu m$ typical CE models: $< \pm 1 \mu m$ or 0.5% of value
<i>Minimum Specimen Size:</i>	< $\varnothing 20 \mu m$ (0.001")
<i>Gauge Length:</i>	2 mm minimum, $\geq 4x$ specimen width or diameter recommended; for gauge lengths <10 mm contact Epsilon
<i>Maximum Elongation:</i>	>1000%, limited by field of view and gauge length
<i>Maximum Tracking Speed:</i>	>1500 mm/second (90,000 mm/minute)
<i>Cyclic Testing:</i>	>100 Hz typical cyclic test frequency, waveform independent
<i>Strain Control:</i>	Suitable for monotonic and cyclic strain control applications
<i>Out-of-Plane Sensitivity*:</i>	Allowable out-of-plane motion for ISO 9513 Class 0,5 @15 mm gauge length and ASTM E83 Class B-1: <1000 μm (0.040") for ONE-PT-xx <25 μm (0.001") for ONE-CE-xx *Understand this specification before you purchase any optical extensometer – see the Tech Note at www.epsilontech.com
<i>Power Supply:</i>	100-240 VAC, 50-60 Hz, 100W, IEC 320 C14 receptacle. Specify plug type when ordering.
<i>System Environment:</i>	10-40°C (50-100°F), for use and storage; 20-80% relative humidity non-condensing environments
<i>Host PC (optional):</i>	Requires PC with Windows 7 or later, 900x550 minimum display, one serial or USB port

OPTIONS

- Mounting Systems for testing machine base mount, T-slot column mount, or cylindrical column mount
- ONE-TI-1 Touch Interface
- ONE-BIS Barrier Interlock Systems for setups where Epsilon ONE is installed behind the test area (opposite the test machine operator)
- Customized specimen marking templates
- Connectors to interface to nearly any brand of test equipment



Epsilon ONE[®] Optical Non-Contact Extensometers, continued

ORDERING INFORMATION

The Epsilon ONE[®] system includes an Optics Package, lighting, Laser Assist Alignment System, Sensor Controller, cables, mounting interface, standard specimen marking kit and software. The included user interface software will run on your testing machine's existing computer.

Select an Optics Package that meets your range of gauge length and elongation requirements. Start with the largest gauge length that you will need and determine which Optics Packages have enough elongation range for that gauge length. Repeat this process for the smaller gauge lengths in your range of applications. Telecentric lenses are superior to conventional lenses, especially for applications involving strain measurements <~2%. Learn more about telecentric lenses at www.epsilontech.com.

Epsilon ONE will work with any gauge length that is within the stated range for the Optics Package. Maximum strain values in the tables below are estimates for tensile specimens with a reduced cross-sectional area in the gauge section. When using straight-sided specimens, see the Epsilon ONE web page for recommended estimating methods.

Touch Interface (Optional)

The optional full-color Touch Interface provides all functions necessary to set up and use an Epsilon ONE system. May be mounted on the column of the testing machine near the Epsilon ONE.

Model Number: **ONE-TI-1**

 See a Touch Interface demo

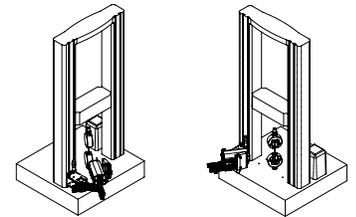


High-Stiffness Mounting Systems

Epsilon ONE is a high-precision optical extensometer and requires rigid load frame mounting. Other configurations than the ones shown below are available – contact Epsilon. Further details are in the Epsilon ONE Mounting System Selection Guide at www.epsilontech.com.

Model Number **ONE-MS-01** For testing machines with integral T-slots on the column:

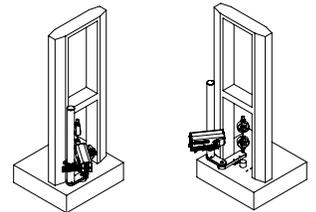
- Mounts to the vertical T-slots of the testing machine
- Provides rigid mounting for any Epsilon ONE Optics Package
- Swing-away and retraction features make it easy to move the Epsilon ONE out of the way when not in use or between tests
- Repeatable placement provided by reference stops



MODEL ONE-MS-01

Model Number **ONE-MS-02** Universal base mounting for all testing machines:

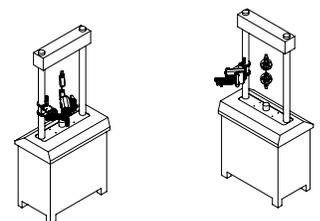
- Mounts to the horizontal surface of the stationary baseplate / lower crosshead on most any testing machine
- Provides rigid mounting for any Epsilon ONE Optics Package
- Swing-away and retraction features make it easy to move the Epsilon ONE out of the way when not in use or between tests
- Repeatable placement provided by reference stops
- Includes design by an Epsilon engineer to ensure that ONE-MS-02 fits your specific testing machine



MODEL ONE-MS-02

Model Number **ONE-MS-03** For servohydraulic or electrodynamic testing machines with cylindrical columns:

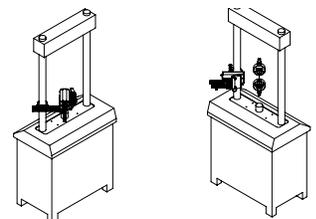
- Mounts to a cylindrical column on a servohydraulic, electrodynamic or static hydraulic testing machine
- Provides very rigid mounting for any Epsilon ONE Optics Package
- Swing-away and retraction features make it easy to move the Epsilon ONE out of the way when not in use or between tests
- Repeatable placement provided by reference stops



MODEL ONE-MS-03

Model Number **ONE-MS-04** For servohydraulic or electrodynamic testing machines with cylindrical columns (no swing-away feature):

- Mounts to a cylindrical column on a servohydraulic, electrodynamic or static hydraulic testing machine
- Provides rigid mounting for any Epsilon ONE Optics Package
- Retraction feature makes it easy to move the Epsilon ONE out of the way when not in use or between tests
- Designed to put the Epsilon ONE in a fixed position; this model does not have the swing-away feature and only mounts Epsilon ONE in an angled orientation

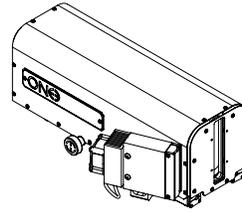


MODEL ONE-MS-04

Epsilon ONE Optical Extensometer Systems

Model Number ONE - 78PT - System

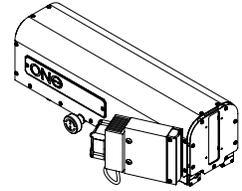
- Premium performance, precision telecentric lens
- 78 mm field of view and 200 mm working distance
- Any gauge length between 10 mm and 65 mm



Range of Gauge Lengths and Maximum % Strain		
Gauge Length	Maximum Strain	Maximum Elongation
10 mm	580%	58 mm
12 mm	470%	56 mm
25 mm	170%	43 mm
50 mm	35%	18 mm
65 mm	5%	3 mm

Model Number ONE - 52PT - System

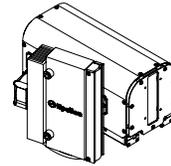
- Precision telecentric lens
- 52 mm field of view and 150 mm working distance
- Any gauge length between 10 mm and 40 mm



Range of Gauge Lengths and Maximum % Strain		
Gauge Length	Maximum Strain	Maximum Elongation
10 mm	320%	32 mm
12 mm	250%	30 mm
25 mm	68%	17 mm
40 mm	5%	2 mm

Model Number ONE - 200CE - System

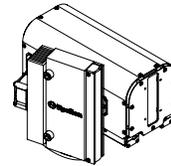
- Conventional entocentric lens – recommended for high elongation applications and for measuring strain values of $\sim 2\%$ or greater; suitable for smaller strains in some applications
- 200 mm field of view and 220 mm working distance
- Any gauge length between 10 mm and 180 mm



Range of Gauge Lengths and Maximum % Strain		
Gauge Length	Maximum Strain	Maximum Elongation
10 mm	>1000%	180 mm
25 mm	660%	165 mm
50 mm	280%	140 mm
100 mm	90%	90 mm
180 mm	5%	10 mm

Model Number ONE - 250CE - System

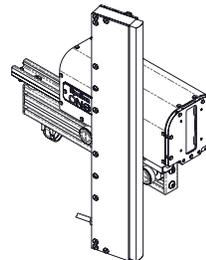
- Conventional entocentric lens – recommended for high elongation applications and for measuring strain values of $\sim 2\%$ or greater; suitable for smaller strains in some applications
- 250 mm field of view and 280 mm working distance
- Any gauge length between 10 mm and 200 mm



Range of Gauge Lengths and Maximum % Strain		
Gauge Length	Maximum Strain	Maximum Elongation
10 mm	>1000%	230 mm
25 mm	860%	215 mm
50 mm	380%	190 mm
100 mm	140%	140 mm
200 mm	20%	40 mm

Model Number ONE - 500CE - System

- Conventional entocentric lens – recommended for high elongation applications and for measuring strain values of $\sim 2\%$ or greater; suitable for smaller strains in some applications
- 500 mm field of view and 270 mm working distance
- Any gauge length between 10 mm and 400 mm



Range of Gauge Lengths and Maximum % Strain		
Gauge Length	Maximum Strain	Maximum Elongation
10 mm	>1000%	480 mm
25 mm	>1000%	465 mm
50 mm	880%	440 mm
100 mm	390%	390 mm
200 mm	145%	290 mm
400 mm	23%	90 mm

Example: ONE-78PT-System, ONE-MS-01, and ONE-TI-1: Precision Telecentric Lens, 78 mm Field of View, mounting for T-slots on the column of the testing machine, and the Touch Interface.

These extensometers are high precision non-contacting units for strain measurement in materials testing. They use a high speed laser scanner to measure the spacing between reflective tape strips on the sample. The measurement range is from 8 to 127 mm (0.3 to 5 inches). The gauge length is determined by the user. This allows high elongation measurements when shorter gauge lengths are used.



Model LE-05 laser extensometer control panel



Laser extensometer

Model LE-05 laser extensometers measure strain optically, without contacting the specimen, using laser diode technology. The extensometers are self-contained and portable. They may be interfaced with a variety of testing machines and data acquisition systems using the $\pm 10V$ analog output or bi-directional RS-232 serial port. Operation may be local or remote. A digital display is included.

The scanning beam is always perpendicular to the specimen, unlike most laser extensometers. This eliminates errors when viewing through windows in chambers. It also minimizes sensitivity to the distance between the extensometer and the sample. Because the unit measures reflected light, no receiver is required behind the sample.

For non-contacting measurement applications requiring higher resolution or higher data rates, see the Epsilon ONE.

Easy to use.

The visible laser light is simply aimed at the specimen, which has small reflective tape strips set at the gauge length desired. The extensometer displays the actual measured gauge length. If desired, the zero button will offset the output to zero. As the specimen is tested, the display will then read the elongation directly.

The analog output and RS-232 interface are easily connected to existing controls or data acquisition systems.

The reflective tape can be used at temperatures up to 80 °C (180 °F). High temperature clip-on reflectors may be used as an alternate to tape reflectors. These are re-usable and available as an option. They are rated for use to 425 °C (800 °F).



Laser extensometer high temperature clip-on reflectors

Features

- Non-contacting optical design requires only reflective tape marks on the specimen, or clip-on reflectors
- Ideal for use in chambers - calibration not affected by aiming through viewing windows
- High resolution of 1 micron
- 127 mm (5 inch) measuring range allows high elongation measurements

SPECIFICATIONS

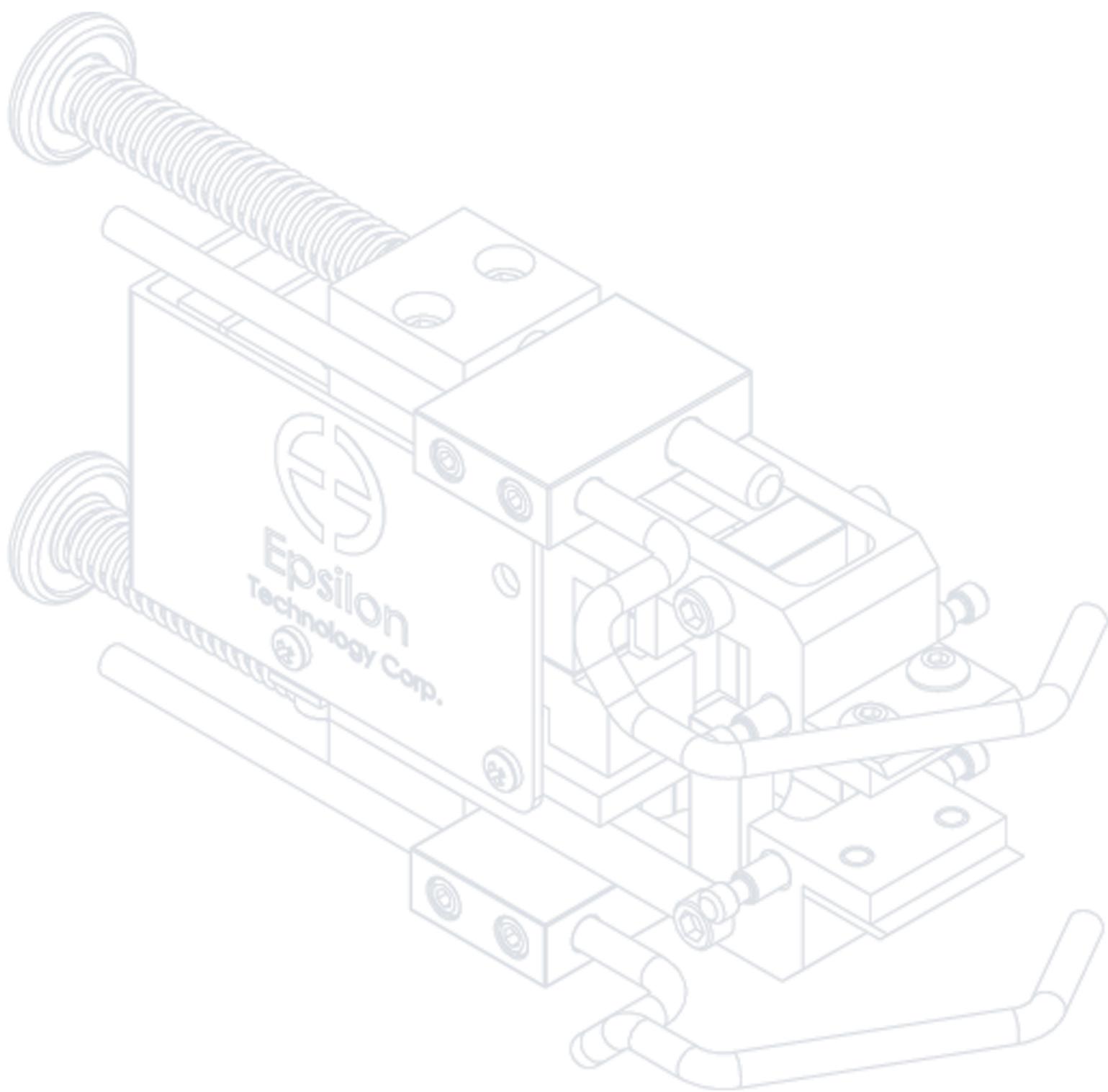
Model LE-05

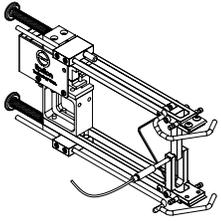
<i>Measurement Range:</i>	8 to 127 mm (0.3 to 5 inches))
<i>Max. Resolution:</i>	0.001 mm (0.0001 inches)
<i>Linearity ¹:</i>	±0.01 mm (±0.0004 inches)
<i>Repeatability ¹:</i>	±0.005 mm (±0.0002 inches)
<i>Max. Scan Rate:</i>	100 scans/second
<i>Target Distance:</i>	250 mm nominal, 500 mm max., selectable 10 inches nominal, 20 inches max., selectable
<i>Zero Suppression:</i>	Reading may be set to zero anywhere in measuring range
<i>Scan Line Orientation:</i>	Vertical
<i>Scan Averaging:</i>	Moving window averaging over a selectable number of scans
<i>Analog Output:</i>	16 bit, ±10 VDC standard
<i>Full Scale Ranges:</i>	2.0, 5.0, 10, 20, 50, or 100 mm 0.1, 0.2, 0.5, 1.0, 2.0, or 5.0 inches
<i>Digital Communications:</i>	RS-232 serial communications, standard 3 wire
<i>Selectable Baud Rate:</i>	9600, 4800, 2400, or 1200
<i>Display:</i>	2 line, 16 character digital display, backlit LCD
<i>Power Input:</i>	115 VAC ±10%, 50/60 Hz standard 230 VAC ±10%, 50/60 Hz optional
<i>Size:</i>	381 L x 180 H x 114 W mm (15 L x 7.1 H x 4.5 W inches)
<i>Weight:</i>	6 kg (13 lbs.)
<i>Mounting Provisions:</i>	1/4-20 UNC tapped holes in base (4)
<i>Laser Source:</i>	Diode laser, 670 nm, <1 mW maximum scanned output CDRH Certified Class II laser instrument
<i>Options:</i>	Consult factory for options like reflective clips for high temperature use

¹ Over optimum displacement range at calibrated distance
Note: Specifications measured at 25 °C and 50% relative humidity.

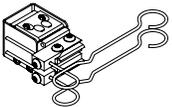
Visit our website at www.epsilontech.com
Contact us for your special testing requirements.



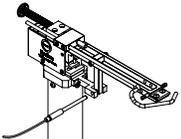




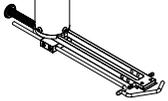
3542 Axial Extensometers



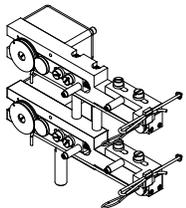
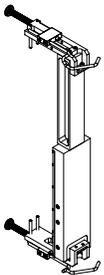
3442 Miniature / Low Profile Extensometers



3542L Extra-Long Gauge Length Extensometers

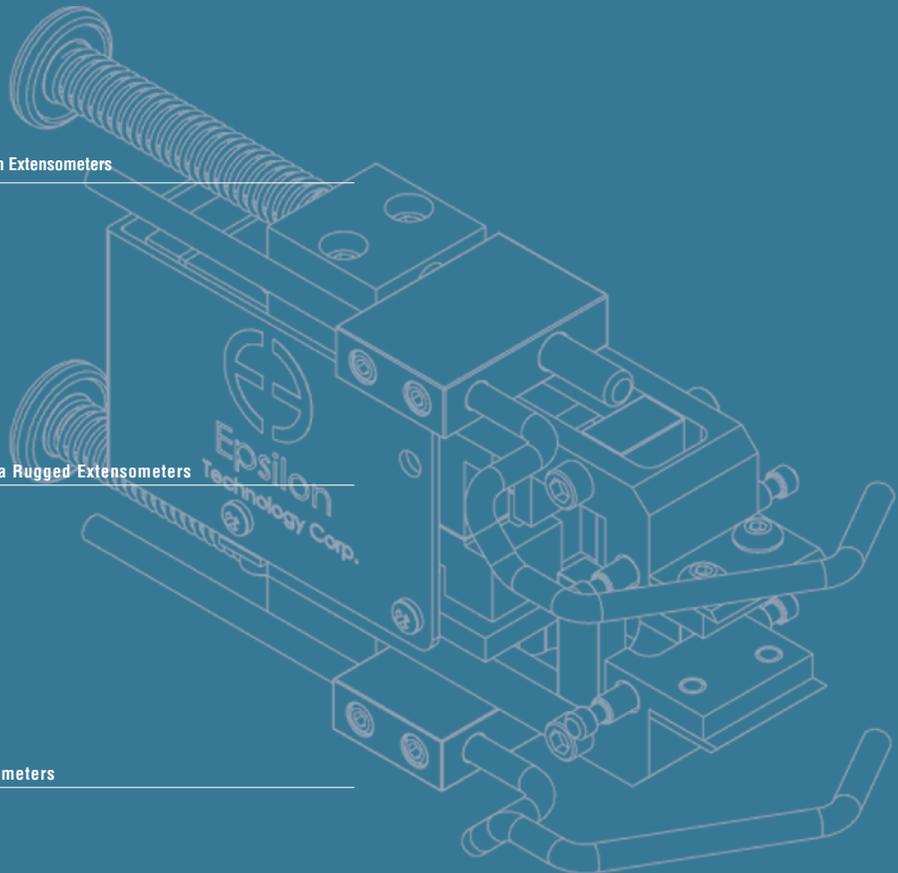


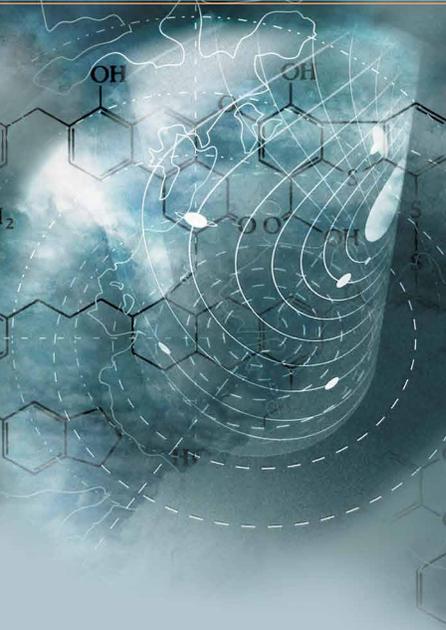
3543 Long Gauge Length Extra Rugged Extensometers



3800 High Elongation Extensometers

**Axial
Extensometers**





General purpose extensometers for axial tensile, compression, and cyclic testing. Gauge lengths from 20 to 80 mm (and 0.8 to 2 inches) and full scale measuring ranges from 5% to 100% strain.



Model 3542 with 25 mm gauge length and $\pm 10\%$ measuring range

These extensometers are designed for testing a wide range of materials, including metals, plastics, composites and ceramics. All will perform both tension and compression strain measurement. The dual flexure design makes them very rugged and insensitive to vibrations, which permits higher frequency operation.

They come standard with Epsilon's quick attach kit, making it possible to mount the extensometer on the test specimen quickly and easily with one hand. The quick attach kit can be removed, allowing mounting of the extensometer with springs or rubber bands.

Model 3542 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of solutions for signal conditioning and connection to data acquisition systems or other equipment.

For gauge lengths less than 20 mm (0.8 inches), Epsilon recommends the more compact Model 3442.

For gauge lengths 100 mm (4 inches) or greater, see Model 3542L.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3542 with round metal specimen



Model 3542 Quick Attach feature enables mounting with one hand



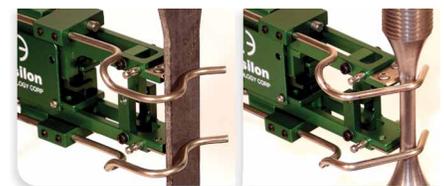
Model 3542 configured for a very large specimen diameter

Extensometers for Composites Compression Testing

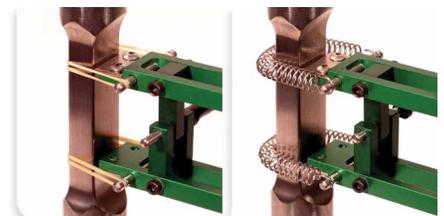
Models 3542 and 3442 extensometers can be furnished to clip directly onto composites compression fixtures, such as for ASTM D695. These use specially made wire forms for the test fixture. Contact Epsilon for details. Also see the Model 3442 miniature extensometer.



Model 3542 mounted on a D695 compression fixture for composite materials



Standard quick attach wire forms included for round and flat samples



Rubber band and spring attachment options are included with Models 3542 and 3442

 See the Model 3542 extensometer videos

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Applicable for testing to:
 - ISO 6892-1, 527-2, 527-4, 527-5, 10113
 - ASTM E8, E9, D3039, D638, A370, D3552, E517, E646
- All models can measure in both tension and compression and can be used for cyclic testing.
- Standard quick attach kit allows one hand mounting to specimens.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- All models have mechanical overtravel stops in both directions. Cable stops are used for overtravel protection where required. Epsilon's cable stops are fully contained between the arms of the extensometer and do not hang below where they can interfere with fixturing—especially during compression testing.
- Hardened tool steel knife edges are easily replaced. A spare set of standard knife edges and a set of 3-point knife edges come with every model 3542.
- Gauge length adapter kits enable configuration of multiple gauge lengths with one extensometer.
- Replaceable arms and spacers for ease of repair.
- High and low temperature options extend operation from as low as -270 °C to +200 °C (-454 °F to +400 °F).
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Includes high quality foam lined case.

SPECIFICATIONS

<i>Excitation:</i>	5 to 10 VDC recommended, 12 VDC or VAC max.
<i>Output:</i>	2 to 4 mV/V, nominal, depending on model
<i>Accuracy:</i>	Standard configurations meet ASTM E83 class B-1 accuracy requirements for gauge lengths ≥ 20 mm and class B-2 for < 20 mm. All standard configurations meet ISO 9513 class 0,5. A test certificate is included.
<i>Linearity:</i>	$\leq 0.15\%$ of full scale measuring range
<i>Temperature Range:</i>	Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F) Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)
<i>Cable:</i>	Integral, ultra-flexible cable, 2.5 m (8 ft) standard
<i>Standard Quick Attach Kit:</i>	Wireforms are included for round samples 2-25 mm (0.08-1.0 inch) diameter and flats up to 12 mm thick by 31 mm wide (0.5 inch by 1.25 inch); wireforms are available for many other specimen sizes - contact Epsilon Rubber bands and springs for attachment are also included Model 3442 is recommended for specimen diameters < 2 mm
<i>Operating Force:</i>	Depends on model configuration; 10 to 100 g typical

OPTIONS

- Quick attach kit wire forms or cable attachment for large specimens
- Adapter kits to change gauge lengths
- Connectors to interface to nearly any brand of test equipment
- Special coatings and stainless steel knife edges available for biomedical tests
- Specialty knife edges (see page 106)



EPSILON TECH—Innovative designs and factory direct sales.

ORDERING INFORMATION

Model 3542 Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Gauge Length	
METRIC	
-010M ¹	10.0 mm
-012M ¹	12.0 mm
-0125M ¹	12.5 mm
-020M	20.0 mm
-025M	25.0 mm
-030M	30.0 mm
-035M	35.0 mm
-040M	40.0 mm
-045M	45.0 mm
-050M	50.0 mm
-075M	75.0 mm
-080M	80.0 mm
U.S.A.	
-0050 ¹	0.500"
-0064 ¹	0.640"
-0100	1.000"
-0140	1.400"
-0200	2.000"

Measuring Range ²	
DESIGNATION	% STRAIN
-005 ³	$\pm 5\%$
-010	$\pm 10\%$
-020	+20%/-10%
-025	+25%/-10%
-050	+50%/-10%
-100	+100%/-10%

Model Number 3542- _____ - _____ - _____

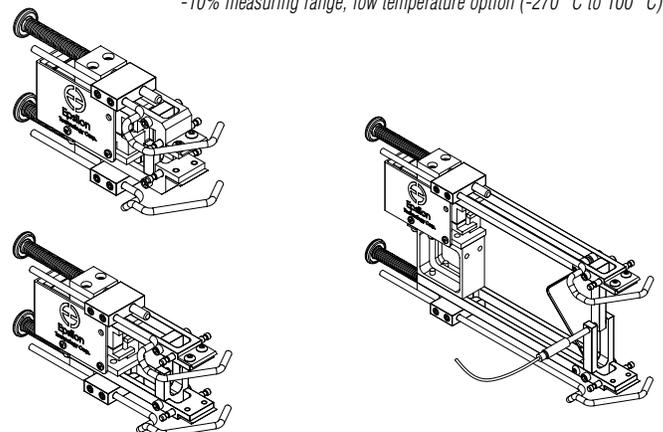
Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

¹ Epsilon recommends model 3442 for applications with gauge lengths < 20 mm (0.8 inches).

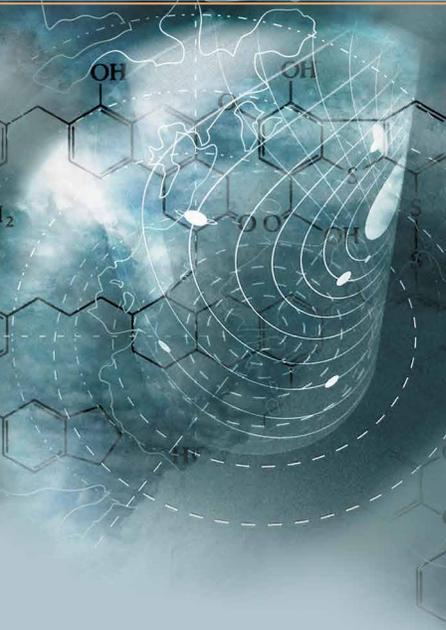
² Compressive ranges can be adjusted to higher values if required. Please contact Epsilon for your specific testing requirement.

³ Not available in 10 mm, 12.5 mm, or 0.50 inch gauge lengths.

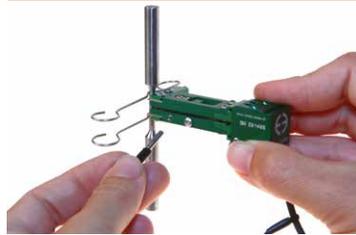
Example: 3542-050M-025-LT: 50.0 mm gauge length, +25% / -10% measuring range, low temperature option (-270 °C to 100 °C)



MODEL 3542 EXAMPLES



Small profile and ultra-light weight, these units are appropriate for testing small and delicate samples yet rugged enough for daily use on standard specimens. Ideal for strain measurement of wire specimens, sheet materials, and standard ASTM or ISO specimen geometries. Excellent for low and high cycle fatigue testing.



Model 3442 low-profile extensometer with gauge length pin

Weighing as little as 8 grams, these miniature extensometers are designed to have very low operating force with minimal specimen influence. Their low mass makes them the optimum choice for fatigue testing in strain control and high-frequency testing.

Suitable for tension or compression testing, all configurations use an improved version of Epsilon's dual flexure design which makes them very rugged for their size. With a compact module that is 15.2 mm (0.6 inches) high, they will fit in the limited space between grips that is typical with small test samples.

Gauge lengths can be as short as 3 mm or as long as 50 mm. A newly designed gage setting pin and assembly allows the gauge length to be set accurately and repeatably to ASTM and ISO requirements for all gauge lengths. Reengineered quick attach wire forms provide simple and secure specimen attachment. Wire forms for round and flat specimens are included, as well as knife edges in flat, 3-point, and vee configurations. The wire forms may be removed to enable mounting using elastic bands or springs. A tethering attachment point provides fall protection and enables counterbalancing of the extensometer's weight when testing delicate specimens.

Model 3442 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of solutions for signal conditioning and connection to data acquisition systems or other equipment.

Extensometers for Composites Compression Testing

Models 3542 and 3442 extensometers can be furnished to clip directly onto composites compression fixtures, such as for ASTM D695. These use specially made quick attach kit wire forms for the test fixture. Consult the factory for specifics.

Also see the Model 3542 extensometer.



Model 3442 with 6.0 mm gauge length, ±1.0 mm (±16.7% strain) measuring range, and suspension tether



Model 3442 with 6.0 mm gauge length and +5.0 mm/-1.0 mm (+83%/-17% strain) measuring range



Model 3442 with 25 mm gauge length testing carbon fiber tow

 See the Model 3442 extensometer videos



Rubber band and spring attachment options included with Models 3442 and 3542

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Gauge length pin helps set gauge length accurately for all gauge length configurations.
- All models can measure in both tension and compression and can be used for cyclic testing.
- Mechanical overtravel stops in both directions.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Gauge length adapter kits enable configuration of multiple gauge lengths with one extensometer.
- Replaceable arms and spacers for ease of repair.
- High and low temperature options extend operation from as low as -270 °C to +200 °C (-454 °F to +400 °F).
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Accuracy: Standard configurations meet ASTM E83 class B-1 accuracy requirements for gauge lengths ≥ 6 mm and class B-2 for ≤ 5 mm. All standard configurations meet ISO 9513 class 0,5. A test certificate is included.

Linearity: $\leq 0.15\%$ of full scale measuring range

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Standard Quick Attach Kit: Fits round samples 0.5-13 mm (0.02-0.5 inch) diameter and flats 0.1-13 mm thick by up to 15 mm wide (0.005-0.5 inch by up to 0.6 inch); attach to larger specimens using rubber bands or springs (included)

Operating Force: Depends on model configuration; 10 to 100 g typical

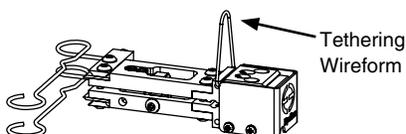
OPTIONS

Adapter kits to change gauge lengths

Connectors to interface to nearly any brand of test equipment

Special coatings and stainless steel knife edges available for biomedical tests

Specialty knife edges (see page 106)



ORDERING INFORMATION

Model 3442 Available Versions: ANY combination of gauge length, measuring range and temperature range listed above is available, except as noted. The measuring range should not exceed the gauge length. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

Gauge Length	
METRIC	
-003M ¹	3.0 mm
-004M ¹	4.0 mm
-005M ¹	5.0 mm
-006M	6.0 mm
-008M	8.0 mm
-010M	10.0 mm
-012M	12.0 mm
-0125M	12.5 mm
-020M	20.0 mm
-025M	25.0 mm
-050M	50.0 mm
U.S.A.	
-0025	0.250 in
-0030	0.300 in
-0050	0.500 in
-0064	0.640 in
-0100	1.000 in
-0200	2.000 in

Measuring Range	
METRIC	
-005M	± 0.5 mm
-010M	± 1.0 mm
-020M	+2.0 mm/-1.0 mm
-025M ²	+2.5 mm/-1.0 mm
-050M ²	+5.0 mm/-1.0 mm
-100M ²	+10.0 mm/-1.0 mm
-125M ²	+12.5 mm/-1.0 mm
U.S.A.	
-005T	± 0.050 "
-010T ²	+0.100"/-0.050"
-025T ²	+0.250"/-0.050"
-050T ²	+0.500"/-0.050"

Model Number 3442- _____ - _____ - _____

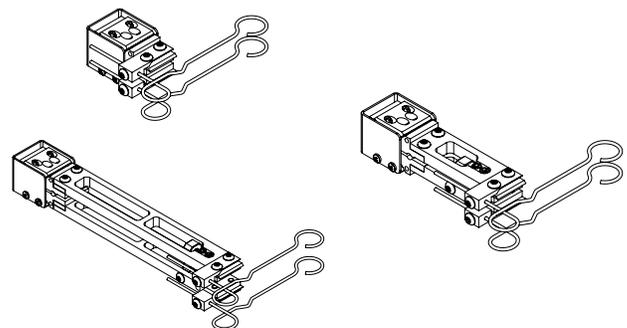
Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

¹ Available in -010M and -020M measuring ranges only; meets accuracy requirements for ASTM E83 class B-2. Gauge lengths of 6 mm or larger are recommended.

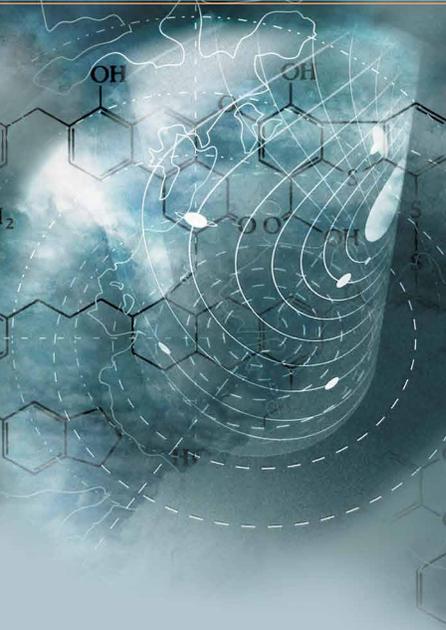
² Extended compressive measuring ranges are available - inquire with Epsilon.

Example: 3442-008M-010M-ST: 8.0 mm gauge length, ± 1.0 mm measuring range, standard temperature range (-40 °C to 100 °C)

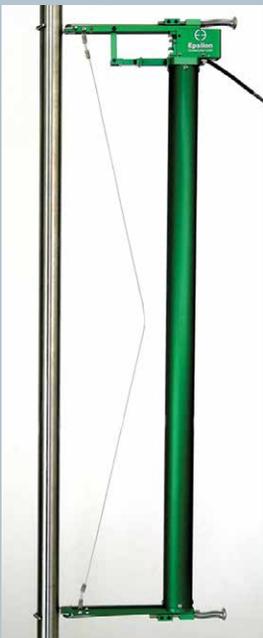
See more extensometers at www.epsilontech.com
Contact us for your special testing requirements.



MODEL 3442 EXAMPLES



Long gauge length extensometers with gauge lengths 100 mm (4 inches) or greater for tensile and compression testing. These units are for long gauge length applications where low-level strain measurements such as offset yield are required.



Model 3542L with 500 mm gauge length and +12.5 mm/-6 mm measuring range



Model 3542L with 8 inch gauge length and +0.5 inch/-0.25 inch measuring range

The dual flexure design makes the 3542L very rugged and insensitive to vibrations. These extensometers are designed for testing a wide range of materials including metals, plastics, composites and ceramics. Epsilon's Model 3543 is recommended for applications requiring long gauge lengths and larger measuring ranges.

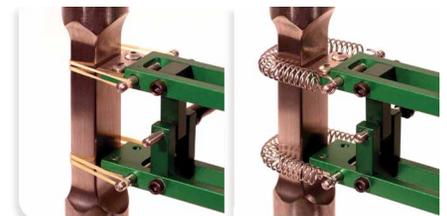
The Model 3542L comes standard with Epsilon's quick attach kit, making it easy to mount the extensometer on the test specimen. The quick attach kit can be removed, allowing mounting of the extensometer with springs or rubber bands.

Model 3542L extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers.

Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

For gauge lengths less than 100 mm (4 inches), see Model 3542.

See the electronics section of this catalog for available signal conditioners and strain meters.



Optional rubber band and spring attachment options included with Model 3542 and 3442

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All models can measure in both tension and compression and can be used for cyclic testing.
- Mechanical overtravel stops in both directions.
- Standard quick attach kit allows quick mounting to specimens.
- Hardened tool steel knife edges are easily replaced. A spare set comes with every extensometer.
- High and low temperature options extend operation from as low as -270 °C to +200 °C (-454 °F to +400 °F).
- Replaceable arms and spacers for ease of repair. This also allows changing the gauge length for different test requirements.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V, nominal, depending on model

Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.

Linearity: ≤0.15% of full scale measuring range

Temperature Range: Standard (-ST) is -40°C to +100°C (-40 °F to 210 °F)

Optional (-LHT) is -270 °C to +200 °C (-454°F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Standard Quick Attach Kit: Wireforms are included for round samples up to 25 mm diameter (1.0 inch) and flats to 12 mm thick by 31 mm wide (0.5 inch by 1.25 inch) wireforms are available for many other specimen sizes - contact Epsilon

Operating Force: Depends on model configuration, less than 30 g typically

OPTIONS

Quick attach kit wire forms for large specimens

Adapter kits to change gauge lengths

Connectors to interface to nearly any brand of test equipment

Special coatings and stainless steel knife edges available for biomedical tests

Specialty knife edges (see page 106)



ORDERING INFORMATION

Model 3542L Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

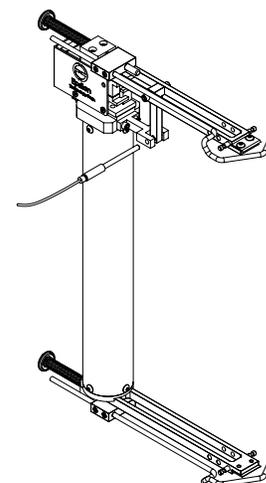
Gauge Length		Measuring Range	
METRIC		METRIC	
-100M	100.0 mm	-0025M	±2.5 mm
-150M	150.0 mm	-006M	±6.0 mm
-200M	200.0 mm	-0125M	+12.5 mm/-6.0 mm
-250M	250.0 mm	-025M	+25.0 mm/-6.0 mm
-500M	500.0 mm		
-600M	600.0 mm		
U.S.A.		U.S.A.	
-0400	4.000"	-010T	±0.10"
-0600	6.000"	-025T	±0.25"
-0800	8.000"	-050T	+0.50"/-0.25"
-1000	10.000"	-100T	+1.00"/-0.25"
-2000	20.000"		
-2400	24.000"		

Model Number 3542L- _____ - _____ - _____

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

Example: 3542L-200M-0125M-ST: 200 mm gauge length, +12.5 / -6.0 mm measuring range, standard temperature option (-40 °C to 100 °C)

Visit our website at www.epsilonotech.com
Contact us for your special testing requirements.



MODEL 3542L EXAMPLE



This model is available in gauge lengths from 50 mm (2 inches) and larger, with measuring ranges up to 100 mm (4 inches). The unique design separates into two halves and the extensometer may be left on through specimen failure. These extensometers are widely used where long samples and large measuring ranges are required. They are ideal for testing steel re-bar, weld joints, and wire materials.



Model 3543 with 12 inch gauge length



Model 3543-0400-200T-ST with 4 inch gauge length and +2 inch measuring range



Model 3543 with 100 mm gauge length

With many years of proven reliability, Model 3543 extensometers are designed to be left on through failure with specimens such as rebar that would damage standard axial extensometers. Epsilon designed the Model 3543 to survive specimen failure by separating into two halves, thus preventing any damage to its strain gage module. During operation, the upper half of the extensometer pulls out of the main body and tapered measuring beams activate strain gaged flexures within the unit. This unique design allows long measuring ranges yet retains compatibility with electronics for strain gaged transducers.

These models offer high accuracy and are lightweight but rugged, with low operating force. They are tension only units.

The units have hardened tool steel knife edges. Standard quick attach wire forms provided with the extensometer work on round specimens up to 25 mm (1 inch) diameter and flat specimens up to 12 x 31 mm (0.5 x 1.25 inch). Optional wire forms are available for use on larger samples. See Model 3542L for long gauge lengths with smaller measuring ranges and also Epsilon ONE® optical non-contact extensometers.

Model 3543 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Special Model 3543 with ability to work on test samples that twist up to 15° during the test

See the Model 3543 extensometer video

Features

- **Specifically designed to be left on through specimen failure.** The unit is designed so that the two halves of the extensometer come apart to prevent damage at specimen failure.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All standard units meet ASTM Class B-2 requirements for accuracy. Suitable for measuring 0.2% offset yield stress, plastic deformation and elongation at failure. For measuring modulus and yield strain, Model 3542, 3542L or Epsilon ONE® is required.
- Rugged design for reliable testing.
- Standard quick attach kit for quick mounting to specimens.
- Hardened tool steel knife edges are easily replaced. A spare set comes with every extensometer.
- High temperature option extends operation to +150 °C (300 °F).
- Replaceable arms and spacers for ease of repair. The optional gauge length spacers allow the gauge length of the extensometer to be easily increased for different testing requirements.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Includes high quality foam lined case.

SPECIFICATIONS

<i>Excitation:</i>	5 to 10 VDC recommended, 12 VDC or VAC max.
<i>Output:</i>	2 to 4 mV/V nominal, depending on model
<i>Accuracy:</i>	Standard configurations meet ASTM Class B-2 requirements for accuracy. Suitable for measuring 0.2% offset yield stress, plastic deformation and elongation at failure. For measuring modulus and yield strain, Model 3542, 3542L or Epsilon ONE® is required.
<i>Linearity:</i>	≤0.2% of full scale measuring range
<i>Temperature Range:</i>	Standard (-ST) is 1 °C to +100 °C (33 °F to 210 °F)
<i>Cable:</i>	Ultra-flexible cable 2.5 m, (8 ft) standard
<i>Standard Quick Attach Kit:</i>	Fits round samples up to 25 mm diameter (1.0 inch) and flats to 12 mm thick by 31 mm wide (0.5 inch by 1.25 inch)
<i>Operating Force:</i>	125 g typical

OPTIONS

- Quick attach kit wire forms for large specimens
- Spacers to change gauge lengths
- Connectors to interface to nearly any brand of test equipment
- A twist option is available for use in applications where the testing machine's grips / actuator are free to rotate and specimen twisting greater than 3° is expected. The 3543TW option can accommodate up to 15° of twist.
- Model 3543GT is an option for geotextile testing. The extensometer is manufactured with special clamps for testing fabric and mesh specimens up to 200 mm wide.
- Specialty knife edges (see page 106)



ORDERING INFORMATION

Model 3543 Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. Intermediate and longer gauge lengths are easily attained by adding gauge length spacers.

Gauge Length	
METRIC	
-050M	50.0 mm
-100M	100.0 mm
-150M	150.0 mm
-200M	200.0 mm
-250M	250.0 mm
-500M	500.0 mm
-600M	600.0 mm
U.S.A.	
-0200	2.000"
-0400	4.000"
-0600	6.000"
-0800	8.000"
-1000	10.000"
-2000	20.000"
-2400	24.000"

Measuring Range	
METRIC	
-025M	+25 mm
-050M	+50 mm
-100M ¹	+100 mm
U.S.A.	
-100T	+1.00"
-200T	+2.00"
-400T ¹	+4.00"

Model Number 3543- _____ - _____ - _____

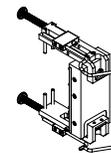
Temperature Range

-ST	1 °C to 100 °C (33 °F to 210 °F)
-HT1	1 °C to 150 °C (33 °F to 300 °F)

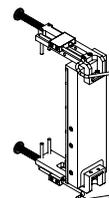
¹ Not available in 50 mm or 2 inch gauge length models.

Example: 3543-200M-100M-ST: 200 mm gauge length, +100 mm measuring range, standard temperature range (1 °C to 100 °C)

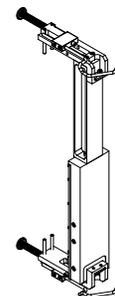
See more extensometry at www.epsilontech.com
Contact us for your special testing requirements.



50 mm or 2" gauge length



100 mm or 4" gauge length



200 mm or 8" gauge length

MODEL 3543 EXAMPLES



Designed for plastics, rubber and elastomer testing, these extensometers have very long measuring ranges. Their unique design allows testing to failure and minimizes interaction with the sample.



Model 3800 with mounting stand

The main body of this unique extensometer remains stationary during testing, held in position by the adjustable magnetic base included. Only the very light, small traveling heads move as the sample elongates during a test. These attach to the sample with small spring clips. Each head pulls a cord out from the extensometer as the head moves.

These models use high precision, low friction potentiometers, and, as a result, have a wide range of factory selectable outputs. The extensometer is driven by an excitation voltage and has output proportional to the input. They can be provided with high level outputs (approximately 2-8 VDC) or ones that mimic strain gaged devices (2-4 mV/V). When set to mimic strain gaged extensometers, the Model 3800 can be used with virtually any signal conditioning electronics designed for strain gaged sensors. The potentiometers employ a hybrid wire wound around conductive plastic, which provides excellent long term stability. The output from the extensometer is readily interfaced with most existing test controllers and may be directly input to data acquisition systems and chart recorders.

Please let us know at the time of order what type of output and connector you require.



Specimen attachment with Model 3800

 See the Model 3800 extensometer videos

Features

- **May be left on through specimen failure.**
- The main body is stationary with only the lightweight traveling heads moving.
- Applicable for testing to ASTM D412.
- Comes with an adjustable magnetic base for easy mounting.
- Large measuring range to 500 mm (20 inches).
- Includes the Epsilon Shunt Calibration System (with units configured to mimic strain gaged sensors) for on-site electrical calibration.
- Includes high quality foam lined case.
- Low cost, high accuracy elastomer strain measurement.

SPECIFICATIONS

- Excitation:* 5 to 10 VDC recommended, 12 VDC or VAC max.
- Output:* 2 to 4 mV/V, nominal; select at time of order
- Accuracy:* ±1 mm (±0.040 inches)
- Resolution:* 0.2 mm (0.008 inches) for all measuring ranges
- Temperature Range:* -40 °C to 100 °C (-40 °F to 210 °F)
- Cable:* Integral, ultra-flexible cable, 2.5 m (8 ft) standard
- Operating Force:* <200 grams typical per head

OPTIONS

- Adapter kits to change gauge lengths.
- Connectors to interface to nearly any brand of test equipment.



ORDERING INFORMATION

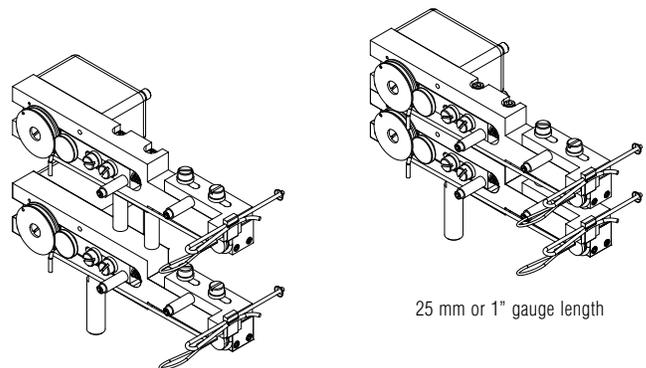
Model 3800 Available Versions: ANY combination of measuring ranges and gauge length listed below is available. Available in intermediate and larger gauge lengths on special order.

Gauge Length		Measuring Range	
METRIC		METRIC	
-020M	20.0 mm	-250M	+250 mm
-025M	25.0 mm	-500M	+500 mm
-050M	50.0 mm		
U.S.A.		U.S.A.	
-0100	1.000"	-100T	+10.0"
-0200	2.000"	-200T	+20.0"

Model Number 3800- _____ - _____

Example: 3800-0100-100T: 1.0 inch gauge length, +10 inches measuring range (+1000% strain), temperature range of -40 °F to 210 °F

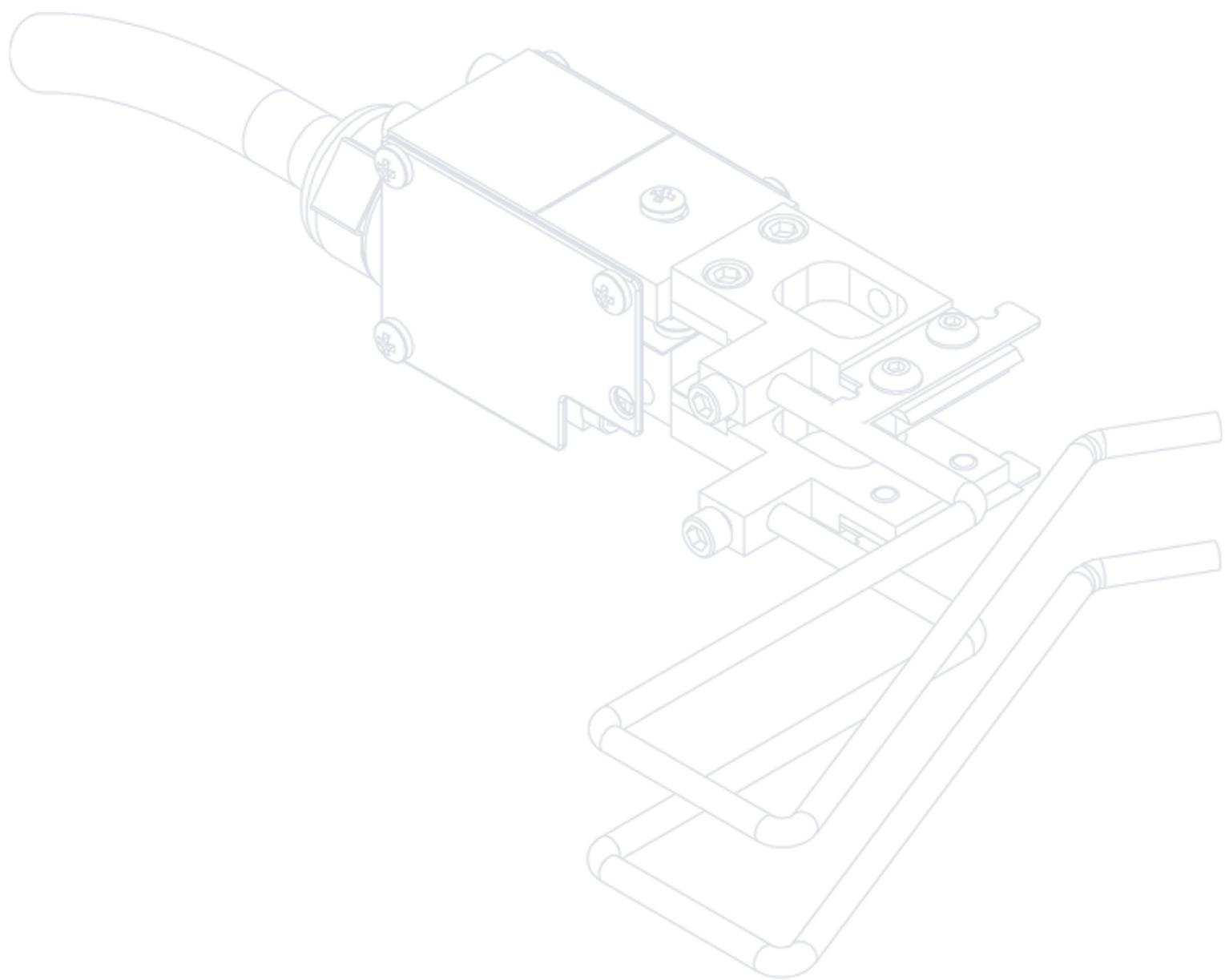
Visit our website at www.epsilontech.com
Contact us for your special testing requirements.

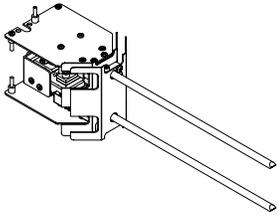


50 mm or 2" gauge length

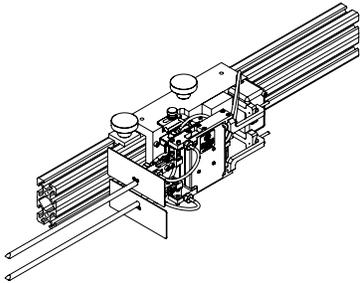
25 mm or 1" gauge length

MODEL 3800 EXAMPLES

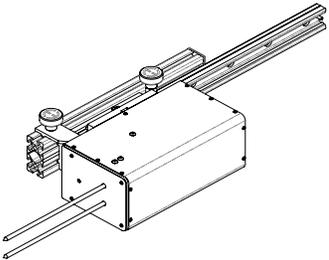




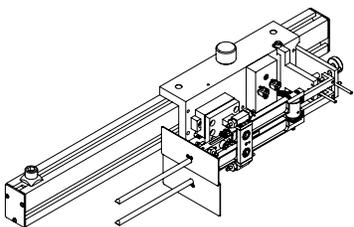
3448 High Temperature Self-Supporting Extensometers (1200 °C)



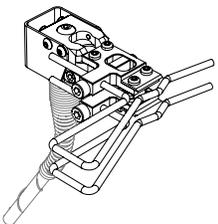
3549 High Temperature Hot Mountable Furnace Extensometers (1200 °C or 1600 °C)



7650A High Temperature, Extended Performance Capacitive Extensometers (1200 °C or 1600 °C)



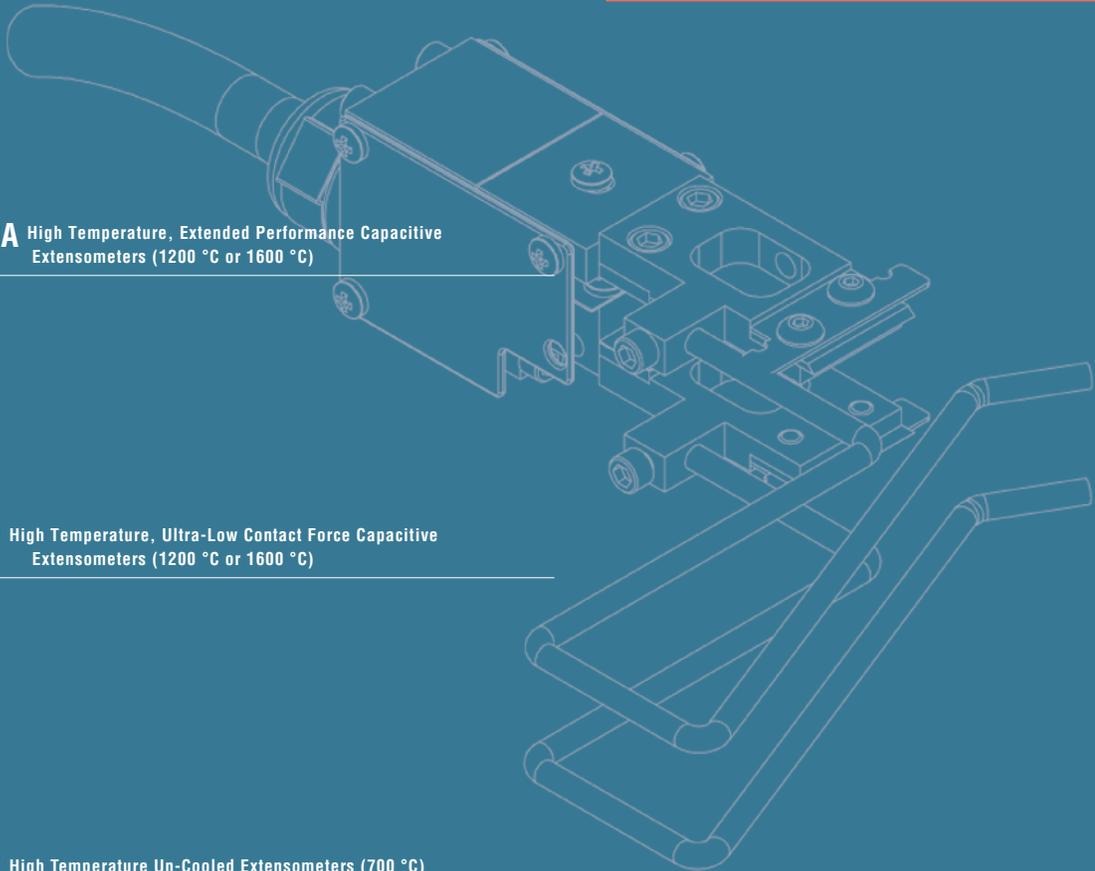
3648 High Temperature, Ultra-Low Contact Force Capacitive Extensometers (1200 °C or 1600 °C)



7642 High Temperature Un-Cooled Extensometers (700 °C)

High Temperature Axial Extensometers

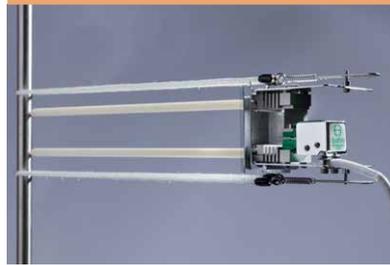
(Above 200 °C or 400 °F)



Designed for use with furnaces and induction heating systems,

these extensometers use Epsilon's exclusive, self-supporting design.

A wide range of options cover most testing applications.



The Model 3448 is self-supporting using reusable ceramic cords

Epsilon developed this unique high temperature extensometer for testing metals, ceramics, and composites at the high temperatures produced by furnaces and induction heating systems. A combination of features make these extensometers easier to use and better in performance than other similar high

temperature extensometers.

The units are held on the specimen by light, flexible ceramic fiber cords. These make the extensometer self-supporting on the specimen. No furnace mounting brackets are required. The side load on the test sample is greatly reduced because of the self-supporting design and light weight of the sensor. Most materials testing furnaces with a side cut-out for an extensometer will readily accept a Model 3448. For induction heating systems, a different ceramic cord placement allows the extensometer to easily pass between the coils.

The combination of radiant heat shields and convection cooling fins allow this model to be used at specimen temperatures up to 1200 °C (2200 °F) without any cooling. An optional tiny air fan does enhance stability at the highest temperatures and is recommended for the highest accuracy and for tests with small elongations. The fan comes with a magnetic base for support so it can be mounted at any convenient location near the extensometer. Fan cooling is not generally needed for induction heated systems. High purity alumina ceramic rods are used. These are available in lengths as required to fit your furnace. A spare set is included with every extensometer. Specify chisel, vee chisel or conical contact points as desired.

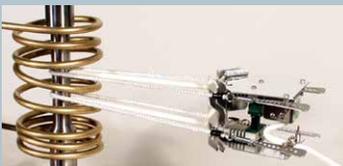
Most units operate equally well in tension and compression. Tensile, compression and cyclic fatigue tests can all be performed with a single unit. For testing in strain control or to get the highest performance during cyclic fatigue tests, models 3549 or 7650A are recommended.

For vacuum furnaces, special models are available. Epsilon can also provide a radiant heat transfer cooled version. This requires that the extensometer module be surrounded by a water cooled enclosure with a front slot for the ceramic rods.

See the electronics section of this catalog for available signal conditioners and strain meters.



Self-supporting Model 3448 with clamshell-type materials testing furnace



The Model 3448 may be used with induction heating



Model 3448 with 25 mm gauge length and 20% measuring range

 [See the Model 3448 extensometer setup video](#)

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Mechanical overtravel stops in both directions.
- All units come with high purity alumina ceramic rods.
- Mounts with flexible ceramic fiber cords. Very simple to install, this Epsilon exclusive design eliminates the need for external support brackets. Low contact force does not vary during testing like some externally supported extensometers.
- Use without cooling to 1200 °C (2200 °F). Optional small fan improves stability at highest temperatures.
- Versions available for use in vacuum and controlled atmospheres. Radiant heat transfer cooled versions are available for these applications.
- May be used on nearly any furnace with side entry cut-out for extensometers. Alternate configuration available for insertion between coils of induction heaters.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case, a spare set of ceramic rods, and eight ceramic fiber cords.

SPECIFICATIONS

- Excitation:* 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V, nominal, depending on model
Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included. Rod lengths >250 mm (10") can affect the final class rating.
Linearity: ≤0.15% of full scale measuring range, depending on model
Temperature Range: Ambient to 1200 °C max (2200 °F), all versions
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Contact Force: Adjustable, approximately 200 g depending on configuration
Operating Force: 10 to 20 g typical

OPTIONS

- Air cooling fan, add suffix -AC
- Ceramic cord orientation for furnaces or induction heaters (specify)
- Specify rod tip style desired; available choice are straight chisel, vee chisel, or conical tip
- Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Model 3448 Available Versions: ANY combination of gauge length and measuring range listed below is available, except as noted. *Ceramic rod lengths are made to fit furnaces as required. Please provide furnace dimensions at the time of order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Gauge Length		Measuring Range	
METRIC		DESIGNATION	% STRAIN
-010M	10.0 mm	-005 ¹	±5%
-025M	25.0 mm	-010	±10%
-050M	50.0 mm	-020	+20%/-10%
U.S.A.		-050	+50%/-10%
-0050	0.500"	-100 ²	+100%/-10%
-0100	1.000"		
-0200	2.000"		

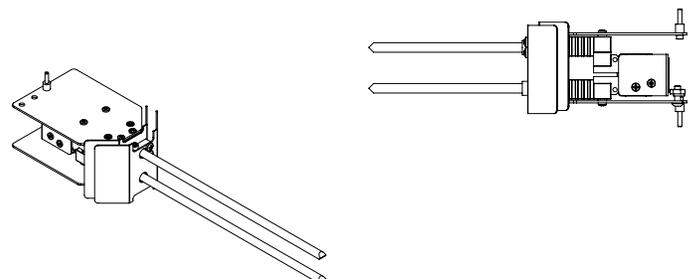
Model Number 3448- _____ - _____

¹ For 10 mm and 0.5 inch gauge lengths, the 5% strain range is only available with short ceramic rods.

² Not available in 50 mm or 2.0 inch gauge lengths.

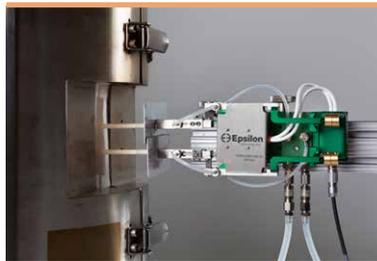
Example: 3448-0100-020: 1.000 inch gauge length, +20%/-10% measuring range, temperature range of ambient to 2200 °F

Visit our website at www.epsilonotech.com
 Contact us for your special testing requirements.



MODEL 3448 EXAMPLES

Suitable for tensile and fatigue testing when using split type materials testing furnaces or induction heaters. This model can be mounted on a hot test sample in a few seconds. With low sensitivity to vibrations, this innovative high-temperature extensometer is ideal for the demanding requirements of strain-controlled, elevated temperature uniaxial tension and fatigue testing.



Model 3549 with a 25 mm gauge length shown with a split furnace

The Model 3549 is a major advancement in the design of externally mounted furnace extensometers. It is designed to meet the stringent requirements of strain-controlled testing as prescribed in ISO 6892, ISO 12106, ASTM E21, and ASTM E606, while introducing many innovative features that improve productivity and performance for static tensile testing, long-term testing such as low cycle fatigue and creep, and other applications requiring small

strain measurements.

The overall design reduces influence from common lab environment vibrations, thermal noise, and thermal drift. It also allows the user to precisely set the contact force against the test specimen. This allows for even and repeatable contact force, limiting contact force induced errors.

The gauge length for the 3549 is automatically set prior to mounting on the test specimen, which allows for hot mounting after thermal equilibrium has been reached. These extensometers can be used in carousel systems for rapid high temperature testing.

This extensometer mounts on a slide bracket (included) that attaches to a load frame mounting bracket or directly to a furnace that has a suitable cutout. Epsilon can supply mounting brackets for nearly any load frame.

The Model 3549 is made for use with split type materials testing furnaces and induction heaters, and it uses liquid cooling in most applications. The -ST version is rated to 1200 °C (2200 °F) and is supplied with high purity alumina rods. The high temperature -HT option allows use to 1600 °C (2900 °F) and is supplied with alpha grade silicon carbide rods. Rods are made to order to the length required for your furnace.

Model 3549 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3549 with 25 mm gauge length



Model 3549 top view showing contact force scale for repeatable placement against test specimens

 See the Model 3549 extensometer videos

Features

- **May be left on through specimen failure.**
- Hot mountable and retractable.
- Designed to meet the demanding requirements of strain-controlled testing, such as required by ISO 6892, ISO 12106, ASTM E21, and ASTM E606, as well as more common testing. The 3549 is designed to isolate the strain sensing components from external vibrations and unwanted thermal effects.
- For applications requiring fatigue testing frequencies >2 Hz and to obtain the highest dynamic performance available, see Model 7650A (page 34).
- All models can measure in both tension and compression and can be used for cyclic testing.
- Innovative slide mount allows the extensometer to engage the specimen once the test temperature has been achieved.
- The gauge length is set automatically between each test with Epsilon's unique auto-setting mechanism, which allows the device to be mounted to a hot sample in seconds.
- The low contact force is easily controlled through the included contact force setting assembly. This allows for easy, repeatable placement of the extensometer on subsequent specimens with the same amount of force.
- The gauge length of the 3549 can be easily adjusted to virtually any gauge length through the use of gauge length spacers.
- The 3549 is designed to be used with single furnaces and carousel systems.
- Rugged, dual flexure design for strength and improved performance.
- Mechanical overtravel stops in both directions.
- All units come with either high purity alumina ceramic rods (1200 °C) or alpha grade silicon carbide rods (1600 °C).
- The 3549 includes quick attach connectors for the liquid cooling lines and the electrical connections, which allow for easy installation of the extensometer body.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Includes high quality foam lined case and a spare set of ceramic rods.

SPECIFICATIONS

- Excitation:** 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 1.5 to 2 mV/V nominal, depending on model
Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included. Rod lengths >250 mm (10") can affect the final class rating.
Temperature Range: Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Coolant Interface: Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
Contact Force: Adjustable from 50 to 400 g
Operating Force: <30 g typical

OPTIONS

- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
 High temperature option (-HT suffix) for use to 1600 °C
 Load frame mounting brackets
 Connectors to interface to nearly any brand of test equipment
 Rod tips can be straight chisels or conical tips; specify when ordering

ORDERING INFORMATION

Model 3549 Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

Gauge Length	
METRIC	
-010M	10.0 mm
-0125M	12.5 mm
-020M	20.0 mm
-025M	25.0 mm
-030M	30.0 mm
-040M	40.0 mm
-050M	50.0 mm
U.S.A.	
-0050	0.500"
-0100	1.000"
-0200	2.000"

Measuring Range	
DESIGNATION	% STRAIN
-010 ¹	±10%
-020	+20%/-10%
-050	+50%/-10%
-100 ²	+100%/-5%

Model Number 3549- _____ - _____ - _____

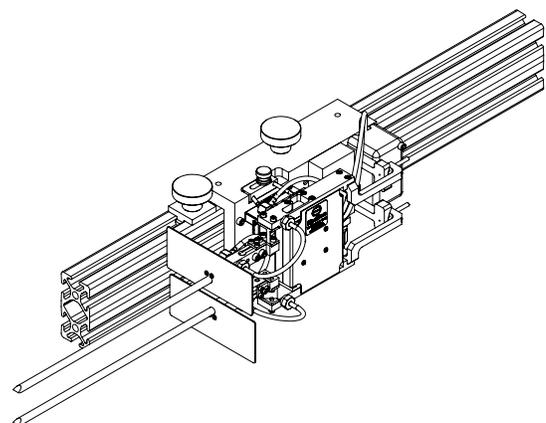
Temperature Range	
-ST	Ambient to 1200 °C (Ambient to 2200 °F)
-HT	Ambient to 1600 °C (Ambient to 2900 °F)

¹ Not available in 10 mm, 12.5 mm, or 0.5 inch gauge lengths.

² Not available in 50 mm or 2 inch gauge lengths.

Example: 3549-025M-050-HT: 25 mm gauge length, +50%/-10% measuring range, high temperature option (room temperature to 1600 °C)

Visit our website at www.epsilontech.com
 Contact us for your special testing requirements.



MODEL 3549 EXAMPLE

This high precision extensometer measures axial strains on specimens at temperatures up to 1600 °C (2900 °F). Compatible with materials testing furnaces or induction heating. May be used for strain-controlled, high frequency fatigue tests. Slide mounting system enables mounting to hot specimens in seconds.



Model 7650A axial extensometer

Model 7650A extensometers measure strains with extremely high precision due to their design features and low strain range. All models are capable of tension and compression strain measurement, and may be used for fatigue testing under fully reversed load and strain conditions at

frequencies up to 10 Hz.

All 7650A models mount rigidly on the load frame and incorporate slide mounting to bring the extensometer into contact with the specimen. The gauge length is set automatically before mounting on the test specimen, which allows for hot mounting after thermal equilibrium has been reached.

These units are specifically designed to provide high accuracy, high resolution measurements and perform high temperature fatigue testing at the highest possible frequencies. They incorporate capacitive sensors for low operating force and include electronics with programmable filtering and multi-point linearization for improved performance and accuracy. The overall design minimizes, and in many cases virtually eliminates, any influence from common lab environment vibrations.

These liquid-cooled extensometers are equipped with high purity alumina rods for specimen contact when testing to 1200 °C (2200 °F). Silicon carbide rods are used for the 1600 °C (2900 °F) high temperature option.

The Model 7650A is often customized for specific test needs. Contact Epsilon for a configuration that matches your requirement.



Model 7650A extensometer with rigid load frame mounting



Model DT6229 single-channel signal conditioner provides analog and digital outputs

Features

- **May be left on through specimen failure.**
- Hot mountable and retractable.
- Self-setting gauge length with fine adjustment feature.
- All models can measure in both tension and compression and may be used for cyclic testing at test frequencies up to 10 Hz.
- Ships fully calibrated with calibration that is traceable to NPL; voltage output may be user-specified (typically 0-10V).
- Excellent ambient vibration rejection; primary vibration mode >100 Hz typical.
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
- Includes high speed analog and digital outputs.
- Web-based user interface for setup and data acquisition.
- Selectable analog and digital filter options from 2 Hz to 3 kHz.
- Built-in calibration reference and auto-zero features.
- Multiple extensometer calibration files may be loaded for use with one controller.
- Can be used with specimens at elevated temperatures while only requiring room temperature calibration.
- Quick-disconnect liquid cooling fittings and signal cables.
- Includes high quality foam lined case and a spare set of rods.

SPECIFICATIONS

- Analog Output:** User specified, ± 10 VDC typical, ± 10.8 VDC rail
- Digital Output:** 24 bit high speed Ethernet output with built-in web interface
- Cyclic Testing:** up to 10 Hz, depending on test system and test amplitude
- Accuracy:** Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included. Rod lengths >250 mm (10") can affect the final class rating.
- Linearity:** 11 point digital linearization, $\leq 0.1\%$ FS typical linearity
- Hysteresis:** $\leq 0.1\%$ FS typical
- Resolution:** <75 PPM (0.0075%FS) RMS @ 4 kHz, <6PPM (0.0006%FS) @ 100 Hz at gauge length
- Filter:** Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters
- Temperature Range:** Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
- Sensor Cable:** 2 m (6.5 ft) room temperature cable
- Output Cable:** Flexible 2.4 m (8 ft) analog output cable
- Coolant Interface:** Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
- Operating Force:** <30 grams typical
- Contact Force:** <560 grams typical
- Environment:** Recommended for testing in dry air, inert / non-corrosive gases, or vacuum
- Power:** Includes power supply

OPTIONS

- High temperature option (-HT suffix) for use to 1600 °C
- Load frame mounting brackets
- Bulkhead adapters for use in vacuum chambers
- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
- Connectors to interface to nearly any brand of test equipment
- Rod tips can be straight chisels or conical tips; specify when ordering

ORDERING INFORMATION

Ceramic rod lengths are made to fit furnaces as required. Provide furnace dimensions and electrical outlet type at time of ordering. Requires external mounting brackets and 110 - 240VAC / 4W electrical power. Liquid cooling is recommended; required for 800 °C and above. Other configurations are available with special order; please contact Epsilon to discuss your requirements.

Gauge Length		Measuring Range	
METRIC		METRIC	
-0125M	12.5 mm	-015M	+1.5 mm / -1.5 mm
-025M	25.0 mm	-020M	+2.0 mm / -1.0 mm
		-025M	+2.5 / -0.5 mm
U.S.A.		U.S.A.	
-0050	0.500"	-060T	+0.060" / -0.060"
-0100	1.000"	-080T	+0.080" / -0.040"
		-100T	+0.100" / -0.020"

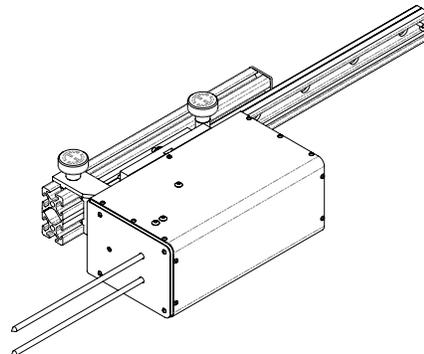
Model Number 7650A- _____ - _____ - _____

Temperature Range	
-ST	Ambient to 1200 °C (RT to 2200 °F)
-HT	Ambient to 1600 °C (RT to 2900 °F)

Example: 7650A-025M-020M-ST: 25 mm gauge length, +2.0 / -1.0 mm measuring range, standard temperature range (room temperature to 1200 °C)



Visit our website at www.epsilontech.com
Contact us for your special testing requirements.



MODEL 7650A EXAMPLE

This model was designed for applications that require ultra-low contact force when using split type materials testing furnaces or induction heaters.

It features very low specimen contact force and includes a slide bracket for mounting. Liquid cooling allows use to 1200°C (2200°F) standard or 1600°C (2900°F) with the high temperature option.



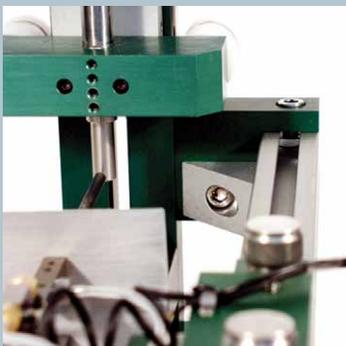
Model 3648 with 1 inch gauge length shown with a split furnace



Model 3648 with 1 inch gauge length



Model 3648 slide mounting system



Model 3648 extensometer mounted to a calibrator

These extensometers use a high temperature capacitive sensor in combination with an innovative design to achieve high accuracy strain measurements in low measuring ranges. They mount on a slide bracket (included) that can attach to the load frame of your test system; optional load frame mounting brackets are available.

The standard temperature version (to 1200 °C) is supplied with high purity alumina rods. The high temperature option is furnished with alpha grade silicon carbide rods. Rods are made to order to the length required for your furnace. These units are made to order in many different gauge lengths and measuring ranges.

The extensometer comes with a signal conditioner. The output is an analog DC voltage, factory calibrated with the extensometer to 0 to ± 10 VDC typically. They are readily interfaced with most existing test controllers and may be directly connected to data acquisition systems. Bringing the signal into a spare DC input channel (or external input) on the test controller allows the extensometer to be used for strain controlled tests like low cycle fatigue.

Features

- **May be left on through specimen failure.**
- Designed for applications requiring ultra-low contacting force with a measuring range less than ± 2.5 mm (± 0.10 inches). Epsilon recommends Model 3549 or Model 7650A for most applications.
- Capacitive signal conditioner and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers and data acquisition boards.
- Hot mountable and retractable.
- Shipped fully calibrated with electronics (traceable to NPL) with user specified voltage output.
- All models can measure in both tension and compression and can be used for cyclic testing.
- Mechanical overtravel stops in both directions.
- Innovative slide mount allows the extensometer to engage the specimen once the test temperature has been achieved.
- Includes high quality foam lined case and a spare set of ceramic rods.

SPECIFICATIONS

- Output:** User specified, ± 5 VDC or ± 10 VDC typical
- Accuracy:** Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included. Rod lengths >250 mm (10") can affect the final class rating.
- Linearity:** 0.15% of full scale measuring range (rod length dependent)
- Temperature Range:** Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
- Cable:** Integral, ultra-flexible cable, 2.5 m (8 ft) standard
- Coolant Interface:** Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
- Contact Force:** Adjustable up to 150 g (30-50 g typically used)
- Operating Force:** <10 g typical
- Power:** Includes power supply for your country (specify)

OPTIONS

- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
- High temperature option (-HT suffix) for use to 1600 °C
- Load frame mounting brackets
- Connectors to interface to nearly any brand of test equipment
- Rod tips can be straight chisels or conical tips; specify when ordering
- VREF Module (see p. 125)

Model EPS170 Constant-Temperature Recirculating Chiller

This chiller provides a continuous flow of coolant at a constant temperature for liquid-cooled extensometers. Capable of cooling or heating the coolant, coolant temperature is maintained within 0.1 °C. These units are ideal for obtaining the maximum stability of liquid-cooled extensometers. See website for dimensions.



ORDERING INFORMATION

Model 3648 Available Versions: ANY combination of gauge length and measuring range listed below is available, except as noted. Contact Epsilon for additional gauge length options. Ceramic rod lengths are made to fit furnaces as required. Please provide furnace dimensions at the time of order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

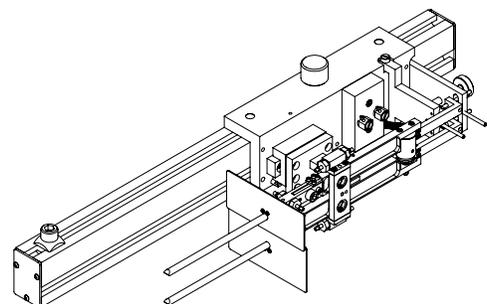
Gauge Length		Measuring Range	
METRIC		METRIC	
-010M	10.0 mm	-005M	± 0.5 mm
-0125M	12.5 mm	-010M	± 1.0 mm
-025M	25.0 mm	-025M	± 2.5 mm
-050M	50.0 mm		
U.S.A.		U.S.A.	
-0050	0.500"	-020T	± 0.020 "
-0100	1.000"	-040T	± 0.040 "
-0200	2.000"	-100T	± 0.100 "

Temperature Range	
-ST	Ambient to 1200 °C (RT to 2200 °F)
-HT	Ambient to 1600 °C (RT to 2900 °F)

Model Number 3648- _____ - _____ - _____

Example: 3648-025M-010M-ST: 25.0 mm gauge length, ± 1.0 mm (± 4 % strain) measuring range, standard temperature option (room temperature to 1200 °C)

Visit our website at www.epsilonotech.com
Contact us for your special testing requirements.



MODEL 3648 EXAMPLE

For use in environmental chambers where the entire extensometer must be exposed to elevated temperatures. These capacitive extensometers may be used up to 700 °C (1300 °F) without any cooling.



Model 7642-010M-025M extensometer

These extensometers use a high-temperature capacitive sensor and do not require any cooling. They will operate up to the maximum temperature limit of most environmental chambers used in materials testing. The Model 7642 is ideal for testing composites, metals and high temperature polymers in tensile, compression or

cyclic testing. All units can be displaced in both compression and tension.

The extensometer is supplied with the advanced DT6229 controller. The standard output is 0-10VDC analog signal, factory calibrated with the extensometer. This system provides a number of functional enhancements, including high speed digital output, built in calibration and tare functions, analog and digital filters, and more.

The 7642 is readily interfaced with most existing test controllers, and may be directly connected to a data acquisition system or chart recorder, or directly to a PC. The 7642 may be used for strain controlled tests such as low cycle fatigue (LCF).



Model 7642-050M-125M extensometer



Models 7642 and 7675 extensometers



Models 7642 and 7675 extensometers

Features

- **May be left on through specimen failure.**
- Improved performance at high temperature.
- Reduced size and weight, and improved high frequency performance up to 100 Hz.
- Improved noise rejection.
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
 - Includes high speed analog and digital outputs
 - Intuitive web-based user interface for setup, calibration, and data acquisition
 - Built-in calibration reference and auto-zero features
 - Multiple extensometer calibration files may be loaded for use with one controller
 - Multiple temperature-specific calibrations may be stored
 - Selectable analog and digital filter options from 2 Hz to 3 kHz
- Ships fully calibrated with electronics with user specified voltage output. (traceable to NPL).
- All models can measure in both tension and compression and may be used for cyclic testing.
- Mechanical over-travel stops.
- Hardened tool steel knife edges are easily replaced. A spare set comes with every extensometer.
- Includes high quality foam lined case and a spare set of knife edges.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.

SPECIFICATIONS

<i>Analog Output:</i>	User specified, ± 5 VDC or ± 10 VDC typical, ± 10.8 VDC rail
<i>Digital Output:</i>	24 bit high speed Ethernet output with built-in web interface
<i>Accuracy:</i>	Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.
<i>Linearity:</i>	11 point linearization, $\leq 0.1\%$ FS typical linearity
<i>Resolution:</i>	< 55 PPM (0.006%FS) RMS @4 kHz, < 6 PPM (0.0006%FS) @100 Hz
<i>Cyclic Testing:</i>	> 25 Hz typical, up to 100 Hz with small travel units, @0.5 mm travel
<i>Analog Filter:</i>	Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters
<i>Temperature Range:</i>	Ambient to 700°C (1300°F). Use up to 800 °C is possible – contact Epsilon for details. Wire forms may require periodic adjustment or replacement after long-term testing above ~ 600 °C.
<i>Temperature Sensitivity (Gain):</i>	< 100 PPM/°C (0.01%FS/°C) typical
<i>Sensor Cable:</i>	0.7 m (2.5 ft) tri-axial high temperature cable, plus 1.5 m (5 ft) room temperature extension cable
<i>Standard Quick Attach Kit:</i>	Fits round samples up to $\varnothing 15$ mm (0.60"). Fits flat samples up to 50 mm (2.0") wide with thicknesses up to 6.35 mm (0.25"), and up to 19 mm (0.75") wide with thicknesses from 6.35 mm to 12.5 mm (0.25" to 0.50")
<i>Operating Force:</i>	< 100 g typical
<i>Environment:</i>	Recommended for elevated temperature testing in dry air, inert / non-corrosive gases, or vacuum
<i>Overall Dimensions:</i>	Contact Epsilon for overall dimensions
<i>Power:</i>	Includes power supply

OPTIONS

- Gauge length adapter kits (for use at temperatures ≤ 300 °C (570 °F))
- Connectors to interface to nearly any brand of test equipment
- Bulkhead adapters for vacuum chambers
- Dual-channel DT6229 controller available

ORDERING INFORMATION

Model 7642 Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

Gauge Length		Measuring Range	
METRIC		METRIC	
-010M	10.0 mm	-025M	+2.5/-0.5 mm*
-012M	12.0 mm	-075M	+7.5/-0.5 mm**
-0125M	12.5 mm	-125M	+12.5/-0.5 mm**
-020M	20.0 mm		
-025M	25.0 mm	U.S.A.	
-050M	50.0 mm	-010T	+0.10"/-0.02**
U.S.A.		-030T	+0.30"/-0.02***
-0050	0.50"	-050T	+0.50"/-0.02***
-0100	1.00"		
-0200	2.00"		

Model Number 7642- _____ - _____

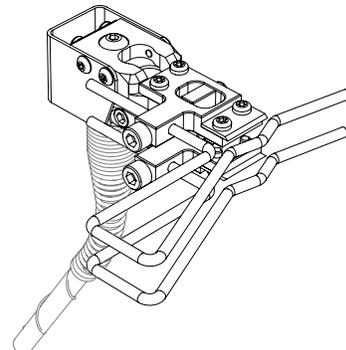
* Tilted cable exit

** Vertical cable exit

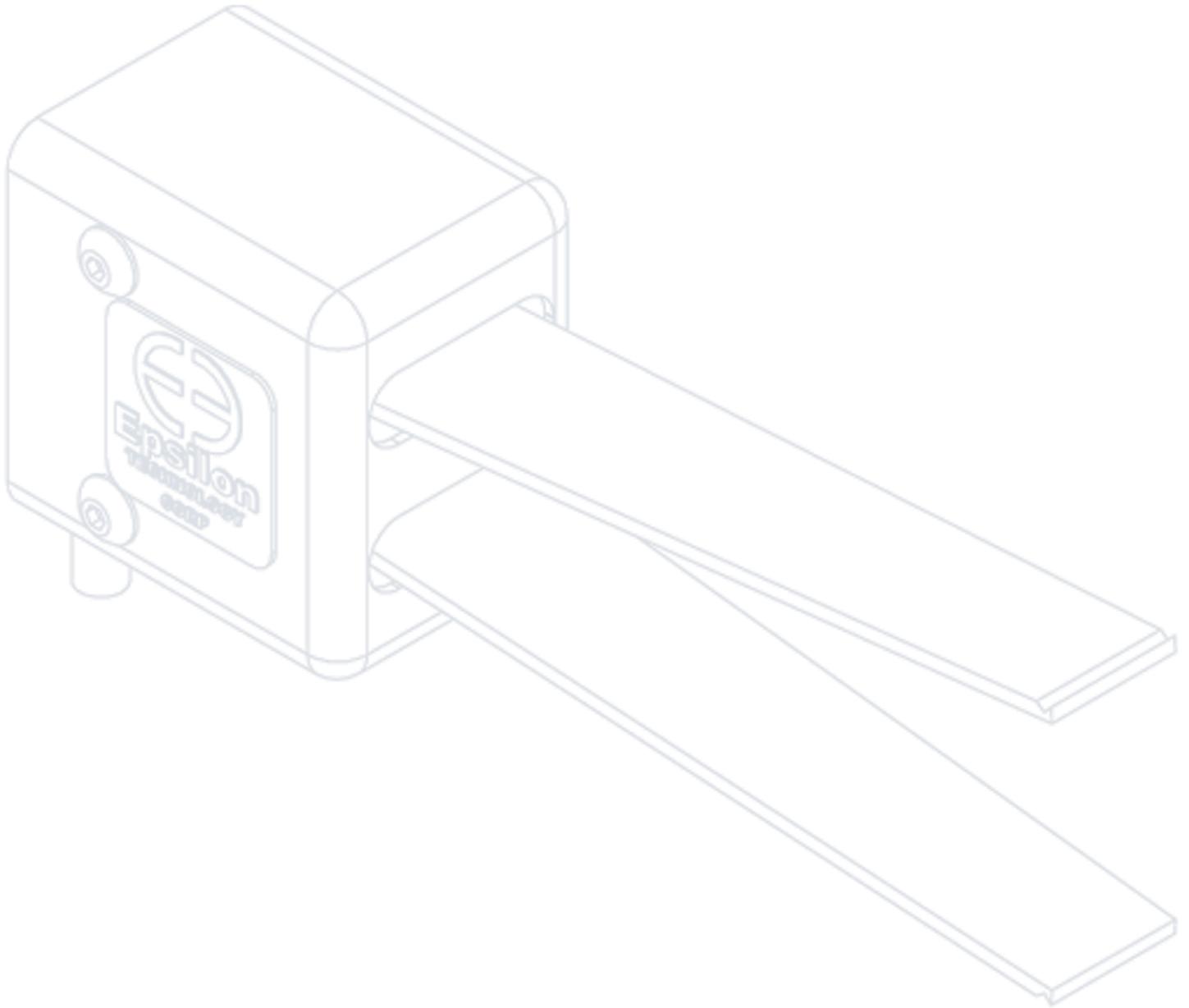
Example: 7642-025M-075M: 25.0 mm gauge length, +7.5/-0.5 mm measuring range

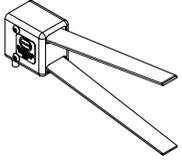


Visit www.epsilontech.com to see more extensometry
Contact us for your special testing requirements.

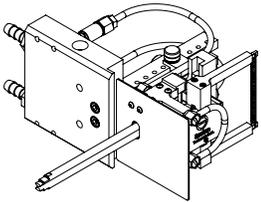


MODEL 7642 EXAMPLE

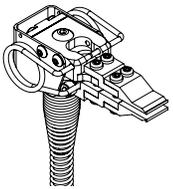




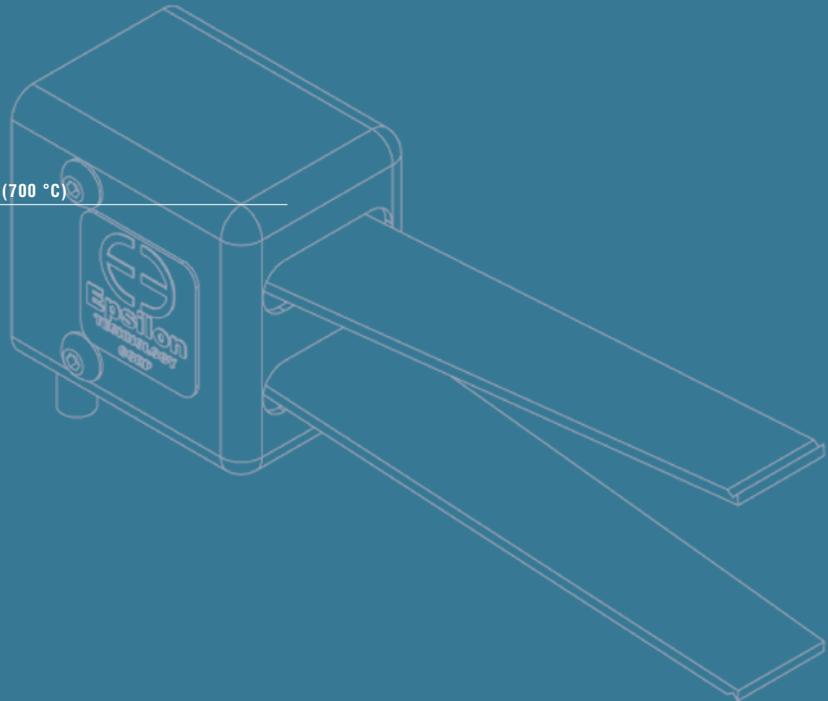
3541 Fracture Mechanics Clip-On Gages



3548COD High Temperature COD Gages (1200 °C or 1600 °C)



7641 High Temperature Clip-On Gages (700 °C)



**Fracture Mechanics
Clip-On Gages**

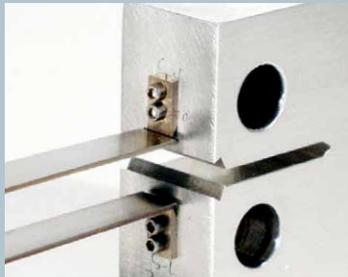


For fracture mechanics studies, these COD gages are in compliance with standardized test methods, such as ASTM E1820 for determination of fracture toughness properties of metallic materials.

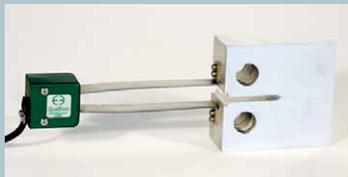


Model 3541 COD gage

The Model 3541 is designed for determination of fracture mechanics parameters such as JIC, KIC, R-curve, fatigue crack growth rate (da/dN), and testing to standards such as E1820, E399, E647, etc. These COD gages conform to the requirements of E1820 for JIC and R-curve determination. Special configurations are available to meet the requirements of ASTM E399 for fracture toughness (*please consult the factory for these configurations*). In addition, the modified groove design complies with E1820 tests where greater stability and accuracy results from the sharper groove root. Clip-on gages are used for a variety of fracture mechanics tests, including compact tension, arc shaped, disk shaped, bend specimens or other specimen geometries in compliance with ASTM and other standards organization's test methods. Clip-on gages can be used directly on test specimens where the knife edges are integral with the test specimen or, alternately, with optional bolt-on knife edges mounted on the test specimen.



Model 3541 attached to bolt-on knife edges



Model 3541-012M-120M with 12 mm gauge length and +12 mm measuring range

Model 3541 crack opening displacement gages are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Fully enclosed gages are protected from accidental damage.
- Sharp grooves per ASTM E1820, E813, and E399 for improved stability when mounted.
- For da/dN testing or pre-cracking, where maximum frequency (>50 Hz) is required, minimum measuring ranges are recommended.
- For KIC/JIC testing, maximum accuracy is achieved with the smallest measuring range and the largest gauge length that will perform the test.
- Maximum operating frequency may be from 5 Hz to >200 Hz depending on COD gage and test apparatus configurations.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Accuracy Class: All standard configurations meet ASTM E1820, ISO 12135, and ISO 9513 Class 1 requirements for accuracy. A test certificate is included. Models that additionally meet ASTM E399 accuracy requirements are available in 2.5 and 4.0 mm (0.10 and 0.15 inch) measuring ranges. A test certificate for ASTM E399 is included with those models.

Linearity: $\leq 0.2\%$ of full scale measuring range

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Operating Force: 9 to 14 N (2 to 3 lbs), depending on model

OPTIONS

Connectors to interface to nearly any brand of test equipment
Available in special versions, including setups for narrow grips
Bolt-on knife edges (see p.106)



Special Model for Other Fracture Mechanics Testing

Special units are available for other fracture mechanics tests. For example, the photo to the right shows a gage for ASTM E1304, *Standard Test Method for Plane-Strain (Chevron-Notch) Fracture Toughness of Metallic Materials*.

This example was produced for a 1 inch diameter bar, with 0.4 inches of measuring range. Its performance, design, and accuracy is an enhancement of the design recommended in E1304.



ORDERING INFORMATION

Model 3541 Available Versions: The following combinations of gauge length and measuring range listed below are available as standard, except as noted. All are available in any temperature range listed. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Gauge Length		Measuring Range	
METRIC		METRIC	
-003M	3.0 mm	-025M ¹	+2.5 mm
-005M	5.0 mm	-040M ¹	+4.0 mm
-008M	8.0 mm	-070M	+7.0 mm
-010M	10.0 mm	-100M	+10.0 mm
-012M	12.0 mm	-120M	+12.0 mm
-020M	20.0 mm		
U.S.A.		U.S.A.	
-0010	0.100"	-100T ¹	+0.100"
-0020	0.200"	-150T ¹	+0.150"
-0030	0.300"	-200T ²	+0.200"
-0040	0.400"	-250T	+0.250"
-0047	0.475"	-500T	+0.500"
-0050	0.500"		

Model Number 3541-_____

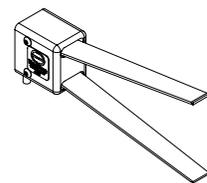
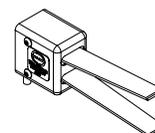
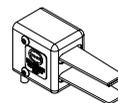
Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

¹ Available with special configuration to meet the requirements of ASTM E399 – inquire with Epsilon.

² Not available in 0.1 inch gauge length.

Example: 3541-010M-070M-LT: 10.0 mm gauge length, +7.0 mm measuring range, low temperature option (-270 °C to 100 °C)

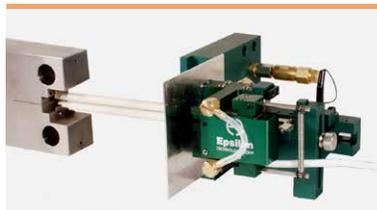
See more COD gages at www.epsilontech.com
Contact us for your special testing requirements.



MODEL 3541 EXAMPLES



High temperature COD gages for use in split type materials testing furnaces with a slot for the ceramic rods. These liquid-cooled COD gages are for use to 1200 °C (2200 °F). The high temperature option allows use to 1600 °C (2900 °F). They are specifically designed for fracture mechanics testing.



Model 3548COD mounted to a compact tension specimen

Model 3548COD mounts on a cooled manifold, which is mounted on an optional load frame mounting system from Epsilon or your furnace's side cut-out. Epsilon can provide load frame mounting brackets to fit nearly any test frame.



Model 3548COD with no heat shields mounted to a Model 3590VHR calibrator

The standard temperature version (to 1200 °C) is supplied with high purity alumina rods. The high temperature option is furnished with alpha grade silicon carbide rods. Rods are made to order to the length required for your furnace. Contact edges on the test sample should be somewhat rounded (not sharp knife edges) for best performance with this model.

Model 3548COD gages are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- For KIC/JIC testing, maximum accuracy is achieved with the smallest measuring range and the largest gauge length that will perform the test.
- All units come with either high purity alumina ceramic rods (1200 °C) or alpha grade silicon carbide rods (1600 °C).
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case and a spare set of ceramic rods.

SPECIFICATIONS

- Excitation:** 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V nominal, depending on model
Accuracy: Standard configurations meet existing ASTM E1820 requirements for accuracy. A test certificate is included. Rod lengths >250 mm (10") can affect the final class rating.
Linearity: ≤0.15% of full scale measuring range, depending on model
Temperature Range: Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Coolant Interface: Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
Operating Force: <30 g typical

OPTIONS

- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
 Load frame mounting brackets
 High temperature option (-HT suffix) for use to 1600 °C
 Connectors to interface to nearly any brand of test equipment



Model EPS170 Constant-Temperature Recirculating Chiller

This chiller provides a continuous flow of coolant at a constant temperature for liquid-cooled extensometers. Capable of cooling or heating the coolant, coolant temperature is maintained within 0.1 °C. These units are ideal for obtaining the maximum stability of liquid-cooled extensometers. See website for dimensions.



ORDERING INFORMATION

Model 3548COD Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. *Ceramic rod lengths are made to fit furnaces as required. Please provide furnace dimensions at the time of order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Gauge Length		Measuring Range	
METRIC		METRIC	
-005M	5.0 mm	-025M	+2.5 mm
-008M	8.0 mm	-040M	+4.0 mm
-010M	10.0 mm	-070M	+7.0 mm
-012M	12.0 mm	-100M	+10.0 mm
-020M ¹	20.0 mm	-120M	+12.0 mm
U.S.A.		U.S.A.	
-0020	0.200"	-100T	+0.100"
-0030	0.300"	-150T	+0.150"
-0040	0.400"	-200T	+0.200"
-0047	0.475"	-250T	+0.250"
-0050	0.500"	-500T	+0.500"

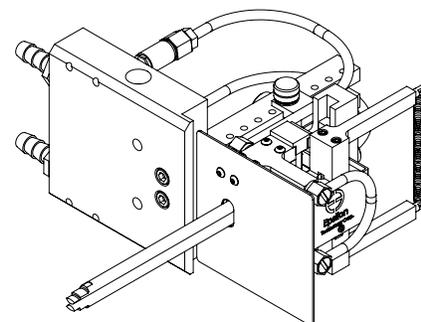
Temperature Range	
-ST	Ambient to 1200 °C (Ambient to 2200 °F)
-HT	Ambient to 1600 °C (Ambient to 2900 °F)

Model Number 3548COD- _____ - _____ - _____

¹ Only available in small measuring ranges (rod length dependent).

Example: 3548COD-0050-200T-HT: 0.500 inch compressed gauge length, +0.20 inch measuring range, high temperature option (room temperature to 1600 °C (2900 °F))

Visit our website at www.epsilontech.com
 Contact us for your special testing requirements.



MODEL 3548COD EXAMPLE



Designed for fracture mechanics testing in environmental chambers

where the entire gage must be exposed to elevated temperatures.

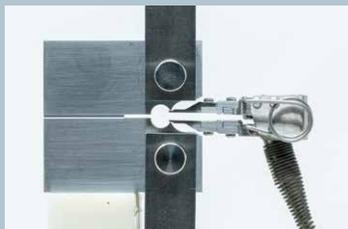
These capacitive sensors may be used up to 700 °C (1300 °F) without any cooling.



Model 7641 COD gage

These COD gages use a high-temperature capacitive sensor and do not require any cooling. They will operate up to the maximum temperature limit of most environmental chambers used in materials testing.

The Model 7641 is ideal for determination of fracture mechanics parameters such as JIC, KIC, R-curve, fatigue crack growth rate (da/dN), and testing to standards such as ISO 12135, ASTM E1820, E399, E647, etc. All units can be displaced slightly in compression for ease of installation.



Model 7641 COD gage fits in tight spaces

The COD gage is supplied with the advanced DT6229 controller. The standard output is a 0-10V analog signal, factory calibrated with the COD gage. This system provides a number of functional enhancements including: built in calibration and tare functions, multi-point linearization, analog and digital filters, high speed digital output, and more.



Mounting the Model 7641 COD gage

The 7641 is readily interfaced with most existing test controllers or may be directly connected to a data acquisition system, chart recorder, or a PC. The 7641 may be used for strain-controlled tests such as JIC.

The 7641 Gen2 now includes improved overtravel protection. The enhanced mounting tips accommodate even more specimen geometries, while simultaneously improving handheld ergonomics and ease of installation. Additionally, the improved design now comes standard with an attachment point for tethers and/or counterbalances. The Gen2 model maintains the same high-temperature performance, capable of withstanding temperatures up to 700°C (1500°F), and is available in whole-millimeter gauge lengths ranging from 3mm to 12mm with a variety of measuring ranges.



Model 7641 COD gage with signal conditioner

See the Model 7641 COD gage video

Features

- **May be left on through specimen failure.**
- All standard models are suitable for cyclic testing.
 - >10 Hz typical for 5mm GL and larger
 - Typically limited by the user's test apparatus, software settings, and filter selection
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
 - Includes high speed analog and digital outputs
 - Intuitive web-based user interface for setup, calibration, and data acquisition
 - Built-in calibration reference and auto-zero features
 - Multiple extensometer calibration files may be loaded for use with one controller
 - Multiple temperature-specific calibrations may be stored
 - Selectable analog and digital filter options from 2 Hz to 3 kHz
- Ships fully calibrated with electronics (traceable to NPL (UK)) with user specified voltage output.
- Mechanical over-travel protection.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

<i>Analog Output:</i>	User specified, ±10V typical, ±10.8V rail
<i>Digital Output:</i>	24 bit high speed Ethernet output with built-in web interface
<i>Accuracy:</i>	All standard configurations meet ASTM E1820, ISO 12135, ISO 9513 Class 0.5, and ASTM E399 (up to 3mm) requirements for accuracy
<i>Linearity:</i>	11 point linearization, ≤0.15% FS typical linearity
<i>Resolution:</i>	<55 PPM (0.006%FS) RMS @4 kHz, <6 PPM (0.0006%FS) @100 Hz
<i>Cyclic Testing:</i>	Models available for 10-50Hz testing; see website
<i>Analog Filter:</i>	Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters
<i>Temperature Range:</i>	Ambient to 700 °C (1300 °F). Use up to 800 °C is possible – contact Epsilon for details. Springs may require periodic adjustment or replacement after long-term testing above ~600 °C.
<i>Temperature Sensitivity (Gain):</i>	<100 PPM/°C (0.01%FS/°C) typical
<i>Sensor Cable:</i>	0.7 m (2.5 ft) tri-axial high temperature cable, plus 1.5 m (5 ft) room temperature extension cable
<i>Operating Force:</i>	10-50 N typical, depending on model
<i>Environment:</i>	Recommended for elevated temperature testing in dry air, inert / non-corrosive gases, or vacuum
<i>Overall Dimensions:</i>	See website for overall dimensions
<i>Power:</i>	Includes power supply

OPTIONS

- Connectors to interface to nearly any brand of test equipment
- Bolt on knife edges for attachment to test specimens without machined attachment points
- Bulkhead adapter for vacuum chambers

ORDERING INFORMATION

Model 7641 Available Versions: ANY combination of gauge length and measuring listed below is available, except as noted. *Make sure that model 7641 fits your specimens, grips, and chamber/furnace - see the web page for details.*

Gauge Lengths		Measuring Ranges		
Model #	Gauge Length	Model #	Measuring Range	Total Length
-030M	3.0 mm(0.12")	-055MV ¹	5.5 mm(0.22")	47.6mm(1.88")
-040M	4.0 mm(0.16")	-070MV ²	7.0 mm(0.28")	56.5mm(2.23")
-050M	5.0 mm(0.20")	-080MV	8.0 mm(0.31")	60.3mm(2.38")
-060M	6.0 mm(0.24")	-090MV	9.0 mm(0.35")	66.7mm(2.63")
-070M	7.0 mm(0.28")	-035MA [*]	3.5 mm(0.14")	51.1mm(2.01")
-080M	8.0 mm(0.31")	-045MA ^{*2}	4.5 mm(0.18")	59.9mm(2.36")
-090M	9.0 mm(0.35")	-050MA [*]	5.0 mm(0.20")	63.8mm(2.51")
-100M	10.0 mm(0.39")	-055MA [*]	5.5 mm(0.22")	70.1mm(2.76")
-110M	11.0 mm(0.43")			
-120M	12.0 mm(0.47")			

Installed Gauge Length is set by your specimen. Round DOWN to the nearest available size.

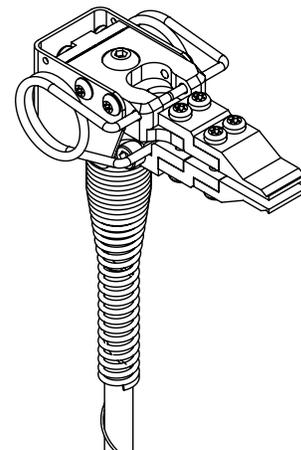
Model Number 7641- _____ - _____

* -xxxMA = angled cable exit

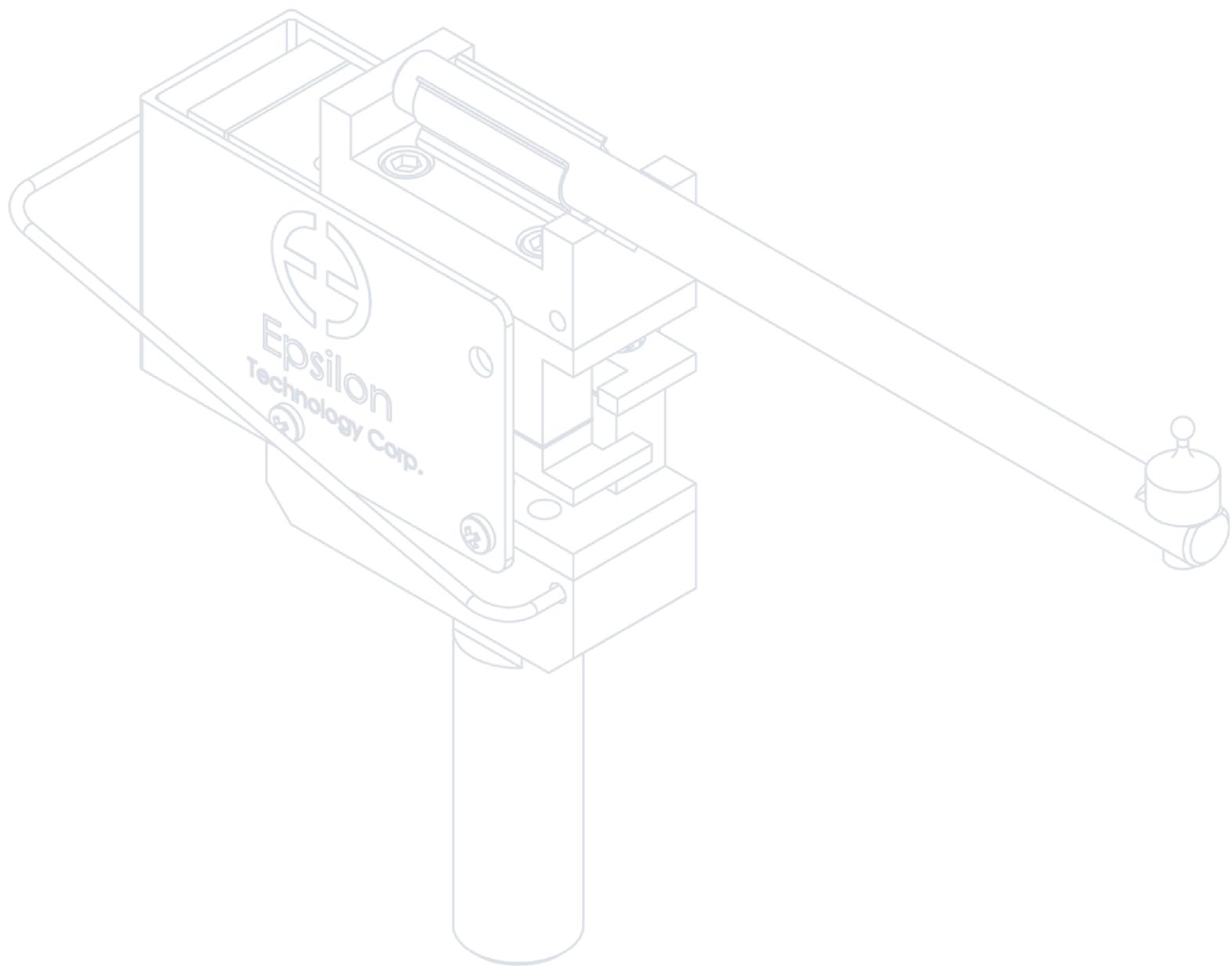
¹ Best dynamics and stability; recommended for front face specimen

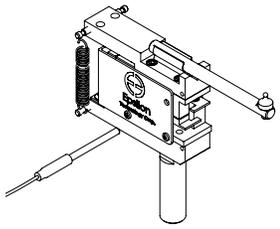
² Good dynamics and stability; best ergonomics; recommended for load line specimens

Example: 7641-010M-055MV: 10.0 mm gauge length, +5.5 mm measuring range, vertical cable exit



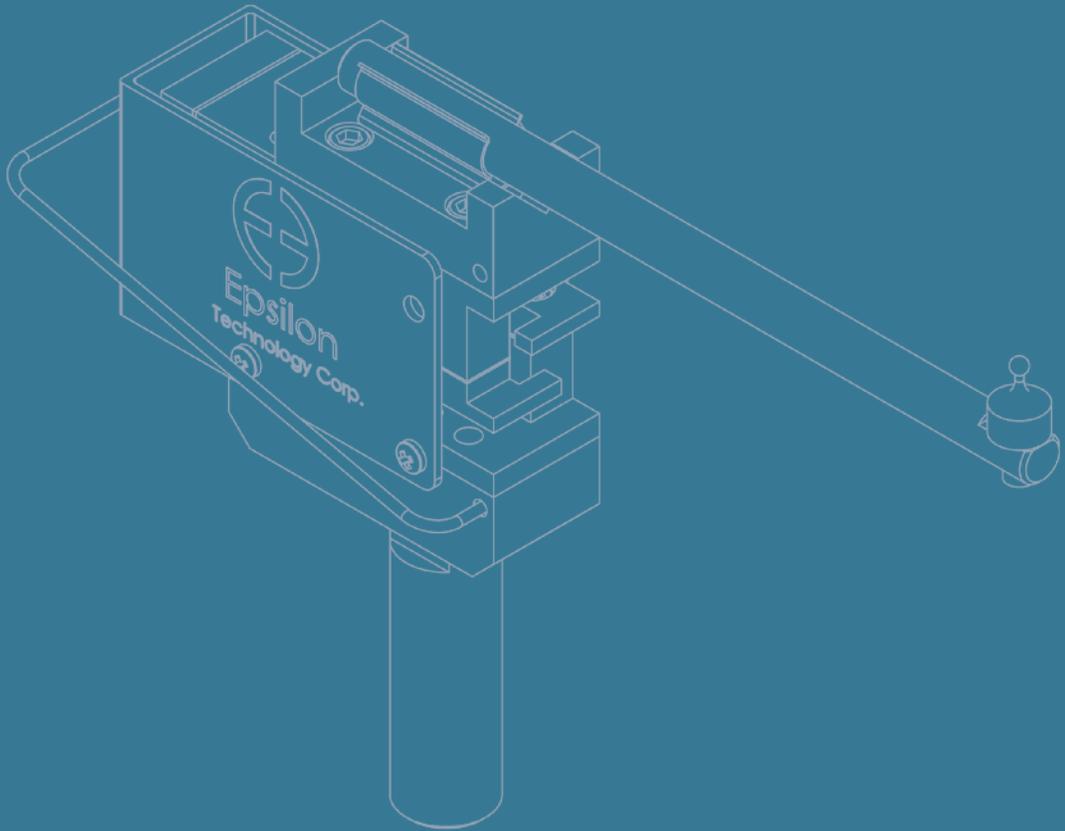
MODEL 7641 EXAMPLE





3540 Deflection Gages (Deflectometers)

Deflection Gages



Widely used for measuring deformations in three- and four-point bend tests, compression tests and a variety of general-purpose deflection measurements. These strain gaged devices come with a magnetic base for easy mounting.



Model 3540 with 4 mm measuring range

Deflection is measured with a single arm with an attached spherical contact tip, similar to those on a dial indicator. The full bridge strain gaged construction provides an electrical output compatible with any electronics designed for a strain gaged transducer.

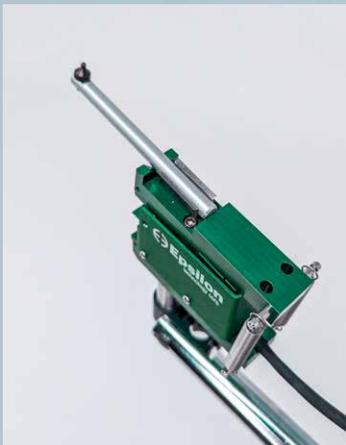
The magnetic mounting base supplied with the deflectometer can be mounted to the desired reference surface, whether flat or round, and the tip can be easily positioned to measure deformations during the test. The mounting system is designed to enable convenient swing in / swing out positioning of the deflectometer, when needed, without having to realign the deflectometer between tests.

All models feature a spring-loaded arm that can break free in the event of excessive displacement, protecting the deflection gage from damage. The upper arm exerts a small spring force against the specimen, which is sufficient to allow dynamic cyclic testing if desired, yet light enough in force to avoid influence on the test.

These units come standard with the arm set to measure downward deflections when oriented in the upright position. They can be used upside down or in any orientation. The measuring ranges listed are total displacement.

Model 3540 deflectometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the deflectometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3540 deflectometer



Model 3540 with 25 mm measuring range



Model 3540 with included magnetic mounting base

 See the Model 3540 deflectometer video

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- General purpose deflection sensor covers many test requirements; may be used in any orientation.
- Comes with an adjustable magnetic base for easy mounting and convenient swing in / swing out positioning.
- Spring loaded arm detaches to prevent damage from overtravel.
- Meets ASTM and ISO accuracy classes as follows:
-001M, -004M, -006M, -005T, -015T, -025T:
ASTM E2309 Class A
ISO 9513 Class 1
ASTM E83 Class B-2 (assuming 50 mm gauge length per D790 and D6272)
-012M, -025M, -050M, -050T, -100T, -200T:
ASTM E2309 Class B
ISO 9513 Class 2
ASTM E83 Class C (assuming 50 mm gauge length per D790 and D6272)
- All standard units have linearity of 0.25% of FS or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

- Excitation:* 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V, nominal, depending on model
Linearity: $\leq 0.25\%$ of full scale measuring range
Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
 Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)
Cable: Integral ultra-flexible cable, 2.5 m (8 ft) standard
Operating Force: <1.5 N (0.3 lbf) typical

OPTIONS

Connectors to interface to nearly any brand of test equipment
 Model PH2040 magnetic mounting base – provides 6+ degrees of freedom adjusted with one knob; ideal when measuring deflections of assemblies and structures



ORDERING INFORMATION

Model 3540 Available Versions: ANY combination of measuring range and temperature range listed below is available. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Measuring Range	
METRIC	
-001M	1.0 mm
-004M	4.0 mm
-006M	6.0 mm
-012M	12.0 mm
-025M	25.0 mm
-050M	50.0 mm
U.S.A.	
-005T	0.050"
-015T	0.150"
-025T	0.250"
-050T	0.500"
-100T	1.000"
-200T	2.000"

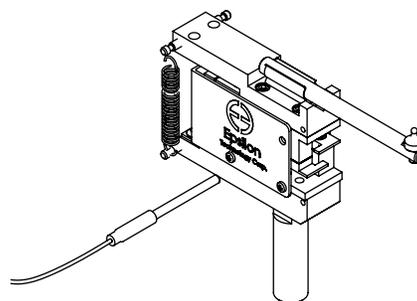
Model Number 3540- _____ - _____

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F) ¹
-HT2	-40 °C to 200 °C (-40 °F to 400 °F) ¹
-LHT	-270 °C to 200 °C (-454 °F to 400 °F) ¹

¹ Magnetic base not suitable for high temperature use; 50 °C (125 °F) max.

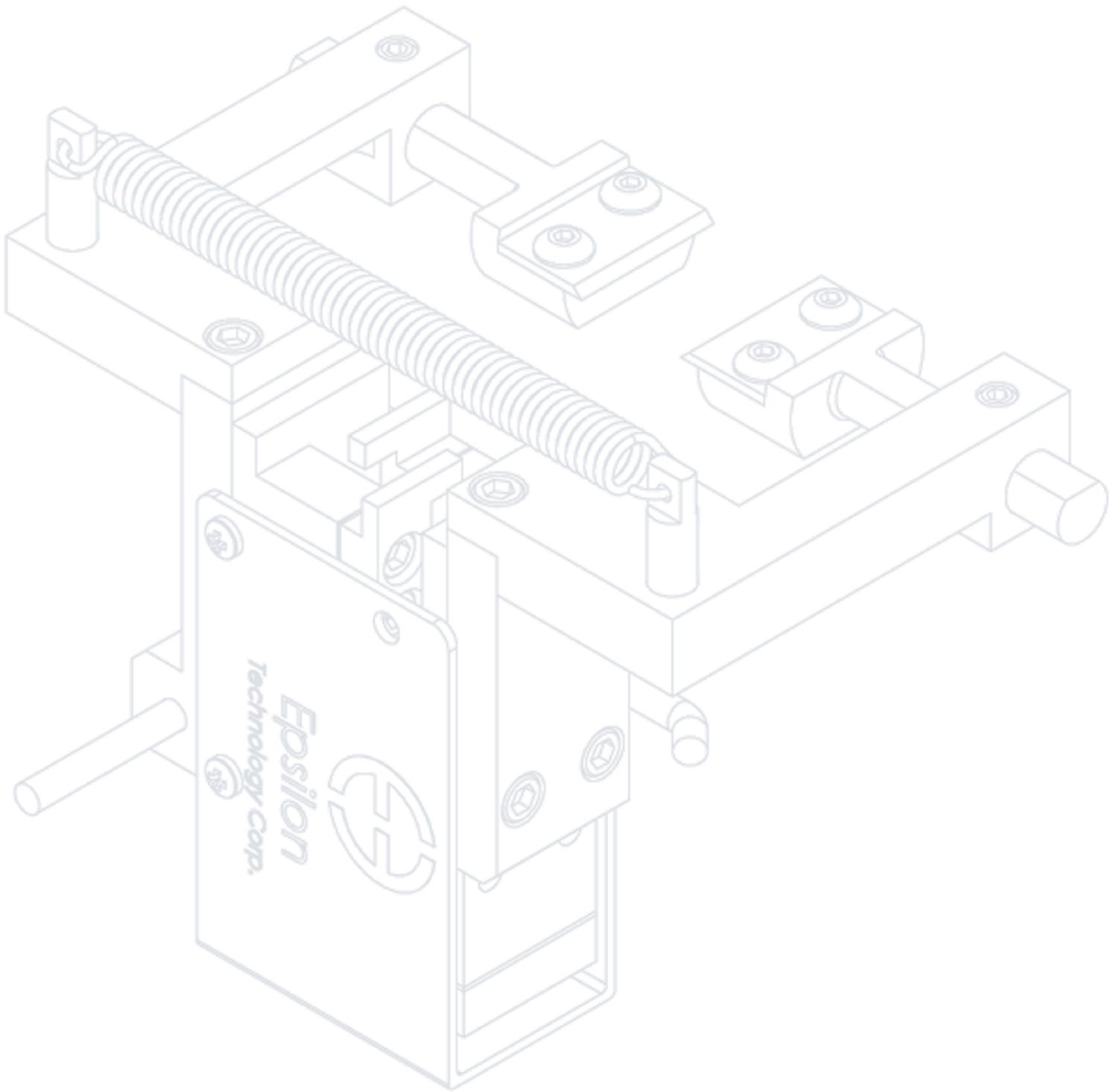
Example: 3540-012M-ST: 12.0 mm measuring range, standard temperature option (-40 °C to 100 °C)

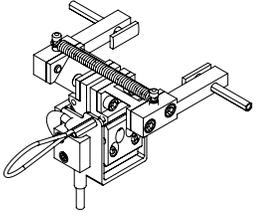
Visit our website at www.epsilontech.com
 Contact us for your special testing requirements.



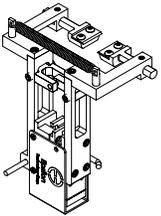
1 mm measuring range (shown without magnetic base)

MODEL 3540 EXAMPLE

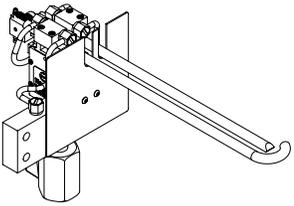




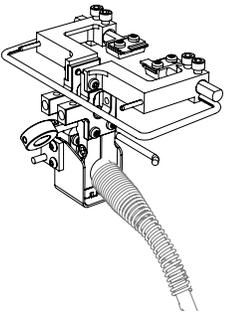
3575 Transverse (Diametral) Extensometers



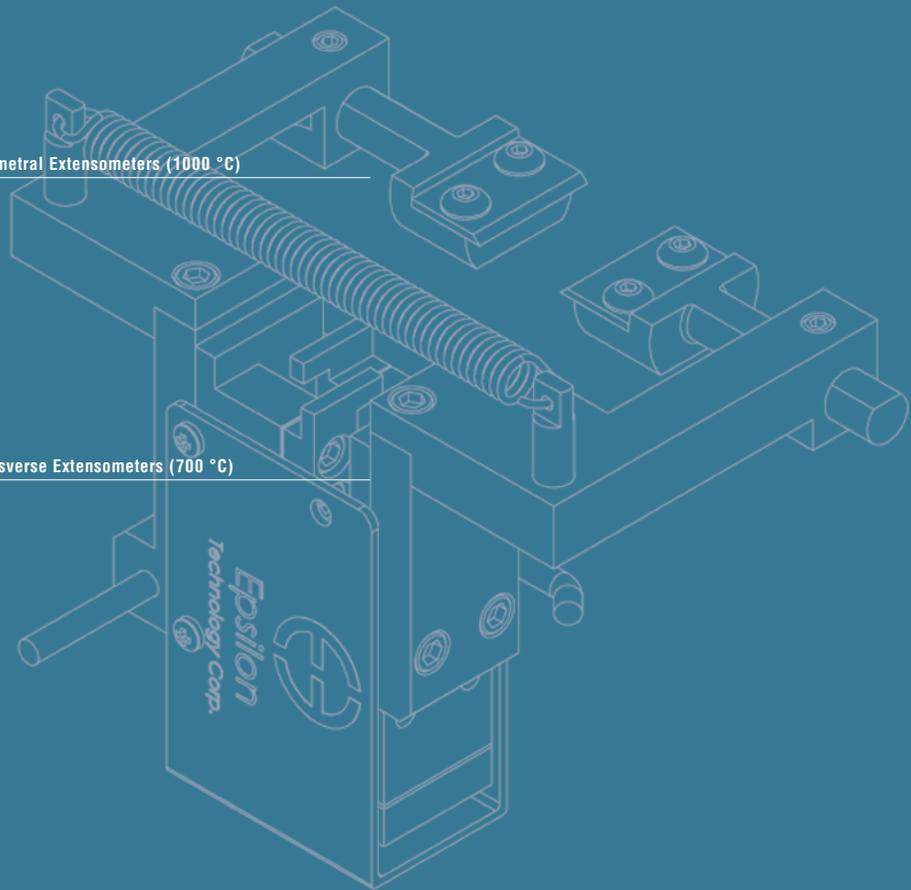
3475 Miniature Transverse Diametral Extensometers



3580 High Temperature Diametral Extensometers (1000 °C)



7675 High Temperature Transverse Extensometers (700 °C)



**Transverse
and Diametral
Extensometers**

Designed for general purpose transverse or diametral strain

measurement on axially loaded specimens. This model may be used

simultaneously with the Model 3542 axial extensometer.



Model 3575 extensometer

Self-supporting on the test sample, these extensometers will work on any width or diameter specimen from 0 to 25 mm (0-1 inch). Most often they are used simultaneously with Epsilon's axial extensometers, and together these extensometers are suitable for measurement of Poisson's ratio per ASTM E132, for transverse measurements with anisotropic materials like many composites, and for r-value testing of sheet metal specimens per ASTM E517.

These units easily clip onto the sample and are held in place with an integral spring. Rounded contact surfaces maintain the position on the specimen. All models are high

accuracy strain gaged units.

The Model 3575 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3575 special long measuring range (custom model)

▶ See the Model 3575 extensometer video

Poisson's Ratio and Sheet Metal r-Value Determination with Models 3575 and 3542

The Model 3575 may be used simultaneously with a Model 3542 axial extensometer to measure Poisson's ratio per ASTM E132 or r-value of sheet metal per ASTM E517.



Models 3575 and 3542 extensometers

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Suitable for measuring Poisson's ratio per ASTM E132 with most materials and specimens.
- All models will measure both positive and negative displacements.
- Easy to mount, with integral springs to keep the extensometer on the sample.
- Self-supporting on the specimen.
- All standard units have linearity readings of 0.20% or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Includes high quality foam lined case and spare set of tool steel knife edges.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V, depending on model

Linearity: ≤0.20% of full scale measuring range, depending on model

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Specimen Size: Works with samples up to 25 mm (1 inch) width or diameter

OPTIONS

Connectors to interface to nearly any brand of test equipment
Specialty knife edges (see page 106)



ORDERING INFORMATION

Model 3575 Available Versions: ANY combination of measuring range and temperature range listed below is available. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Measuring Range	
METRIC	
-050M	±0.5 mm
-100M	±1.0 mm
-250M	±2.5 mm
-300M	±3.0 mm
-500M	±5.0 mm
U.S.A.	
-020T	±0.020"
-050T	±0.050"
-100T	±0.100"
-150T	±0.150"
-200T	±0.200"

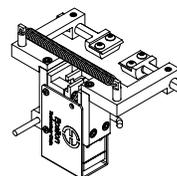
Model Number 3575- _____ - _____

Temperature Ranges

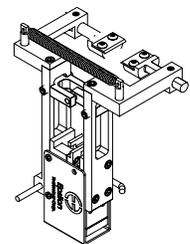
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

Example: 3575-050T-ST: ±0.050 inches measuring range, standard temperature option (-40 °F to 210 °F)

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Typical version

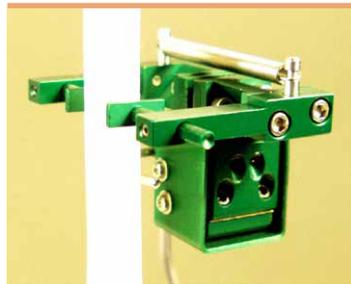


±3 mm or ±5 mm measuring range

MODEL 3575 EXAMPLES

A miniature extensometer designed for general purpose transverse or diametral strain measurements on small or thin specimens.

May be used simultaneously with the Model 3442 miniature axial extensometers or the Model 3542 axial extensometers.



Model 3475-050M-ST with ± 0.50 mm measuring range

These very lightweight extensometers are self-supporting on the test sample. They are used for measuring transverse or diametral strain. Often they are used simultaneously with an Epsilon axial strain measuring extensometer to determine Poisson's ratio. They also are used for characterizing materials with anisotropic properties, such as with many composite materials.

This model clips easily onto the sample with an integral spring to hold the unit in place. It can be adjusted to work on any size sample from 0 to 25 mm (1 inch) width or diameter. The Model 3475 has an arm thickness of only 3.81 mm (0.15 inches), and will work simultaneously with any axial extensometer having sufficient clearance between arms (not all versions of the 3442 miniature extensometer can be used). Large radius contacts prevent the unit from digging into the samples. This model utilizes Epsilon's dual flexure design, allowing use in dynamic applications. All units have measuring ranges in both directions.

The Model 3475 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3475-050T-ST with ± 0.050 inch measuring range

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Suitable for measuring Poisson's ratio per ASTM E132 with most materials and specimens.
- All models will measure both positive and negative displacements.
- Easy to mount, with integral springs to keep the extensometer on the sample.
- Self-supporting on the specimen.
- All standard units have linearity readings of 0.20% or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V, depending on model

Linearity: $\leq 0.20\%$ of full scale measuring range

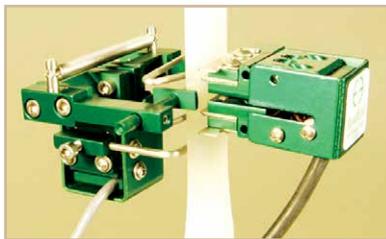
Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Specimen Size: Works with samples up to 25 mm (1 inch) width or diameter

OPTIONS

Connectors to interface to nearly any brand of test equipment



Model 3475 Transverse

Use with Model 3442 axial extensometer to measure Poisson's ratio.

ORDERING INFORMATION

Model 3475 Available Versions: ANY combination of measuring range and temperature range listed below is available. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

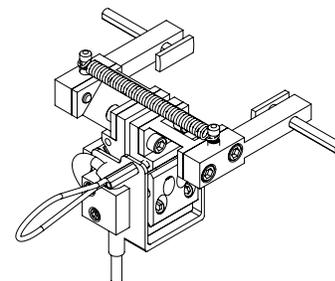
Measuring Range	
METRIC	
-025M	±0.25 mm
-050M	±0.50 mm
-100M	±1.00 mm
-125M	±1.25 mm
U.S.A.	
-010T	±0.010"
-020T	±0.020"
-040T	±0.040"
-050T	±0.050"

Model Number 3475- _____ - _____

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

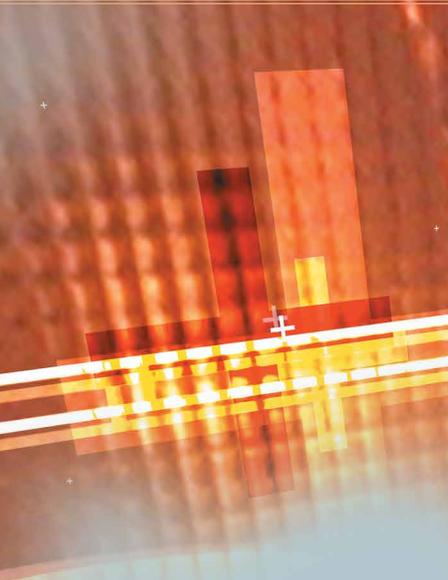
Example: 3475-050M-LT: ±0.50 mm measuring range, low temperature option (-270 °C to 100 °C)

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±0.5 mm measuring range

MODEL 3475 EXAMPLE



For transverse or diametral strain measurements at temperatures to 1000 °C (1832 °F). These extensometers may be used with furnaces having a side entry slot for an extensometer or with induction heating systems. They utilize a proprietary, rugged dual flexure design.



Model 3580 extensometer

This model is for diametral strain measurement with furnace and induction heating systems. Quartz rods and liquid cooling allow the unit to be used for high temperature testing of metals, ceramics and composites.

With induction heating, this model often can be used without liquid cooling.

When used in furnaces, the extensometer is often mounted directly to the furnace side cut-out. Optional load frame mounting brackets are available for supporting the extensometer in cases where furnace mounting is not possible. These optional mounts are used with induction heating or furnace systems.

Model 3580 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3580 mounted to split furnace

Features

- **May be left on through specimen failure.**
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All standard units have linearity readings of 0.15% or better.
- Suitable for measuring Poisson's ratio per ASTM E132 with most materials and specimens.
- High purity alumina ceramic rods (1200 °C) or alpha grade silicon carbide rods (1600 °C) are available.
- Versions available for use in vacuum environments (consult factory).
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Each unit comes with a spare set of quartz rods, universal liquid-cooled mounting bracket and a foam lined storage case.

SPECIFICATIONS

- Excitation:* 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V nominal, depending on model
Linearity: ≤0.15% of full scale measuring range, depending on model
Temperature Range: Standard is -40 °C to +1000 °C (-40 °F to 1832 °F)
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Coolant Interface: Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
Specimen Size: Works with sample diameters from 4.5 to 16 mm (0.18 to 0.63 inch)
Contact Force: Adjustable, 100 to 300 g typical

OPTIONS

- Special rods are available for large specimens
 Ceramic rods for testing to 1200 °C or 1600 °C
 Model EPS170 constant-temperature recirculating chiller - *see the Options tab on the web page for important details about liquid cooling requirements*
 Connectors to interface to nearly any brand of test equipment



Model EPS170 Constant-Temperature Recirculating Chiller

This chiller provides a continuous flow of coolant at a constant temperature for liquid-cooled extensometers. Capable of cooling or heating the coolant, coolant temperature is maintained within 0.1 °C. These units are ideal for obtaining the maximum stability of liquid-cooled extensometers. See website for dimensions.



ORDERING INFORMATION

Model 3580 Available Versions: ANY combination of measuring range and temperature range listed below is available. Quartz rod lengths are made to fit furnaces as required. Please provide furnace and specimen dimensions at the time of order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

Measuring Range	
METRIC	
-050M	±0.50 mm
-075M	±0.75 mm
-150M ¹	1.50 mm
-200M ^{1,2}	2.00 mm
-500M ^{1,2}	5.00 mm
U.S.A.	
-020T	±0.020"
-030T	±0.030"
-060T ¹	0.060"
-075T ^{1,2}	0.075"
-200T ^{1,2}	0.200"

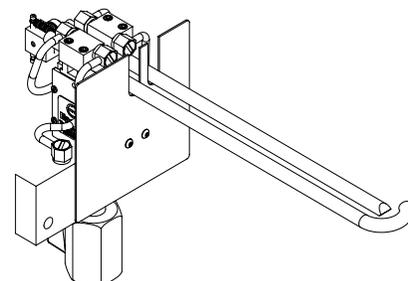
Model Number 3580- _____

¹ Total measuring range in either tension or compression. Specify direction of extensometer measuring range when ordering.

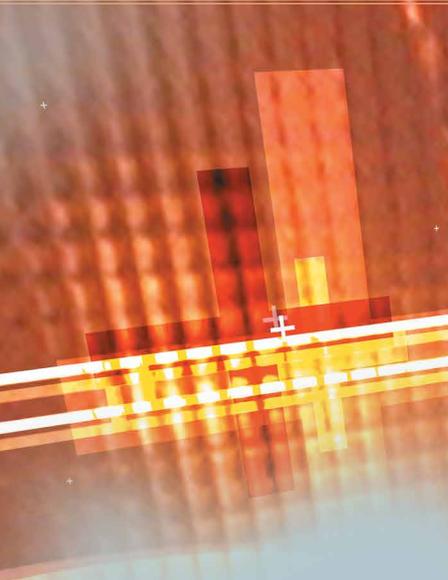
² Special order only.

Example: 3580-030T: ±0.030 inches measuring range, temperature range of -40 °F to 1832 °F

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 Contact us for your special testing requirements.



MODEL 3580 EXAMPLE



Designed for transverse or diametral strain measurement in environmental chambers where the entire extensometer must be exposed to elevated temperatures. These capacitive extensometers may be used up to 700 °C (1300 °F) without any cooling.



Model 7675 transverse extensometer

These transverse extensometers use a high-temperature capacitive sensor and do not require any cooling. They will operate up to the maximum temperature limit of most environmental chambers used in materials testing. The Model 7675 is ideal for determination of Poisson's ratio, and for characterization of anisotropic materials such as composites. All units can accommodate both positive and negative displacements. Model 7675 transverse extensometers are compatible with most Model 7642 high-temperature axial extensometers.

The 7675 is supplied with the advanced DT6229 controller. The standard output is 0-10VDC analog signal, factory calibrated with the extensometer. This system provides a number of functional enhancements, including high speed digital output, built in calibration and tare functions, analog and digital filters, and more.



Model 7675 with model 7642



Model 7675 and 7642 with DT6229-02 (dual channel) signal conditioner

Features

- **May be left on through specimen failure.**
- Self-supporting on specimen.
- Improved accuracy, resolution, and noise rejection at high temperature.
- Reduced size and weight, and improved high frequency performance.
- All standard models are suitable for cyclic testing, >25 Hz is typical.
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
 - Includes high speed analog and digital outputs
 - Intuitive web-based user interface for setup, calibration, and data acquisition
 - Built-in calibration reference and auto-zero features
 - Multiple extensometer calibration files may be loaded for use with one controller
 - Multiple temperature-specific calibrations may be stored
 - Selectable analog and digital filter options from 2 Hz to 3 kHz
- Ships fully calibrated with electronics (traceable to NPL (UK)) with user specified voltage output.
- Mechanical over-travel protection.
- Suitable for measuring Poisson's ratio per ASTM E132 with most materials and specimens.
- Durable stainless steel knife edges.
- Includes high quality foam lined case.
- Rugged, dual flexure design for strength and improved performance. The next-generation design enables cyclic testing at much higher frequencies.

SPECIFICATIONS

Analog Output: User specified, ± 5 VDC or ± 10 VDC typical, ± 10.8 VDC rail

Digital Output: 24 bit high speed Ethernet output with built-in web interface

Linearity: 11 point linearization, $\leq 0.15\%$ of full scale typical

Resolution: < 55 PPM (0.006%FS) RMS @ 4 kHz, < 6 PPM (0.0006%FS) @ 100 Hz

Analog Filter: Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters

Temperature Range: Ambient to 700 °C (1300 °F). Use up to 800 °C is possible – contact Epsilon for details. Springs may require periodic adjustment or replacement after long-term testing above ~ 600 °C.

Temperature Sensitivity (Gain): < 100 PPM/°C (0.01%FS/°C) typical

Sensor Cable: 0.7 m (2.5 ft) tri-axial high temperature cable, plus 1.5 m (5 ft) room temperature extension cable

Specimen Size: Fits round samples up to 25 mm (1.0 inch) diameter and flats to 25 mm (1.0 inch) wide

Axial Extensometer Compatibility: Compatible with model 7642 with gauge length ≥ 25 mm (1 inch); contact Epsilon if a shorter gauge length is required

Operating Force: 1-2 kgf (30-60 oz.) typical, depending on model

Environment: Recommended for elevated temperature testing in dry air, inert / non-corrosive gases, or vacuum

Overall Dimensions: Contact Epsilon for overall dimensions

Power: Includes power supply

OPTIONS

Reverse cable exit available

Connectors to interface to nearly any brand of test equipment

Bulkhead adapters for vacuum chambers

Dual-channel DT6229 controller

Specialty knife edges (see page 106)

ORDERING INFORMATION

Model 7675 Available Versions: Available standard measuring ranges are listed below. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

Measuring Range	
METRIC	
-012M	± 1.2 mm
-025M	± 2.5 mm*
U.S.A.	
-050T	± 0.05 "
-100T	± 0.10 "*

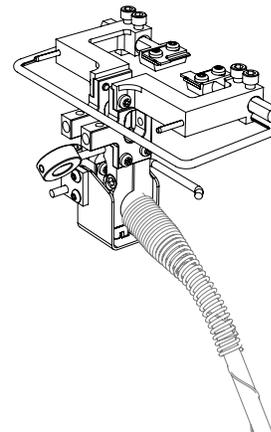
Model Number 7675- _____

*Preferred configuration

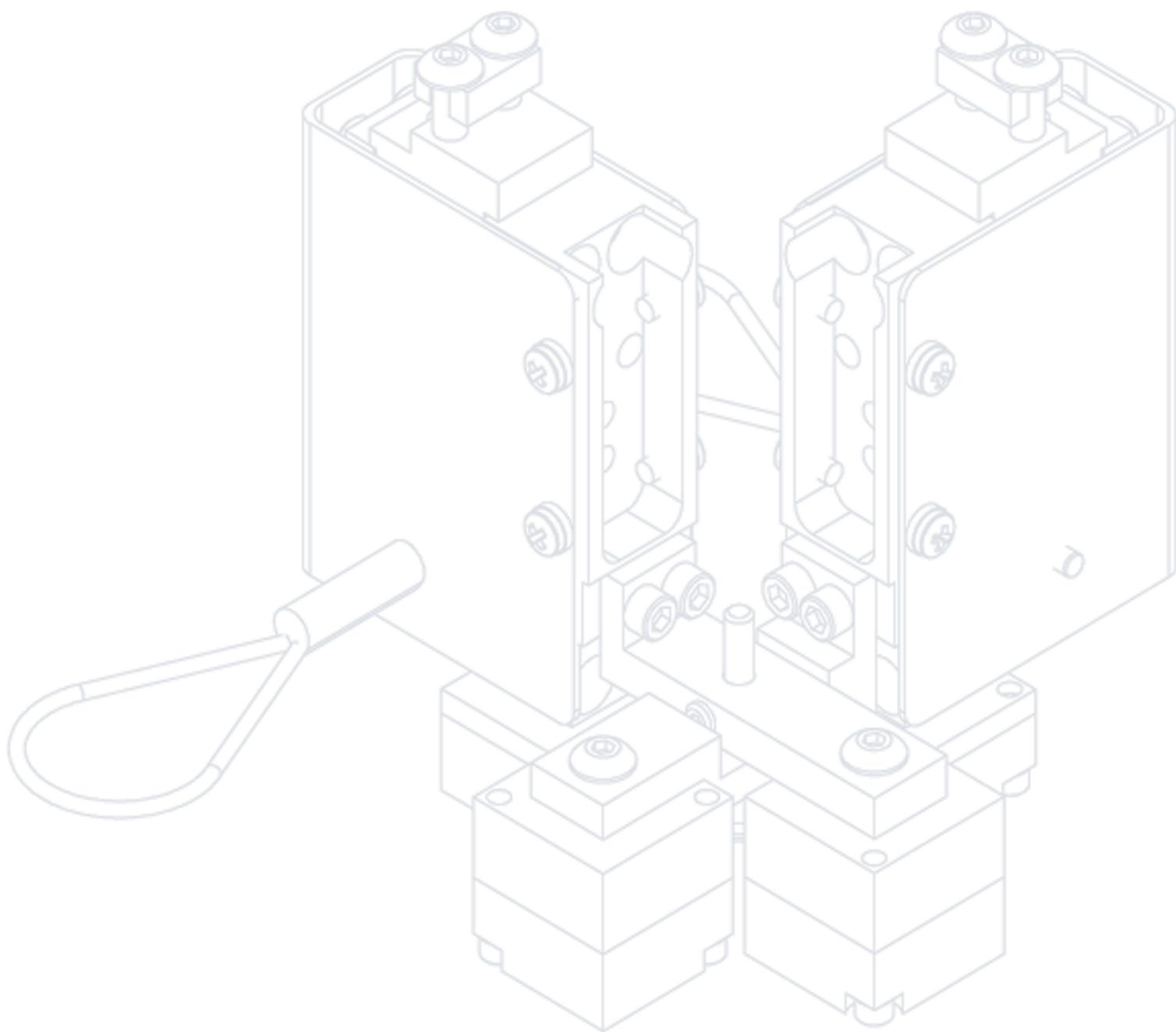
Example: 7675-025M: ± 2.5 mm measuring range

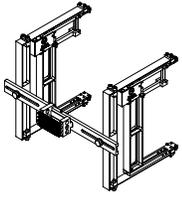


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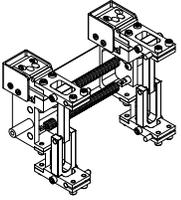


MODEL 7675 EXAMPLE

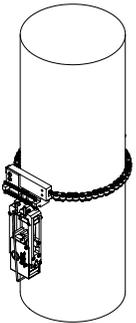




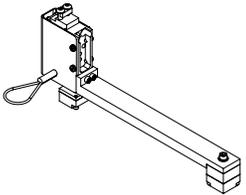
3542RA Averaging Axial Extensometers



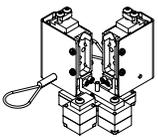
3442RA1 Miniature Averaging Axial Extensometers



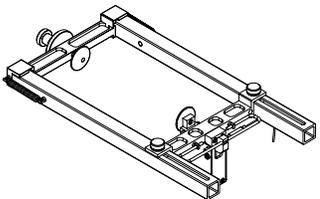
3544 Circumferential Extensometers



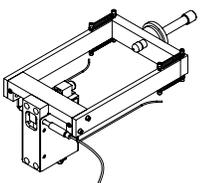
3909 Extensometers for Simple Performance Testing of Asphalt



3910 Extensometers for Creep Compliance and Tensile Strength Testing of Asphalt

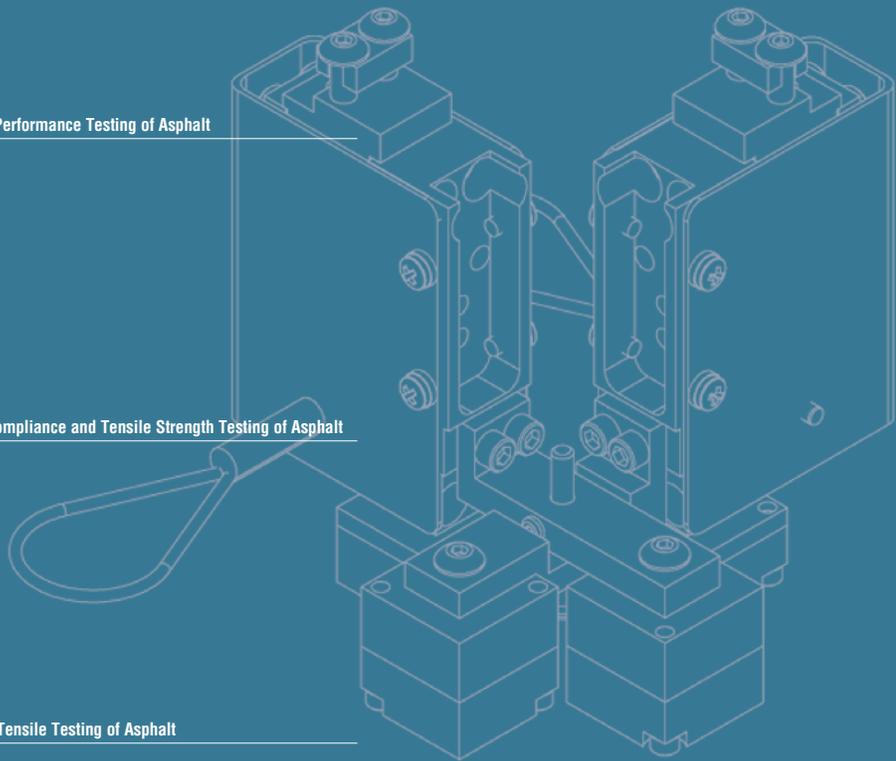


3911 Extensometers for Indirect Tensile Testing of Asphalt



3975 Extensometers for Diametral Rock and Concrete Testing

**Rock, Concrete and
Asphalt Extensometers**





Designed primarily for compressive strength tests on rock, concrete and other large compression samples, this model measures axial strain on opposite sides of the test specimen, and the output is an average of the two readings. Gauge lengths from 25 to 200 mm (1 to 8 inches) and measuring ranges from 1.2 to 6 mm (0.050 to 0.250 inches) are available.



Model 3542RA1 extensometer with 50 mm gauge length



Model 3542RA2 dual averaging rock and concrete extensometer

The Model 3542RA is available in a variety of configurations. All are self-supporting on the specimen and mount very easily. For tests where a single diameter specimen is typically used, the fixed diameter Model 3542RA1 is recommended. For applications where a continuously adjustable diameter extensometer is required, the Model 3542RA2 is available. The standard configuration for this model allows it to work on samples from 50 mm to 150 mm (2 inches to 6 inches). If desired, the two readings can be independent, providing two outputs. Many rock tests are done in tri-axial pressure vessels. Epsilon has versions for use in oil to 1360 bar at 200 °C (20,000 psi at 400 °F). These will fit in unusually small inside diameter vessels. For small diameter specimens, we suggest the Model 3442RA1 averaging axial extensometer.

All Model 3542RA extensometers are designed so they may be used together with the Model 3544 circumferential or Model 3975 diametral extensometer. Epsilon's rock extensometers can withstand the punishment of daily, high volume testing. Some units have been used for several thousand tests without damage. The conical point contacts included with the extensometer are made from tungsten carbide.

Model 3542RA extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- High accuracy, averaging output or optional dual independent outputs.
- The 3542RA1 is configured for a single specimen diameter, specified when ordering, in the range of 50 to 200 mm (2 to 8 inches). The 3542RA2 is adjustable to work on any specimen diameter from 50 to 150 mm (2 to 6 inches). Special configurations of the 3542RA2 will allow for smaller diameter sizes.
- Easy mounting, attaches with integral springs.
- Self-supporting on the specimen.
- May be used simultaneously with Model 3544 circumferential extensometers or Model 3975 diametral extensometer.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.

Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Specimen Size: Fits a wide range of specimen sizes:
AX, BX, NX and larger specimens
Diameters from 50 to 200 mm (2 to 8 inches) standard; larger sizes on special order

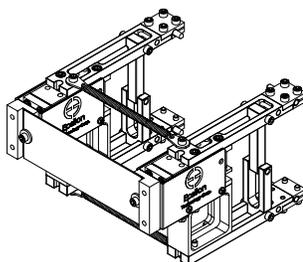
Operating Force: <30 g typical per side

OPTIONS

Fixed or variable diameter configurations

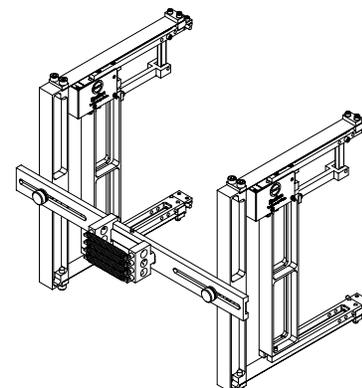
Dual, independent outputs

Connectors to interface to nearly any brand of test equipment



50 mm (2") gauge length

MODEL 3542RA1 EXAMPLE

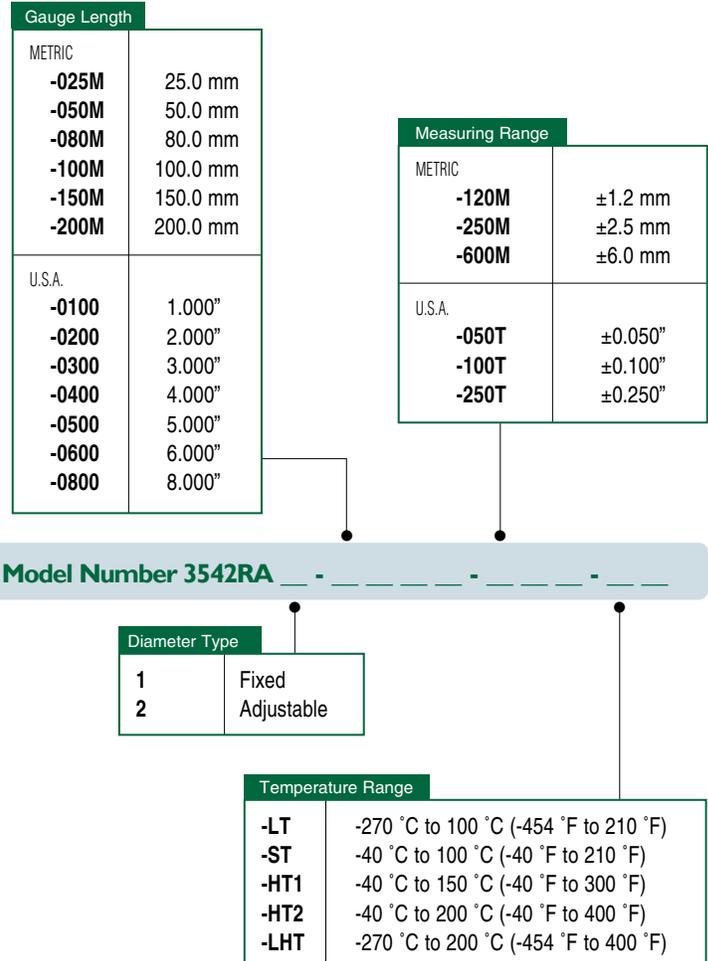


150 mm (6") gauge length, fits samples from 50 to 150 mm (2" to 6") diameter

MODEL 3542RA2 EXAMPLE

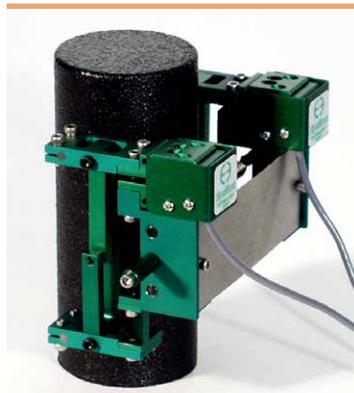
ORDERING INFORMATION

Model 3542RA Available Versions: ANY combination of gauge length, measuring range and temperature range listed above is available, except as noted. Specify specimen diameter(s) when ordering. Other specimen diameters and extensometer gauge lengths may be available with special order; please contact Epsilon to discuss your requirements.



Example: 3542RA1-100M-600M-ST: Fixed size, 100 mm gauge length, 6.0 mm measuring range, standard temperature option (-40 °C to 100 °C)

With gauge lengths of 25 and 50 mm (1 and 2 inches) and measuring ranges of 1.2 and 2.5 mm (0.050 and 0.100 inches), the Model 3442RA1 was designed for applications where tensile or compressive strength tests on small rock, concrete and other small compression samples is desired.



Model 3442RA1-0200-050T-ST with 2 inch gauge length and ± 0.050 inch measuring range

Axial strain is measured on opposite sides of the test specimen and the output is an average of the two readings. The Model 3442RA1 is available in a variety of configurations for samples 50 mm (2 inches) or smaller in diameter. All are self-supporting on the specimen and mount very easily. The conical point contacts included with the extensometer are made from tungsten carbide. If desired, the two outputs can be independently configured, providing two readings. Epsilon has versions for use in oil to 1360 bar at 200 °C (20,000 psi at 400 °F). These units will fit in small inside diameter vessels.

For large diameter specimens, we suggest one of the Model 3542RA averaging axial extensometers.

The Model 3442RA1 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- High accuracy, averaging output or optional dual independent outputs.
- Designed for smaller diameter specimens.
- Easy mounting, attaches with integral springs.
- Self-supporting on the specimen.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.

Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Operating Force: <30 g typical per side

OPTIONS

Dual independent outputs

Connectors to interface to nearly any brand of test equipment

ORDERING INFORMATION

Model 3442RA1 Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available, except as noted. Test specimen diameter(s) must be specified at the time of order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

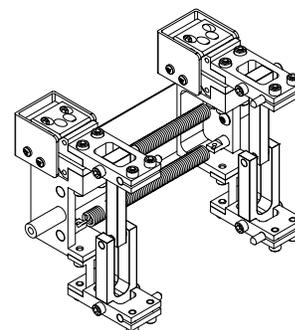
Gauge Length		Measuring Range	
METRIC		METRIC	
-025M	25.0 mm	-125M	± 1.25 mm
-050M	50.0 mm	-250M	± 2.50 mm
U.S.A.		U.S.A.	
-0100	1.000"	-050T	± 0.050 "
-0200	2.000"	-100T	± 0.100 "

Model Number 3442RA1- _____ - _____ - _____

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

Example: 3442RA1-0200-050T-ST: 2.0 inch gauge length, 0.050 inch measuring range, standard temperature option (-40 °F to 210 °F)

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50 mm gauge length

MODEL 3442RA1 EXAMPLE



Designed for concrete and rock compression testing or for compression tests on other large samples. This model may be used simultaneously with the Model 3542RA axial extensometers.



Model 3544 in a horizontal body style

Circumferential extensometers measure the change in circumference as the sample is compressed. This is considered by many researchers to be a more accurate way to determine diametral strain, since the measurement is taken over the entire material inside the circumference.

A high precision, custom roller chain with special rollers mounts the extensometer to the specimen. As the specimen diameter enlarges during the test, the chain causes the extensometer to expand. The unit is self-supported on the sample with integral springs. Links are easily added or removed to adjust for different size specimens. A mechanical adjustment allows the output to be set to zero. A breakaway device protects the extensometer in the event of specimen rupture. Often rock specimens are tested in tri-axial pressure cells. Versions of the Model 3544 are available to fit inside the vessel and operate in oil environments at up to 1360 bar at 200 °C (20,000 psi at 400 °F).

The Model 3544 is the best choice for large diametral strains in large compression samples. Epsilon's diametral rock and concrete extensometer, the Model 3975, is recommended for small strain measurements such as Poisson's ratio.

The Model 3544 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3544 with a 4 inch diameter specimen

 See the Model 3544 extensometer setup video

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Adapts to a wide range of specimen sizes by adding or removing chain links.
- Self-supporting on the specimen.
- May be used simultaneously with Model 3542RA axial extensometers.
- Versions available for use in tri-axial confining pressure cells, at high pressures and temperatures.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Linearity: $\leq 0.25\%$ of full scale measuring range

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)

Optional (-HT2) is -40 °C to +200 °C (-40 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Specimen Sizes: Fits round specimens with diameters from 50 mm up to 200 mm (2-8 inches), depending on configuration

OPTIONS

Horizontal, vertical or user convertible orientations

Connectors to interface to nearly any brand of test equipment



Model 3544

Used with Model 3542RA dual averaging extensometer.

ORDERING INFORMATION

Model 3544 Available Versions: Any combination of diameter range, measuring range and temperature range is available, except as noted. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Diameter Range	
METRIC	
-100M	50 mm to 100 mm
-150M	50 mm to 150 mm
-200M	50 mm to 200 mm
U.S.A.	
-0400	2.00" to 4.00"
-0600	2.00" to 6.00"
-0800	2.00" to 8.00"

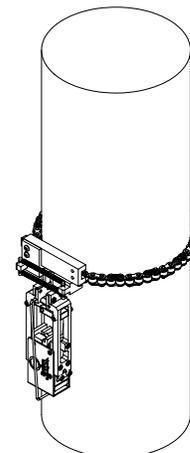
Circumferential Measuring Range	
METRIC	
-020M	+2.0 mm
-030M	+3.0 mm
-060M	+6.0 mm
-120M	+12.0 mm
U.S.A.	
-080T	+0.080"
-125T	+0.125"
-250T	+0.250"
-500T	+0.500"

Model Number 3544- _____ - _____ - _____

Temperature Range	
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)

Example: 3544-200M-120M-ST: 50 mm to 200 mm diameter range, +12 mm measuring range, standard temperature option (-40 °C to 100 °C)

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MODEL 3544 EXAMPLE

Designed for measuring axial displacements in the simple performance tests prescribed by NCHRP Report 465, and determining dynamic modulus of hot mix asphalt per AASHTO TP062.



Model 3909-0400 with 4 inch gauge length

These extensometers are typically mounted as two axial modules with independent outputs capable of measuring specimen deformations in two locations, but they can be mounted as a single unit or up to four on a sample. They quickly clip onto gauge points mounted per the test requirements.

Magnets at each end of the extensometer snap instantly in place on the steel gauge points glued to the test sample. The quick attachment is most advantageous when testing preconditioned samples that are heated or cooled, since

the extensometers can be mounted before the sample changes temperature appreciably. For units intended to be used inside tri-axial cells, extensometers are available with modules rotated 90°.

The standard Model 3909 has full scale measuring range of ± 0.5 mm or ± 0.020 inches. Gauge points are included with the extensometers and an optional gluing fixture is available. Two standard 3909 units can be converted to the Model 3910 with the purchase of optional gauge length adapters.

The Model 3909 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3909-0400 with 4 inch gauge length



Model 3909 Gluing Fixture - adjustable fixture for gluing gauge points to test samples (recommended option)

Features

- Model 3909 for simple performance testing per NCHRP Report 465, and determining dynamic modulus of hot mix asphalt per AASHTO TP062.
- Easy mounting, attaches with magnets, which allows dynamic testing to 40 Hz.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All standard units have linearity readings of 0.20% or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

- Measuring Range:* ± 0.5 mm or ± 0.020 inches
Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max..
Output: 2 to 4 mV/V nominal, depending on model
Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model
Temperature Range: Standard is -40 °C to $+100$ °C (-40 °F to $+210$ °F)
Cable: Integral, flexible Teflon® cable, 2.5 m (8 ft) standard
Operating Force: <30 g typical

OPTIONS

- Adjustable fixture for gluing gauge points to test samples (recommended) - adjustable for offset height and gauge length; configurable for various specimen diameters and mounting gauge points at 90°, 120°, and 180°
 Gauge length adapters
 Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Model 3909 Available Versions: Available in intermediate and larger gauge lengths on special order. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

± 0.5 mm measuring range will be supplied with units that are ordered with gauge lengths in mm units.

± 0.020 " measuring range will be supplied with units that are ordered with gauge lengths in inch units.

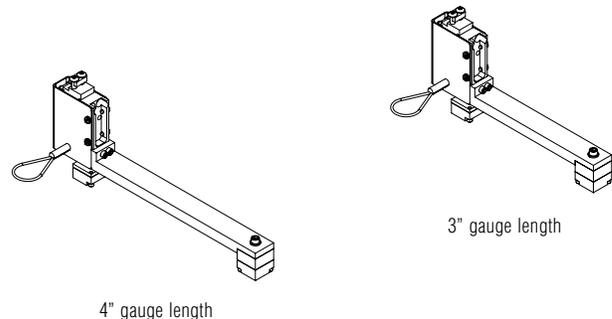
Gauge Length	
METRIC	
-070M ¹	70 mm
-076M	76 mm
-100M	100 mm
U.S.A.	
-0275 ¹	2.75"
-0300	3.00"
-0400	4.00"

Model Number 3909- _____

¹ Special order.

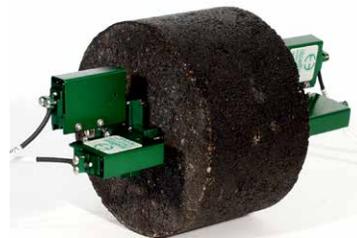
Example: 3909-0300: 3.00 inch gauge length with a full scale measuring range of ± 0.020 inches

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MODEL 3909 EXAMPLES

Designed for asphalt core testing applications with core samples having 100 and 150 mm (4 and 6 inch) diameters. The unit meets test method requirements for strain measurement developed under the U.S. Federal Highways SHRP program.



Model 3910-0100 with 1 inch gauge length

These extensometers are for creep compliance, tensile strength testing and dynamic resilient modulus testing. They are single integral, bi-axial units which measure both lateral and vertical deformations. They quickly clip onto gage points mounted per the test requirements. They mount much faster and easier than other types.

Two units are typically required, with one extensometer mounting to each side of the test specimen. They are changeable from the 1 inch centers used for 4 inch diameter specimens, to the 1.5 inch centers used for 6 inch diameter samples using optional gauge length adapters. Magnets at each end of the extensometer snap instantly in place on the steel gage points glued to the test sample. The quick attachment is most advantageous when testing pre-conditioned samples that are heated or cooled, since the extensometers can be mounted before the sample changes temperature appreciably.

The standard Model 3910 has full scale measuring range of ± 0.5 mm or ± 0.020 inches. Gage points are included with the extensometers and optional gluing templates are available. This model can be converted to the Model 3909 with optional gauge length adapters.

The Model 3910 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Model 3910 gluing template

Features

- Model 3910 for creep compliance, resilient modulus, and tensile strength for testing per AASHTO T322.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Easy mounting, attaches with magnets, which allows dynamic testing to 40 Hz.
- All standard units have linearity readings of 0.20% or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

- Measuring Range:* ± 0.5 mm or ± 0.020 inches
Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V nominal, depending on model
Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model
Temperature Range: Standard is -40 °C to $+100$ °C (-40 °F to $+210$ °F)
Cable: Integral, flexible Teflon® cable, 2.5 m (8 ft) standard
Operating Force: <30 g typical

OPTIONS

- Gauge length adapters
- Gluing template for gage points
- Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Model 3910 Available Versions: Available in intermediate and larger gauge lengths on special order. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

± 0.5 mm measuring range will be supplied with units that are ordered with gauge lengths in mm units.

± 0.020 " measuring range will be supplied with units that are ordered with gauge lengths in inch units.

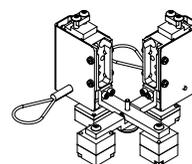
Gauge Length	
METRIC	
-025M	25 mm
-038M	38 mm
-050M¹	50 mm
-076M¹	76 mm
-100M¹	100 mm
U.S.A.	
-0100	1.000"
-0150	1.500"
-0200¹	2.000"
-0300¹	3.000"
-0400¹	4.000"

Model Number 3910- _____

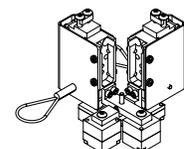
¹ Special order.

Example: 3910-0100: 1.000 inch gauge length with a full scale measuring range of ± 0.020 inches

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1.5" gauge length



1" gauge length

MODEL 3910 EXAMPLES

Designed to meet many of the needs for testing asphalt core samples in 100 and 150 mm diameters (4 and 6 inch). It meets test method requirements for strain measurement developed under the U.S. Federal Highways SHRP program.



Model 3911 extensometer

For indirect tensile testing, such as for resilient modulus, these extensometers measure the lateral deformation of specimens. They are self-supporting on the sample and clip on in seconds. The traditional way this deformation has been measured was prone to errors caused by slight rocking of the sample as it is loaded. The self-supporting design of the Model 3911 eliminates this problem. This unit will handle the dynamic pulse requirements of resilient modulus testing.

The speed of mounting makes test set-up much faster than with the older method. The pivot mounting used ensures that the specimen contact pads meet the often uneven asphalt surface as well as possible. The measuring range options available allow a wide range of testing, yet can easily measure the sometimes very small displacements required.

The Model 3911 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- Model 3911 indirect tensile extensometer for asphalt, for testing per AASHTO TP31 and ASTM D4123.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Easy mounting with built-in breakaway feature should specimen fracture.
- All standard units have linearity readings of 0.20% or better.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

- Excitation:* 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V nominal, depending on the model
Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model
Temperature Range: Standard is -40 °C to +100 °C (-40 °F to +210 °F)
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Specimen Size: Adjustable to fit both 100 mm and 150 mm (4 inch and 6 inch) diameter specimens

OPTIONS

Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

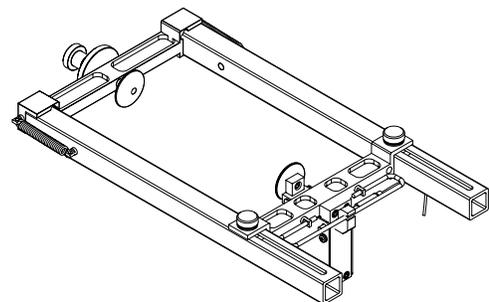
Model 3911 Available Versions: Consult factory for additional ranges.

Measuring Range	
METRIC	
-076M	+0.76 mm
-150M	+1.50 mm
-200M	+2.00 mm
U.S.A.	
-0003	+0.030"
-0006	+0.060"
-0008	+0.080"

Model Number 3911- _____

Example: 3911-150M: +1.50 mm measuring range

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MODEL 3911 EXAMPLE

Designed for accurate measurement of small diametral strains such as those required to determine Poisson's ratio of rock, concrete and asphalt samples. The units are designed to be used in conjunction with the Model 3542RA axial averaging extensometer.



Model 3975, standard configuration, sized for a specimen with an extra-large diameter



Model 3975, customized for a space-limited application



Model 3975, customized for a space-limited application



Model 3975 extensometer

Self-supporting on the test sample, these extensometers will work on standard sized diameter samples, but special configurations are available upon request. They are designed for use in testing for Poisson's ratio and for applications where accurate diametral measurements with low strains are required.

The Model 3975 is the best choice for small diametral strains in large compression samples. Epsilon's circumferential extensometer, the Model 3544, is recommended for large strain measurements. These units are easily attached to the sample, and rounded contact edges maintain the position on the specimen.

The Model 3975 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with a compatible connector that is wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All standard units have linearity readings of 0.20% or better.
- Easy mounting, attaches with integral springs.
- Self-supporting on the specimen.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model

Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to +210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

OPTIONS

Additional frames for larger or smaller diameter samples

Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Model 3975 Available Versions: Consult factory for additional ranges. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

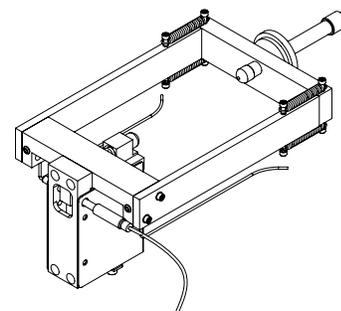
Measuring Range	
METRIC	
-076M	+0.76 mm
-150M	+1.50 mm
-200M	+2.00 mm
U.S.A.	
-0003	+0.030"
-0006	+0.060"
-0008	+0.080"

Model Number 3975- _____ - _____

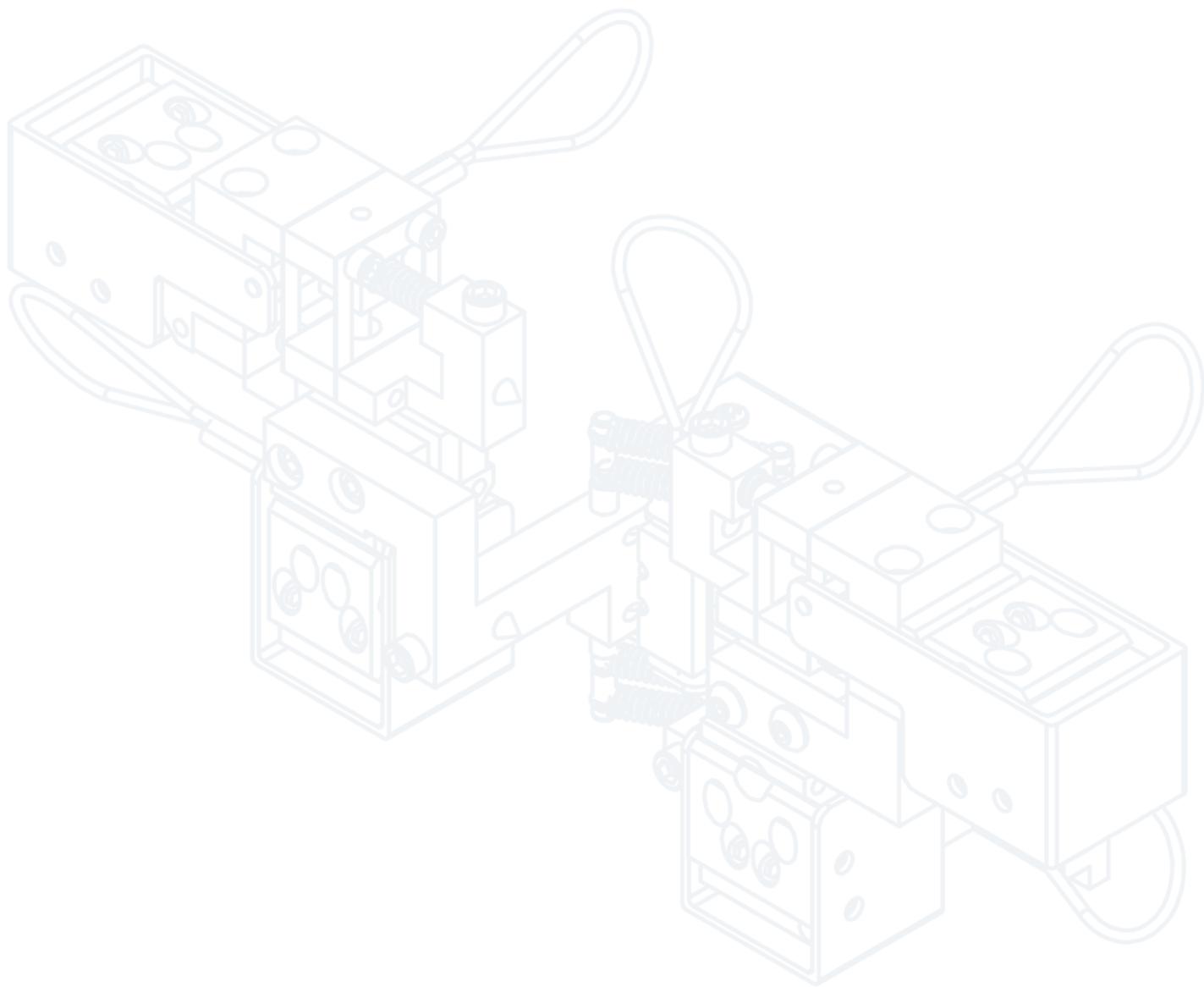
Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

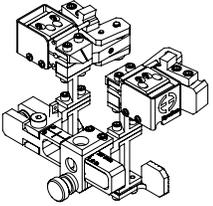
Example: 3975-0008-ST: +0.080 inches measuring range, standard temperature option (-40 °C to 100 °C)

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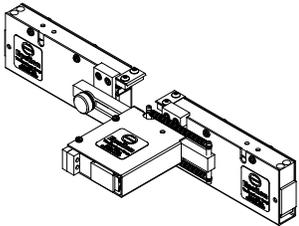


MODEL 3975 EXAMPLE

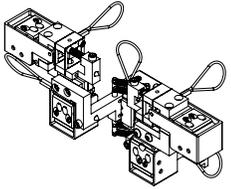




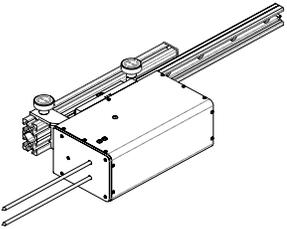
3442AVG Averaging Axial Extensometers



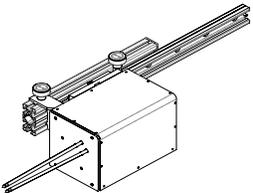
3560-BIA Bi-Axial Averaging Extensometers



3550 Axial/Torsional Extensometers

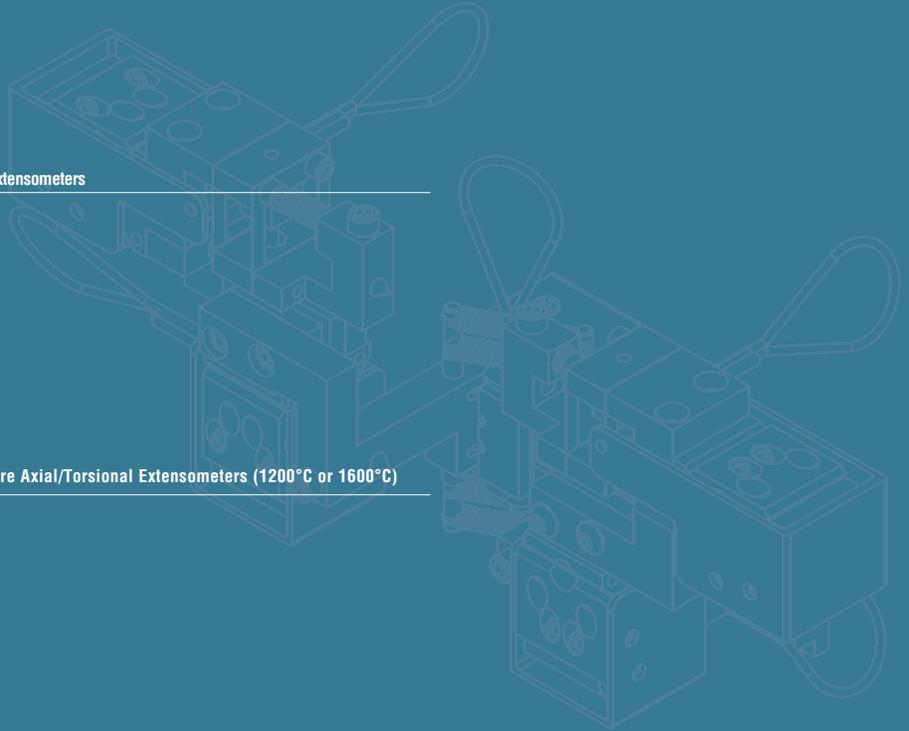


7650 High Temperature Axial/Torsional Extensometers (1200°C or 1600°C)



7651 High Temperature XY Planar Biaxial Extensometer (1200°C or 1600°C)

**Averaging, Bi-Axial and Axial/
Torsional Extensometers**



This all-purpose averaging axial extensometer is used in tension or compression to measure Young's modulus, offset yield, and strain to failure. It is compact and lightweight. Gauge length is set automatically for fast specimen mounting.



Model 3442AVG-050M-025M-ST with 50 mm gauge length and +2.5 mm/-1.0 mm measuring range

The Model 3442AVG is optimized for high-accuracy tension and compression testing. It measures strain simultaneously on opposite sides of the specimen to average out specimen misalignment while measuring axial strain. The averaging capability is useful for measuring Young's modulus per ASTM E111, properties of composite materials per ISO 527 and ASTM D3039, and compression of metals per ASTM E9. It is compact, lightweight, and may be used through specimen failure with most materials. It is fatigue rated and may be used in strain control.

The extensometer sets its gauge length automatically when it is mounted on the specimen. This feature improves repeatability, reduces operator errors and saves time. Just mount the extensometer and it will be at its gauge length and ready for testing.

This extensometer's output can be configured in two ways: with a single output for average strain measurement, or with separate outputs for measuring strain separately on opposite sides of the specimen with two strain channels. The configuration with two outputs can be used during test setup or during the test to measure specimen bending (strain uniformity) caused by misalignment or specimen machining imperfections.

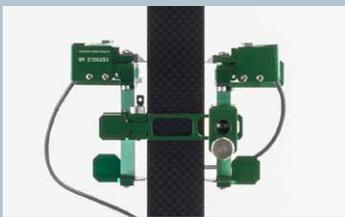
Due to its compact size, the 3442AVG is not compatible with transverse extensometers. To measure Poisson's ratio, the Model 3442AVG may be used in combination with a transverse adhesively bonded strain gage, or other extensometers may be used such as Model 3560-BIA or Model 3542 in combination with Model 3575.

Model 3442AVG extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller, and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of solutions for signal conditioning and connection to data acquisition systems or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



*Model 3442AVG extensometer
3442-050M-025M-ST*



Model 3442AVG extensometer

 See the Model 3442AVG extensometer videos

Features

- May be left on through specimen failure with most materials.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Simple clip-on mounting with automatic gauge length setting.
- Smaller than other averaging extensometers - fits in narrow spaces.
- Measures average strain in both tension and compression, and can be used for cyclic testing.
- Measures opposite sides of the specimen to average out misalignment.
- When configured with separate strain outputs, can be used to calculate average strain and % bending.
- Knife edge mounting allows mounting on round or flat specimens - much easier to mount than designs using conical points, especially on thin flat specimens and round specimens.
- All models have mechanical overtravel stops in both directions. Hardened tool steel knife edges are easily replaced. A spare set comes with every extensometer.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance. Much stronger than single flexure designs, this also allows cyclic testing at higher frequencies.
- Includes high quality foam lined case and spare set of tool steel knife edges.

SPECIFICATIONS

- Excitation:** 5 to 10 VDC recommended, 12 VDC or VAC max.
- Output:** 2 to 4 mV/V nominal, depending on model
- Accuracy:** Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.
- Linearity:** $\leq 0.15\%$ of full scale measuring range, depending on model
- Temperature Range:** Standard (-ST) is $-40\text{ }^{\circ}\text{C}$ to $+100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
Optional (-LHT) is $-270\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)
- Cable:** Integral, ultra-flexible cable, 2.5 m (8 ft) standard
- Specimen Size:** Works with samples 0.25 to 25 mm (0.01 to 1.0 inch) width or diameter
- Operating Force:** 30 to 50 g typical
- Cyclic Testing:** 50 to 100 Hz typical

OPTIONS

- One averaged output or two separate left/right outputs
- Connectors to interface to nearly any brand of test equipment
- Expanded temperature ranges from $-270\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $+400\text{ }^{\circ}\text{F}$)



ORDERING INFORMATION

Model 3442AVG Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available. Specify one or two outputs when ordering. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

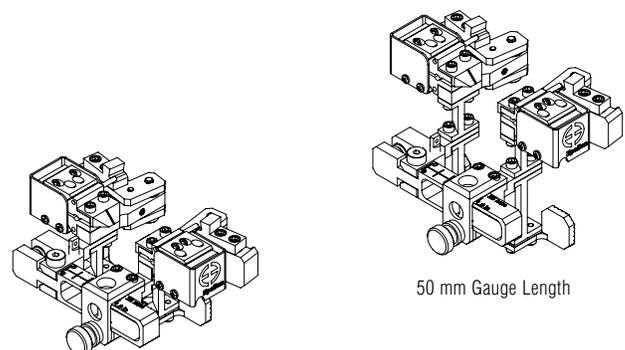
Gauge Length		Measuring Range	
METRIC		METRIC	
-010M	10.0 mm	-005M	± 0.50 mm
-0125M	12.5 mm	-010M	± 1.00 mm
-025M	25.0 mm	-025M	$+2.50$ mm/ -1.00 mm
-050M	50.0 mm		
U.S.A.		U.S.A.	
-0050	0.500"	-002T	± 0.020 "
-0100	1.000"	-005T	± 0.050 "
-0200	2.000"	-010T	$+0.100$ "/ -0.050 "

Model Number 3442AVG - _____

Temperature Range	
-LT	$-270\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
-ST	$-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
-HT1	$-40\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $300\text{ }^{\circ}\text{F}$)
-HT2	$-40\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)
-LHT	$-270\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)

Example: 3442AVG-050M-025M-HT2: 50 mm gauge length, +2.5 mm measuring range, high temperature option ($-40\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$)

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25 mm Gauge Length

50 mm Gauge Length

MODEL 3442AVG EXAMPLES

A single integral unit provides simultaneous, averaged lateral (transverse) strain and averaged axial strain measurement for determining modulus and Poisson's ratio.



Model 3560-BIA with 25 mm gauge length

The model 3560-BIA extensometer is ideally suited for routinely measuring modulus and Poisson's ratio of advanced composites and other anisotropic materials. Transverse strain is averaged and provided as a single output. Axial strain is averaged and provided as a single output in the standard configuration. Model 3560-BIA is also available in an optional configuration that has

separate outputs for the axial strain channels, which enables measurement of specimen bending with the testing machine's software.

Standard configuration – two outputs:

- Average axial strain (electrically averaged)
- Average transverse strain (mechanically averaged)

Optional configuration – three outputs:

- Left axial strain (for averaging using the testing machine's software)
- Right axial strain (for averaging using the testing machine's software)
- Average transverse strain (mechanically averaged)

The Model 3560-BIA uses a design unique to Epsilon, where the knife edges remain parallel during the displacement. This approach greatly reduces crosstalk between axes and allows use on round or flat specimens with equal ease. These extensometers are very easy to mount. Integral springs hold the unit on the test sample. The parallel multiple flexure design makes these units very durable.

The Model 3560-BIA extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller with electronics for a strain channel, and Epsilon will equip the extensometer with compatible connectors that are wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of signal conditioning solutions that enable connecting to data acquisition systems or other equipment. The standard model 3560-BIA configuration requires two strain channels in the testing machine. The optional configuration requires three strain channels in the testing machine.

For customers who only need to measure modulus and do not need to measure Poisson's ratio, Epsilon recommends the smaller, lighter, fatigue test rated model 3442AVG.

See the electronics section of this catalog for available signal conditioners and strain meters.

Features

- May be left on through failure with composites that fail progressively (non-explosive) and low-elongation materials.
- Multiple sets of dual flexures and mechanical stops allow testing through failure and provide a rugged unit.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Knife edge mounting and parallel displacement allows mounting on round or flat specimens. Much easier to mount than designs using conical points (especially on thin flat specimens and round ones).
- Self-supporting on the specimen.
- High accuracy and minimal crosstalk between channels.
- Includes high quality foam lined case and spare set of tool steel knife edges.

SPECIFICATIONS

- Excitation:** 5 to 10 VDC recommended, 12 VDC or VAC max.
Output: 2 to 4 mV/V, depending on model
Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy in the axial direction. A test certificate is included. All standard units have linearity of 0.15% full scale measuring range or better in the transverse direction.
Linearity: $\leq 0.15\%$ of full scale measuring range, depending on model
Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
 Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)
Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard
Specimen Size: Works with samples 2.5 to 25 mm (0.1 to 1 inch) width or up to 15 mm (0.6 inch) diameter
Operating Force: 30 to 50 g typical
Crosstalk: Less than 0.5%

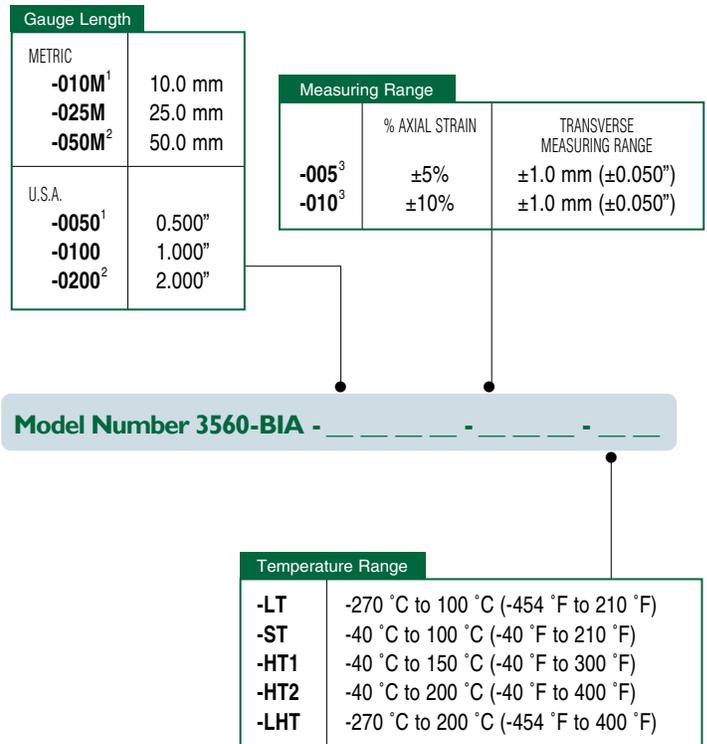
OPTIONS

- Connectors to interface to nearly any brand of test equipment
- Two outputs or three outputs - specify when ordering
- Adapters to fit larger specimens
- Specialty knife edges (see page 106)



ORDERING INFORMATION

Model 3560-BIA Available Versions: ANY combination of gauge length, measuring range and temperature range listed below is available.



¹ 10 mm and 0.5 inch gauge lengths are only available in 10% axial measuring ranges.

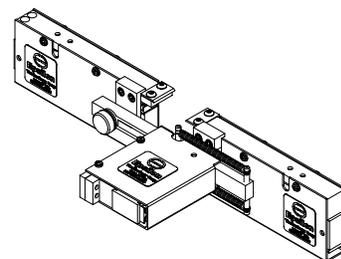
² 50 mm and 2.0 inch gauge lengths are only available in 5% axial measuring ranges.

³ If the gauge length is ordered in mm units, then the transverse measuring range will be in mm. If the gauge length is ordered in inch units, then the transverse measuring range will be in inches.

Note: model 3560-AVG has been replaced by the smaller, fatigue test rated model 3442AVG.

Example: 3560-BIA-050M-010-HT2: 50.0 mm gauge length, ±10% axial strain measuring range/±1.0 mm transverse measuring range, HT2 option (-40 °C to 200 °C)

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 Contact us for your special testing requirements.



MODEL 3560-BIA EXAMPLE

Designed for simultaneously measuring axial and torsional deflections on specimens tested in axial/torsional machines.



Model 3550 axial/torsional extensometer with a 25 mm gauge length, $\pm 10\%$ axial measuring range, and $\pm 2^\circ$ torsional shear strain angle measuring range (this corresponds to a 4° angle of twist on a 12.5 mm diameter specimen)

The Model 3550 extensometer is most often used on round specimens tested in bi-axial test machines capable of simultaneous axial and torsional loading. The extensometer is often customized for particular applications. All units are capable of bi-directional displacement, so they may be used for cyclic testing under fully reversed loading conditions. The standard sized model is self-supporting on the specimen, and works on specimens from 9.5 to 25.4 mm (0.375 to 1.000 inches). The conical point contacts included with the extensometer are made from tungsten carbide. Their unique design directly measures the surface shear strain angle, which allows operation on a wide range of specimen diameters without changing calibration.

All models are designed specifically to minimize crosstalk between axes and to provide high accuracy measurements. All feature the dual flexure design common to other Epsilon extensometers.

Available options cover temperature ranges from -270°C to 200°C (the standard temperature range is -40°C to 100°C). Both inch and metric versions are available. A wide range of gauge length and measuring ranges are available. Because these transducers are often used for specialized tests, contact Epsilon with your specific test needs.

The Model 3550 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



*Model 3550 extensometer (angled view)
3550-025M-010-002-ST*



*Model 3550 extensometer (back view)
3550-025M-010-002-ST*

 See the Model 3550 extensometer setup video

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Self-supporting on the specimen.
- Cyclic testing may be performed at up to 2 Hz.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for strength and improved performance - much stronger than single flexure designs.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V, nominal, depending on model

Accuracy: Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy in the axial direction. A test certificate is included. All standard configurations have linearity of 0.20% full scale measuring range or better in torsion.

Linearity: Axial: $\leq 0.15\%$ of full scale measuring range, typical
Torsional: $\leq 0.20\%$ of full scale measuring range, typical

Temperature Range: Standard (-ST) is $-40\text{ }^{\circ}\text{C}$ to $+100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
Optional (-LHT) is $-270\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Operating Force: $< 30\text{ g}$ typical

Crosstalk: Less than 0.5%

OPTIONS

Connectors to interface to nearly any brand of test equipment
Model 3590AT axial/torsional calibrator (see page 120)



Visit our website at www.epsilontech.com
Contact us for your special testing requirements.

Epsilon's axial/torsional extensometer was designed to directly measure the shear strain, γ shown in the figure. This design allows the correct determination of the shear strain without having to know the radius of the specimen being tested, R_1 .

The shear strain is related to the angle of twist (a commonly referenced parameter in torsion testing), ϕ , by the following relationship:

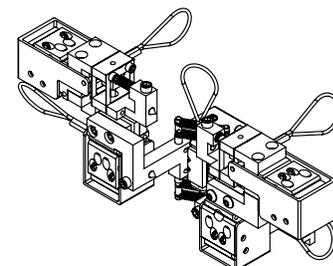
$$\gamma = R_1 \frac{d\phi}{dL_1}$$

For extensometers that measure ϕ directly instead of γ , corrections need to be made for every different specimen diameter tested and for axial strain to correctly determine the shear strain.

The example to the left shows the variation of the angle of twist versus a change in specimen diameter relative to the constant resulting shear strain.

Model Number	Axial Gauge Length	Axial Strain	Torsional Shear Strain Angle
3550-025M-005-002-ST	25 mm	$\pm 5\%$	$\pm 2^{\circ}$
3550-025M-005-003-ST	25 mm	$\pm 5\%$	$\pm 3^{\circ}$
3550-025M-010-002-ST	25 mm	$\pm 10\%$	$\pm 2^{\circ}$
3550-0100-010-002-ST	1 inch	$\pm 10\%$	$\pm 2^{\circ}$

-ST temperature range is $-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$), but -HT1, -HT2, -LT, and -LHT options are also available. This unit is built to order; contact Epsilon for a unit specific to your testing requirements.



MODEL 3550 EXAMPLE



Simultaneously measures axial and torsional strains at high temperatures on specimens tested in axial/torsional machines. For use with materials testing furnaces or induction heating up to 1600 °C (2900 °F). May be used for bi-axial, strain-controlled fatigue. Slide mounting system enables mounting to hot specimens in seconds.



Model 7650 axial/torsional extensometer

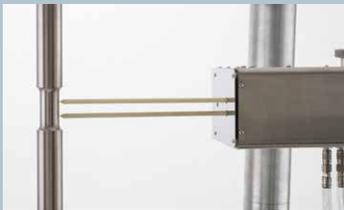
Model 7650 extensometers are primarily used on round specimens tested in bi-axial test machines capable of simultaneous axial and torsional loading. All models are capable of bi-directional displacement in both axes and may be used for strain-controlled fatigue testing under fully reversed load and strain conditions at frequencies up to 10 Hz.

All 7650 models mount rigidly on the load frame and incorporate slide mounting to bring the extensometer into contact with the specimen. The gauge length is set automatically before mounting on the test specimen, which allows for hot mounting after thermal equilibrium has been reached.

These units are specifically designed to minimize crosstalk between axes and to provide high accuracy, high resolution measurements. They incorporate capacitive sensors for low operating force and include electronics with programmable filtering and multi-point linearization for improved performance and accuracy. The overall design minimizes, and in many cases virtually eliminates, any influence from common lab environment vibrations.

These liquid-cooled extensometers are equipped with high purity alumina rods with conical rod tips for specimen contact when testing to 1200 °C (2200 °F). Silicon carbide rods are used for the 1600 °C (2900 °F) high temperature option.

The Model 7650 is often customized for specific test needs. Contact Epsilon for a configuration that matches your requirement.



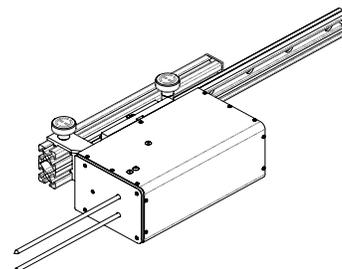
Model 7650 extensometer with 12.5 mm gauge length



Model 7650 extensometer with Model DT6229 two-channel signal conditioner



Model 7650 bi-axial extensometer 7650-0125M-025M-040-ST



MODEL 7650 EXAMPLE

Features

- Hot mountable and retractable.
- Self-setting gauge length with fine adjustment feature.
- All models can measure in both tension and compression and may be used for cyclic testing at test frequencies up to 10 Hz.
- Ships fully calibrated with calibration that is traceable to NPL; voltage output may be user-specified (typically 0-10V).
- Excellent ambient vibration rejection; primary vibration mode >100 Hz typical
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
- Includes high speed analog and digital outputs.
- Web-based user interface for setup and data acquisition.
- Selectable analog and digital filter options from 2 Hz to 3 kHz.
- Built-in calibration reference and auto-zero features.
- Multiple extensometer calibration files may be loaded for use with one controller.
- Can be used with specimens at elevated temperatures while only requiring room temperature calibration.
- Quick-disconnect liquid cooling fittings and signal cables.
- Includes high quality foam lined case and a spare set of rods.

SPECIFICATIONS

Analog Output:	User specified, ±10VDC typical, ±10.8VDC rail
Digital Output:	24 bit high speed Ethernet output with built-in web interface
Accuracy:	Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy (axial). A test certificate is included. All standard units have linearity of 0.10% full scale measuring range or better in the torsional channel.
Linearity:	11 point digital linearization, ≤0.2% FS typical linearity
Hysteresis:	≤0.2% FS typical
Resolution:	<75 PPM (0.0075%FS) RMS @ 4 kHz, < 6PPM (0.0006%FS) @ 100 Hz at gauge length
Filter:	Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters
Specimen Size Range:	Fits most round specimens; diameter ≥10 mm recommended
Cyclic Testing:	Up to 10 Hz, depending on test system and test amplitude
Test Frame Layout:	Accommodates test frames with torsional actuator located above or below specimen
Temperature Range:	Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
Environment:	Recommended for testing in dry air, inert / non-corrosive gases, or vacuum
Operating Force:	<30 grams typical
Contact Force:	<560 grams typical
Sensor Cables:	2 m (6.5 ft) room temperature cables
Output Cables:	Flexible 2.4 m (8 ft) analog output cables
Coolant Interface:	Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
Specimen Size:	Fits most round specimen diameters
Power:	Includes power supply

OPTIONS

- High temperature option (-HT suffix) for use to 1600 °C
- Load frame mounting brackets
- Bulkhead adapters for use in vacuum chambers
- Model 3590AT axial/torsional calibrator (see page 120)
- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
- Connectors to interface to nearly any brand of test equipment

Epsilon's axial/torsional extensometer was designed to directly measure the shear strain, γ shown in the figure. This design allows the correct determination of the shear strain without having to know the radius of the specimen being tested, R_1 .

The shear strain is related to the angle of twist (a commonly referenced parameter in torsion testing), ϕ , by the following relationship:

$$\gamma = R_1 \frac{d\phi}{dL_1}$$

For extensometers that measure ϕ directly instead of γ , corrections need to be made for every different specimen diameter tested and for axial strain to correctly determine the shear strain.

The example to the left shows the variation of the angle of twist versus a change in specimen diameter relative to the constant resulting shear strain.

Model Number	Axial Gauge Length	Axial Strain	Torsional Shear Strain Angle
7650-0125M-025M-040-xx	12.5 mm	+2.5 mm/-0.5 mm	±4.0°
7650-0125M-015M-040-xx	12.5 mm	+1.5 mm/-1.5 mm	±4.0°
7650-025M-025M-020-xx	25.0 mm	+2.5 mm/-0.5 mm	±2.0°
7650-025M-015M-020-xx	25.0 mm	+1.5 mm/-1.5 mm	±2.0°

Temperature Range ("xx" above):
 Room temperature to 1200 °C (2200 °F) -ST
 Room temperature to 1600 °C (2900 °F) -HT

Ceramic rod lengths are made to fit furnaces as required. Specify specimen diameter, load frame configuration, furnace dimensions, and electrical outlet type at time of ordering.

Requires external mounting brackets and 110 - 240VAC / 15W electrical power. Liquid cooling is recommended; required for 800 °C and above.



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 Contact us for your special testing requirements.

Simultaneously measures in-plane bi-axial strains at high temperatures on specimens tested in X-Y bi-axial machines. For use with materials testing furnaces or induction heating up to 1600 °C (2900 °F). May be used for bi-axial strain controlled fatigue. Slide mounting system enables mounting to hot specimens in seconds.



Model 7651 planar biaxial extensometer with tension-tension specimen

Model 7651 extensometers measure combined in-plane strains in flat cruciform specimens tested in machines capable of simultaneous X and Y (perpendicular) axial loading and on standard flat samples tested in pure tension. All models are capable of bi-directional displacement in both axes and may be used for strain-controlled fatigue testing under fully reversed load and strain conditions at frequencies up to 10 Hz.

All 7651 models mount rigidly on the load frame and incorporate slide mounting to bring the extensometer into contact with the specimen. The gauge length is set automatically before mounting on the test specimen, which allows for hot mounting after thermal equilibrium has been reached.

These units are specifically designed to eliminate crosstalk between axes and to provide high accuracy, high resolution measurements. They incorporate capacitive sensors for low operating force and include electronics with programmable filtering and multi-point linearization for improved performance and accuracy. The overall design minimizes, and in many cases virtually eliminates, any influence from common lab environment vibrations.

These liquid-cooled extensometers are equipped with high purity alumina rods with conical rod tips for specimen contact when testing to 1200 °C (2200 °F). Silicon carbide rods are used for the 1600 °C (2900 °F) high temperature option.

The Model 7651 is often customized for specific test needs. *Contact Epsilon for a configuration that matches your requirement.*



Model 7651 extensometer with 12.5 mm X and Y gauge lengths



Model 7651 extensometer with two-channel Model DT6229 signal conditioner



Model 7651 extensometer ceramic arms with conical tips

Features

- Hot mountable and retractable.
- Self-setting gauge length with fine adjustment feature.
- All models can measure in both tension and compression and may be used for cyclic testing at test frequencies up to 10 Hz.
- Ships fully calibrated with calibration that is traceable to NPL; voltage output may be user-specified (typically 0-10V).
- Excellent ambient vibration rejection; primary vibration mode >100 Hz typical
- Digital controller and power supply included. Provides high level DC voltage output with low noise. Easily interfaced to test controllers, data acquisition boards and chart recorders.
- Includes high speed analog and digital outputs.
- Web-based user interface for setup and data acquisition.
- Selectable analog and digital filter options from 2 Hz to 3 kHz.
- Built-in calibration reference and auto-zero features.
- Multiple extensometer calibration files may be loaded for use with one controller.
- Can be used with specimens at elevated temperatures while only requiring room temperature calibration.
- Quick-disconnect water cooling fittings and signal cables.
- Includes high quality foam lined case and a spare set of rods.

SPECIFICATIONS

- Analog Output:** User specified, ± 10 VDC typical, ± 10.8 VDC rail
- Digital Output:** 24 bit high speed Ethernet output with built-in web interface
- Cyclic Testing:** Up to 10 Hz, depending on test system and test amplitude
- Accuracy:** Standard configurations meet ASTM E83 class B-1 and ISO 9513 class 0,5 requirements for accuracy. A test certificate is included.
- Linearity:** 11 point digital linearization, $\leq 0.1\%$ FS typical linearity
- Hysteresis:** $\leq 0.1\%$ FS typical
- Crosstalk:** none
- Resolution:** <75 PPM (0.0075%FS) RMS @ 4 kHz, <6PPM (0.0006%FS) @ 100 Hz at gauge length
- Filter:** Selectable 100 Hz analog and 2 Hz - 3 kHz digital filters
- Temperature Range:** Standard (-ST) is to 1200 °C (2200 °F), optional (-HT) 1600 °C (2900 °F)
- Sensor Cables:** 2 m (6.5 ft) room temperature cables
- Output Cables:** Flexible 2.4 m (8 ft) analog output cables
- Coolant Interface:** Two barbed hose fittings for 1/8" (3.2 mm) ID coolant hoses
- Specimen Size:** Fits any flat cruciform or axial-only test specimen with a test area larger than the extensometer GL
- Operating Force:** <30 grams typical
- Contact Force:** <560 grams typical
- Environment:** Recommended for testing in dry air, inert / non-corrosive gases, or vacuum
- Power:** Includes power supply

OPTIONS

- High temperature option (-HT suffix) for use to 1600 °C
- Load frame mounting brackets
- Bulkhead adapters for use in vacuum chambers
- Model EPS170 constant-temperature recirculating chiller - see the Options tab on the web page for important details about liquid cooling requirements
- Connectors to interface to nearly any brand of test equipment

ORDERING INFORMATION

Ceramic rod lengths are made to fit furnaces as required. Specify load frame configuration, loading axis orientation, furnace dimensions, and electrical outlet type at time of ordering.

Requires external mounting brackets and 110 - 240VAC / 4W electrical power.

Liquid cooling is recommended; required for 800 °C and above.

Other configurations are available with special order; please contact Epsilon to discuss your requirements.

Gauge Length (X & Y) ¹		Measuring Range (X & Y) ¹	
METRIC		METRIC	
-0125M	12.5 mm	-015M	+1.5 mm / -1.5 mm
-025M	25.0 mm	-020M	+2.0 mm / -1.0 mm
		-025M	+2.5 mm / -0.5 mm
U.S.A.		U.S.A.	
-0050	0.500"	-060T	+0.060" / -0.060"
-0100	1.000"	-080T	+0.080" / -0.040"
		-100T	+0.100" / -0.020"

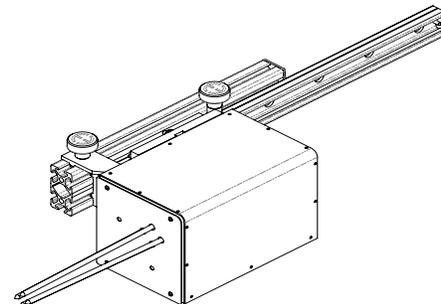
Model Number 765I- _____ - _____ - _____

Temperature Range	
-ST	Room temperature to 1200 °C (2200 °F)
-HT	Room temperature to 1600 °C (2900 °F)

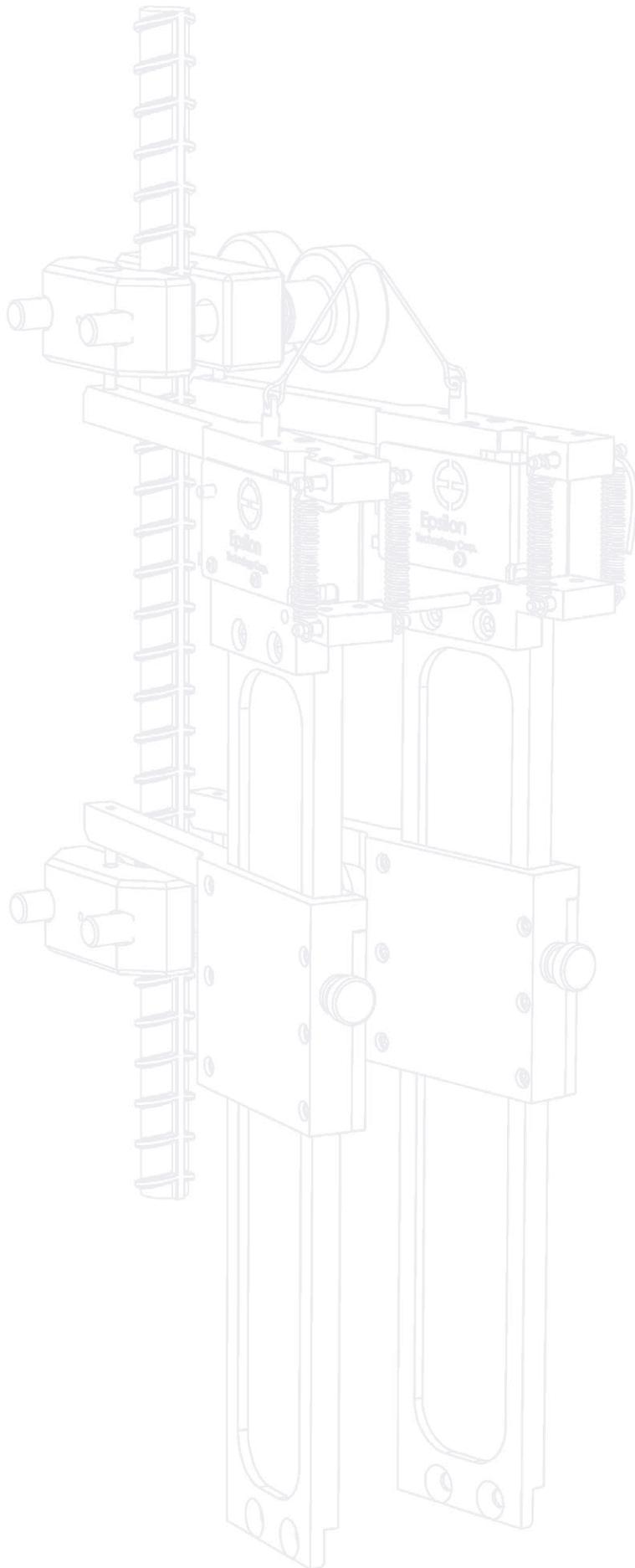
¹ Consult factory for applications requiring different X and Y gauge lengths or measuring ranges.

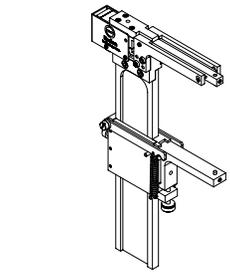
Example: 7651-025M-020M-ST: 25 mm gauge length, +2.0 / -1.0 mm measuring range, standard temperature range (room temperature to 1200 °C)

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Contact us for your special testing requirements.

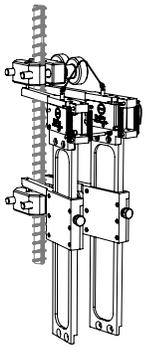


MODEL 7651 EXAMPLE

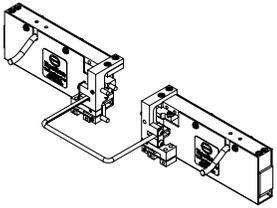




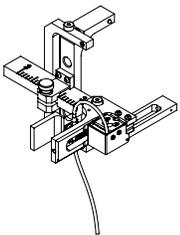
3565 Bolt Extensometers for Proof Load Testing



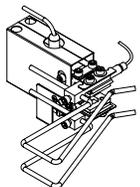
3567 Extensometers for Testing Rebar Couplers, Splices, and Sleeves



4013 Averaging Extensometers for ASTM D5656 Shear Tests



3421 Sandwich Core Shear and Rigid Cellular Plastic Shear Testing Extensometers

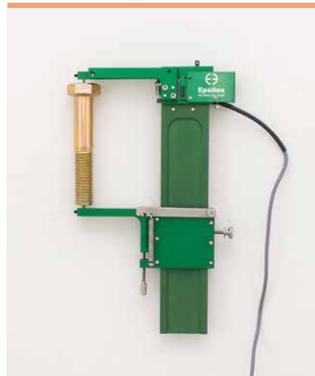


4030 Submersible Extensometers

Bolt Proof, Lap Shear and Specialty Extensometers



Designed for measuring small measuring strain ranges as required for proof load testing of bolts and similar applications such as yield measurement.



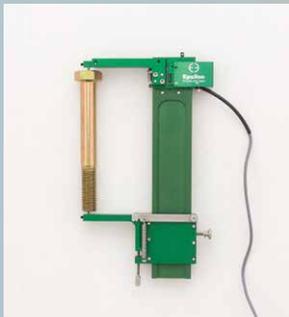
Model 3565 extensometer for bolt proof load testing

The Model 3565 uses hard conical points to contact the bolt at the center of the head and at the bottom. It is fully adjustable for different length bolts ranging from 25 mm (1 inch) in length to 150 mm (6 inches) standard. Extension beams are available for longer bolts. The standard maximum measuring range is 1.25 mm (0.05 inches). Generally, on longer bolts this extensometer will be self-supported without requiring any centering marks or punch marks on the bolt. For shorter bolts these marks may be required. If the conical pins are sharp, marks are often not needed even on the shortest bolts.

The extensometer has a zero adjustment screw to adjust the length between the contact pins. This is used to set the output voltage to zero, which corresponds to the correct starting position for the test. It also includes a breakaway lower arm. In the event a bolt should fail, the breakaway arm snaps free, helping to prevent damage to the extensometer. This is easily re-installed. In the event that bolt failures are likely during a test, it is recommended the user attach a cord around the upper part of the beam and tie the other end to the test frame to prevent the extensometer from falling. The conical point contacts included with the extensometer are made from tungsten carbide.

The Model 3565 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Gauge length may be set to any length by sliding, locking, and fine-adjusting the lower arm



Gauge length adapters may be added for longer fasteners.



Mechanical overtravel protection for the upper arm and a break-away lower arm protect the extensometer if the bolt fails

Features

- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- All standard units have linearity readings of 0.20% or better.
- Breakaway arm to help prevent extensometer damage in the event of bolt failure.
- Self-supporting on the bolt specimen typically without the need for centering or punch marks.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V, nominal, depending on model

Linearity: ≤0.20% of full scale measuring range, depending on model

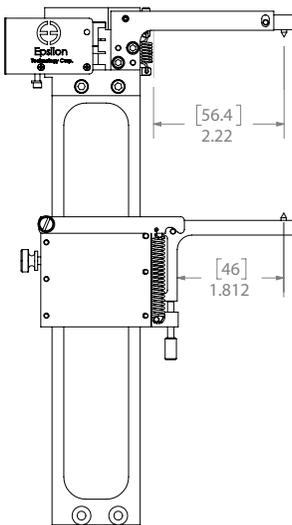
Temperature Range: Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
Optional (-LHT) is -270 °C to +200 °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

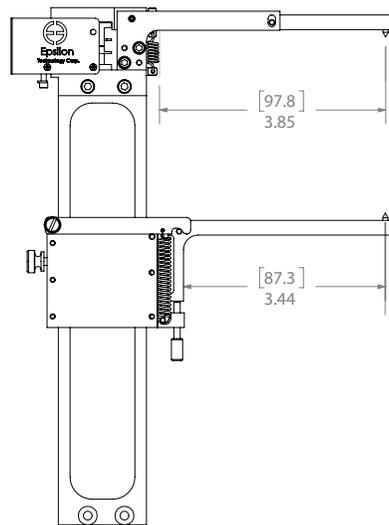
Throat Depth: Model 3565: up to 56.4 mm (2.22 inches)
Model 3565E: up to 97.8 mm (3.85 inches)

OPTIONS

Connectors to interface to nearly any brand of test equipment
Gauge length extension adapters



Model 3565



Model 3565E

ORDERING INFORMATION

Model 3475 Available Versions: ANY combination of measuring range and temperature range listed below is available. *Other configurations may be available with special order; please contact Epsilon to discuss your requirements.*

Measuring Range	
METRIC -125M	+1.25 mm
U.S.A. -050T	+0.050"

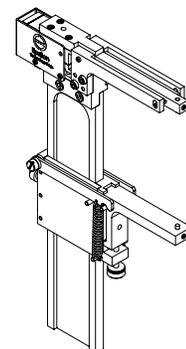
Model Number 3565- _____ - _____
Model Number 3565E- _____ - _____

*Model 3565: throat depth up to 56.4 mm (2.22 inches)
Model 3565E: throat depth up to 97.8 mm (3.85 inches)*

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

Example: 3565-125M-HT2: +1.25 mm measuring range, high temperature option (-40 °C to 200 °C)

Visit our website at www.epsilontech.com
Contact us for your special testing requirements.



MODEL 3565 EXAMPLE

Extensometers for measuring elongation of rebar coupler, splice, and sleeve assemblies. Use for tension, cyclic, slip, and differential elongation tests.



Model 3567 specimen attachment collar with extensometer installed

The Model 3567 extensometer may be used for ASTM A1034 testing to measure strain and elongation during tension testing of rebar splice assemblies consisting of rebar and rebar couplers, coupling sleeves and splices. The extensometer measures strain through yield and may be used for tension, cyclic, slip, and differential elongation tests.

The extensometer may be left on through failure of splice assemblies when failure occurs at the splice. It is designed to automatically release from the rebar splice assembly when the extensometer reaches full scale extension at 12.5 mm (0.5 inches), typically after specimen yield. The extensometer is suspended by a tether for fall protection after it is released from the specimen. The upper arm incorporates mechanical stops that protect the extensometer from over travel.

The Model 3567 is not rated for measuring un-spliced rebar through failure. Use Models 3543 or Epsilon ONE when testing un-spliced rebar.

The unit is self-supporting and mounts to the rebar using attachment collars above and below the coupler. The collars simply clamp on without any need for rebar surface preparation. Collars are available to work with all common rebar and coupling / splice sizes, including 6 – 60 mm (#2 – #18J) diameter rebar. Extensometer gauge length may be adjusted to any value from 95 – 675 mm (3.74 – 26.6 inches) with the standard model, and optionally up to 975 mm (38.4 inches).

The Model 3567 consists of two simultaneous, separate measurements which are averaged to measure axial elongation. A configuration that uses three separate measurements for improved test accuracy is optional.

Model 3567 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller and Epsilon will equip the extensometer with compatible connectors that are wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of solutions for signal conditioning and connection to data acquisition systems or other equipment.



Option for average of three measurements (rebar coupler not shown)



Model 3567 with mounting collars (rebar coupler not shown)

Features

- **Specifically designed to be left on through specimen failure** – extensometer automatically releases from the rebar splice assembly upon reaching the full scale of the extensometer.
- One system may be used for all common rebar coupling / splice sizes, including 6-60 mm (#2-#18J) diameter rebar.
- Replaces homemade clip gages and LVDTs with a reliable, repeatable solution.
- Durable system includes these features:
 - A tether suspends the extensometer after automatic release and provides fall protection
 - The extensometer's upper arm has integral stops to protect it from over travel
- Exceeds ASTM A1034 requirements for extensometer accuracy; meets ASTM class B-1 and ISO 9513 class 0,5 accuracy requirements.
- Averages two or three measurements for accurate and repeatable measurements.
- Extension bars enable gauge lengths up to 975 mm (38.4 inches).
- Replaceable components for ease of repair.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Includes high quality foam lined case.

SPECIFICATIONS

<i>Excitation:</i>	5 to 10 VDC recommended, 12 VDC or VAC max.
<i>Output:</i>	2 to 4 mV/V
<i>Linearity:</i>	≤0.15% of full scale measuring range
<i>Temperature Range:</i>	Standard (-ST) is -40 °C to +100 °C (-40 °F to 210 °F)
<i>Cable:</i>	Integral, ultra-flexible cable, 2.5 m (8 ft) standard
<i>Specimen Size:</i>	Rebar diameter 8 – 36 mm (#3 – #11) standard, 6 – 60 mm (#2 – #18J) optional; coupler diameter up to 102 mm (4.0 inches)
<i>Gauge Length:</i>	95 – 675 mm (3.74 – 26.6 inches) standard, up to 975 mm (38.4 inches) optional

OPTIONS

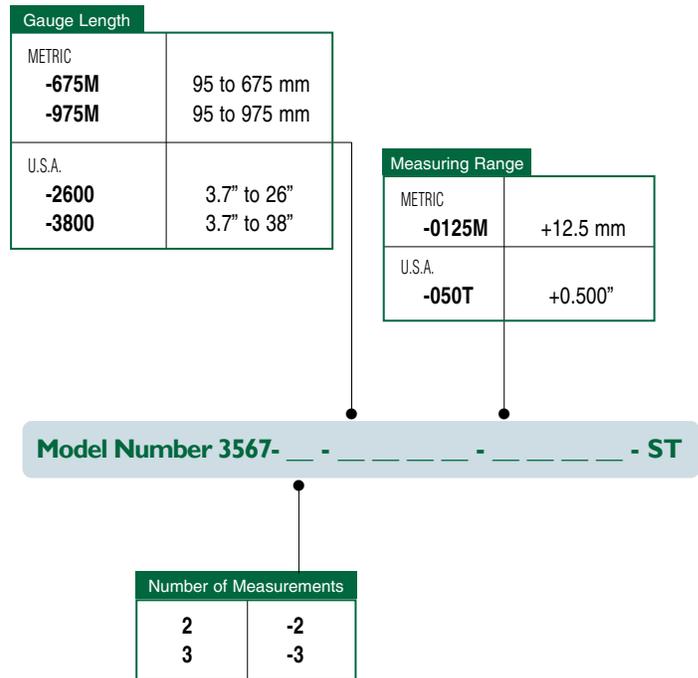
- Gauge length adapters may be added for gauge lengths over 675 mm (26.6 inches) to extend the maximum gauge length to 975 mm (38.4 inches)
- Collars for 6 – 14 mm (#2 - #4) and 32 – 60 mm (#10 - #18J) diameter rebar are optional; collars for 8 – 36 mm (#3 – #11) diameter rebar are included standard
- Average of two or three separate measurements
- Average output at a single connector, or separate outputs and connectors for each measurement to enable subsequent averaging
- Connectors to interface to nearly any brand of test equipment



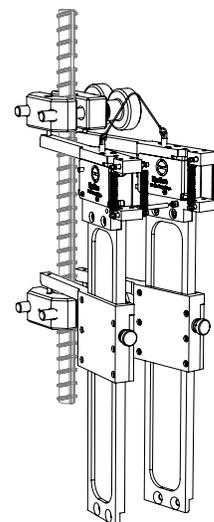
ORDERING INFORMATION

Specify your required range of rebar diameters, range of extensometer gauge lengths, number of measurements (two or three), output at a single connector or multiple connectors, and connector type at time of ordering.

Model 3567 Available Versions: ANY combination of gauge length, measuring range and temperature range listed is available, except as noted. Other configurations may be available with special order; please contact Epsilon to discuss your requirements.



Example: 3567-3-675M-0125M-ST: 3 measurements, 95 - 675 mm gauge length, +12.5 mm measuring range, standard temperature range (-40 °C to 100 °C)



MODEL 3567 EXAMPLE

Designed specifically for performing tests in accordance with ASTM D5656, Standard Test Method for Thick-Adherend Metal Lap-Shear Joints for Determination of the Stress-Strain Behavior of Adhesives in Shear by Tension Loading. The deformation is measured on opposite sides of the test specimen and the output is an average of the two readings.



Model 4013 lap shear extensometer

The Model 4013 extensometer meets the requirements of ASTM D5656 for measuring the strain properties of an adhesive in shear. It uses different contact point spacing compared to the extensometer shown in D5656. This makes it much easier to mount and eliminates the slippage problems associated with the design shown in the ASTM standard. The Model 4013 is available with all of Epsilon's temperature configurations. It has a 3.0 mm (0.12 inches) full scale measuring range. The conical point contacts included with the extensometer are made from tungsten carbide.

The Model 4013 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller. The signal conditioning electronics for the extensometer is typically included with the test machine controller or may often be added. In this case the extensometer is shipped with the proper connector and wiring to plug directly into the electronics. For systems lacking the required electronics, Epsilon can provide a variety of solutions, allowing the extensometer output to be connected to data acquisition boards, chart recorders or other equipment.

See the electronics section of this catalog for available signal conditioners and strain meters.



Side view of the Model 4013 lap shear extensometer with zero pins removed



Close-up of the 3 conical contact points used by the Model 4013 extensometer

Features

- High accuracy - strain is measured on opposite sides of the specimen and output as an average (single connector), or optionally as two independent readings (two connectors).
- Meets the requirements of ASTM D5656.
- Easy mounting, attaches with an integral spring.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Rugged, dual flexure design for improved performance.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V nominal, depending on model

Linearity: $\leq 0.20\%$ of full scale measuring range, depending on model

Temperature Range: Standard (-ST) is $-40\text{ }^{\circ}\text{C}$ to $+100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
Optional (-LHT) is $-270\text{ }^{\circ}\text{C}$ to $+200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

OPTIONS

Option for independent left and right measurement outputs (two connectors - requires two strain channels)

Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Model 4013 Available Versions: ANY combination of measuring range and temperature range listed below is available, except as noted.

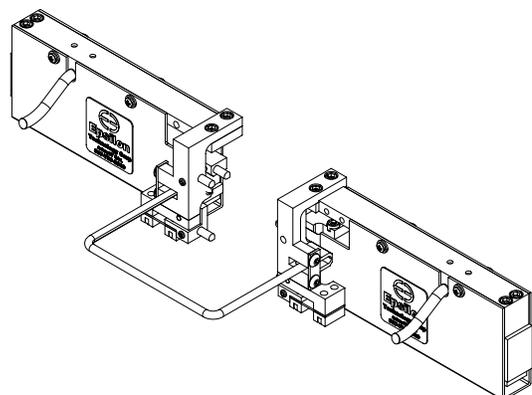
Measuring Range	
METRIC	
-005M	0.5 mm
-010M	1.0 mm
-030M	3.0 mm
U.S.A.	
-025T	0.025"
-050T	0.050"
-125T	0.125"

Model Number 4013- _____ - _____

Temperature Range	
-LT	$-270\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
-ST	$-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $210\text{ }^{\circ}\text{F}$)
-HT1	$-40\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $300\text{ }^{\circ}\text{F}$)
-HT2	$-40\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)
-LHT	$-270\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$ ($-454\text{ }^{\circ}\text{F}$ to $400\text{ }^{\circ}\text{F}$)

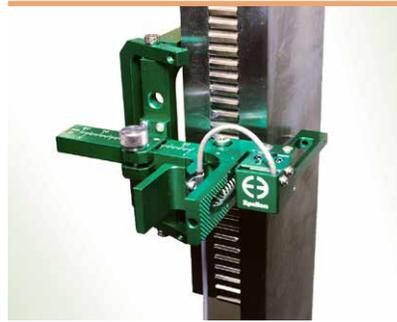
Example: 4013-005M-ST: 0.5 mm measuring range, standard temperature range ($-40\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$)

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MODEL 4013 EXAMPLE

For measuring shear properties of sandwich cores and rigid cellular plastics. The simple clip-on design attaches in seconds and provides repeatable test results.



Model 3421 shear testing extensometer

Model 3421 extensometers measure shear strain of foam and honeycomb sandwich cores, as well as rigid cellular plastics. These extensometers can be used to measure shear modulus, 2% offset shear strength, and stress-strain curves prior to specimen failure. The extensometer may be used to measure strain through specimen failure with

specimen fixturing to limit out-of-plane expansion. The Model 3421 may also be used for sandwich core shear fatigue testing.

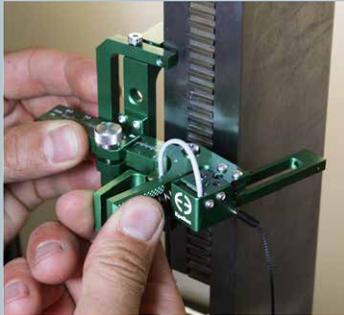
The Model 3421 is applicable for testing to the following standards:

- **ASTM C273** Shear Properties of Sandwich Core Materials
- **ASTM C394** Shear Fatigue of Sandwich Core Materials
- **ISO 1922** Rigid cellular plastics -- Determination of shear strength
- **DIN 53294** Testing of sandwiches; shear test
- **EN 12090** Determination of Shear Behavior of Thermal Insulation Products (single specimen test only)

The extensometer mounts to the test specimen's loading plates. It attaches to the specimen in seconds and can be used with tension or compression test fixture loading. The extensometer is adjustable to work with a range of specimen thicknesses and widths, and includes a built-in scale for setting it to the specimen width.

To use the extensometer, the test operator clips it onto the specimen by squeezing two pads, placing the extensometer against the side of the specimen, and releasing the pads. The extensometer is self-supporting and no further adjustments are necessary. It is removed before failure by unclipping.

Model 3421 extensometers are strain gaged devices, making them compatible with any electronics designed for strain gaged transducers. Most often they are connected to a test machine controller and Epsilon will equip the extensometer with a compatible connector wired to plug directly into the controller. For systems lacking the required electronics, Epsilon can provide a variety of solutions for signal conditioning and connection to data acquisition systems, chart recorders, or other equipment.



Model 3421 clip-on attachment



Model 3421 zero pin removal



Model 3421 ready for testing



See the Model 3421 extensometer video

Features

- Replaces homemade extension gages and LVDTs with a reliable, repeatable solution.
- Simple clip-on design attaches in seconds.
- May be left on through specimen failure when fixturing is used to constrain thickness expansion of the specimen.
- Meets ASTM C273 requirements for extensometers.
- Includes the Epsilon Shunt Calibration System for on-site electrical calibration.
- Extensometer measuring arm has mechanical overtravel stops for durability.
- Replaceable components for ease of repair.
- Full bridge, 350 ohm strain gaged design for compatibility with nearly any test system.
- Includes high quality foam lined case.

SPECIFICATIONS

Excitation: 5 to 10 VDC recommended, 12 VDC or VAC max.

Output: 2 to 4 mV/V

Accuracy: ± 5.0 mm/ ± 0.200 " measuring ranges:
 ≤ 0.003 mm for displacement values < 0.3 mm
 $\leq 1.0\%$ of reading for displacement values ≥ 0.3 mm
 ± 2.5 mm/ ± 0.100 " measuring ranges:
 ≤ 0.0015 mm for displacement values < 0.3 mm
 $\leq 0.5\%$ of reading for displacement values ≥ 0.3 mm

Temperature Range: Standard (-ST) is -40 °C to $+100$ °C (-40 °F to 210 °F)
 Optional (-LHT) is -270 °C to $+200$ °C (-454 °F to 400 °F)

Cable: Integral, ultra-flexible cable, 2.5 m (8 ft) standard

Specimen Size: Thickness (including core and both loading plates): 20-75 mm (0.8-3.0 inches); width: 40 mm (1.5 inch) minimum, 50-150 mm (2-6 inches) typical

OPTIONS

Connectors to interface to nearly any brand of test equipment



ORDERING INFORMATION

Other configurations may be available with special order; please contact Epsilon to discuss your requirements.

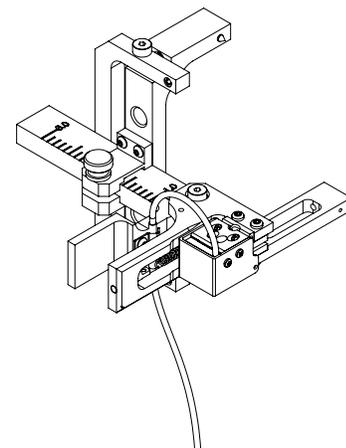
Measuring Range	
METRIC	
-025M	± 2.5 mm
-050M	± 5.0 mm
U.S.A.	
-010T	± 0.100 "
-020T	± 0.200 "

Model Number 3421- _____ - _____

Temperature Range	
-LT	-270 °C to 100 °C (-454 °F to 210 °F)
-ST	-40 °C to 100 °C (-40 °F to 210 °F)
-HT1	-40 °C to 150 °C (-40 °F to 300 °F)
-HT2	-40 °C to 200 °C (-40 °F to 400 °F)
-LHT	-270 °C to 200 °C (-454 °F to 400 °F)

Example: 3421-050M-ST: ± 5.0 mm measuring range, standard temperature range (-40 °C to 100 °C)

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 Contact us for your special testing requirements.



MODEL 3421 EXAMPLE

Due to supply issues this model is presently not available. Contact Epsilon if you have an application that requires a submerged extensometer and you want to be notified by Epsilon when we introduce a submersible extensometer.

Submersible extensometers designed for performing tests in water, saline solutions, and other liquids compatible with the materials of construction.



Model 4030 with 0.5 inch gauge length

The Model 4030 extensometer uses a special LVDT-like sensor to measure strains on samples submerged in water or other compatible liquids. The unit is provided with the signal conditioning electronics. The extensometer is a semi-custom design, which is available in smaller measuring ranges up to 5 mm (0.2 inches).

These are made entirely of corrosion-resistant materials, with Teflon cables and tough stainless steel knife edges. Optionally, they can also be supplied with ceramic knife edges and electrically isolated quick attach kit wires to minimize galvanic corrosion with test samples.

Contact Epsilon for help with configuring a system to meet your test needs.

Features

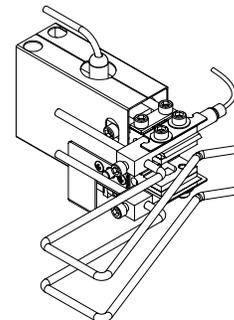
- Signal conditioner and power supply included. Easily interfaced to test controllers, data acquisition boards, and chart recorders.
- Shipped fully calibrated with electronics (traceable to NIST) with user specified voltage output.
- Designed for monotonic tests. Epsilon does not recommend this model for strain control or cyclic testing applications.
- Includes high quality foam lined case.

SPECIFICATIONS

- Analog Output:* Up to $\pm 10V$
- Gauge Length:* May be in the range 10 - 25 mm (specify when ordering)
- Measuring Range:* May be in the range 2.5 - 5.0 mm (specify when ordering)
- Accuracy:* $< \pm 100\mu m$ as supplied from Epsilon
 $< \pm 5\mu m$ with 3rd order polynomial linearization performed in the customer's electronics
- Temperature Range:* $-40\text{ }^{\circ}C$ to $+100\text{ }^{\circ}C$ ($-40\text{ }^{\circ}F$ to $210\text{ }^{\circ}F$)
- Cable:* 0.45 m (1.5 ft), multistranded, shielded, SS reinforced, Teflon[®] insulated
- Standard Quick*
- Attach Kit:* Fits round samples up to 12 mm (0.5 inch) diameter and flats to 12 mm thick by 12 mm wide (0.5 inch by 0.5 inch)
- Environment:* Submersible in water and other liquids compatible with materials of construction
- Power:* Includes power supply for your country (specify)



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MODEL 4030 EXAMPLE

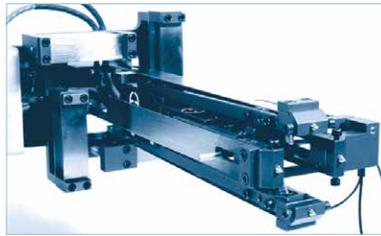
Examples of customized extensometers manufactured and built at Epsilon.

Customized Extensometers

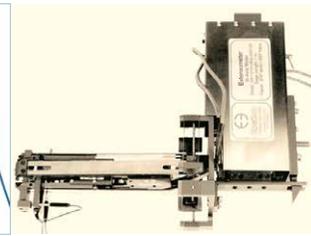
Sometimes the test requires a customized version of one of our extensometers or COD gages. If you have special requirements and do not see it in our catalog, please contact us to discuss your application.

3561 Biaxial

Custom biaxial extensometer for plane strain measurement in sheet metal testing. This unique design contacts the test sample from one side only, as needed for a very wide sample. Used for formability testing.



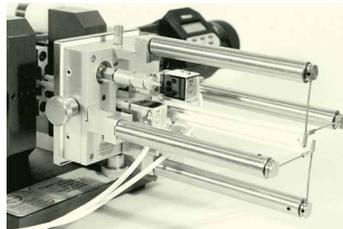
View of 4 conical points



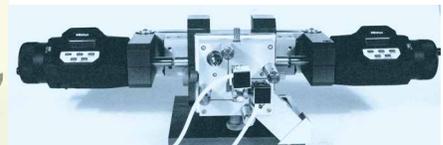
3561 biaxial plane strain

3561 High Temperature Biaxial

Special high temperature biaxial extensometer for cruciform test samples at 1200 °C (induction heated). This extensometer uses ceramic rods and is capable of measuring very small strains.



3561 biaxial for 1200 °C



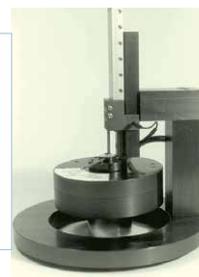
3561 on biaxial calibrator

Bulge Test

Special biaxial extensometer for limiting dome height bulge tester for sheet metal formability testing. Simultaneous X and Y strain measurements are taken.



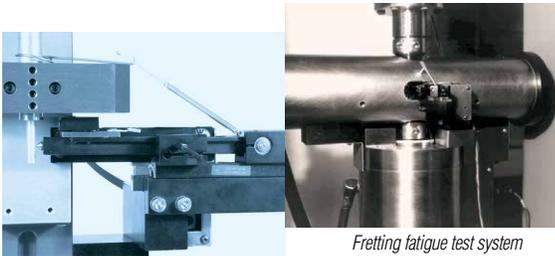
Close-up showing conical points



*Biaxial sheet metal
extensometer*

Fretting Fatigue Slip Sensor

Custom sensor for fretting fatigue test system. Measures very small fret slip amplitudes at frequencies up to 60 Hz. Capacitive sensor with full scale displacement of 100 microns.



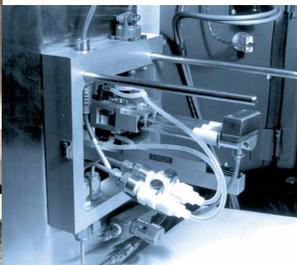
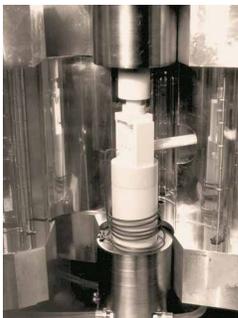
Fretting fatigue slip amplitude sensor

Fretting fatigue test system

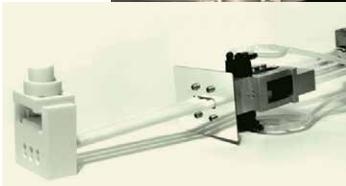
High Temperature Bend Extensometer

High temperature bend fixture and 3 point bend deflection sensor for bend tests up to 1000 °C. Capacitive sensor allows very small full scale measurement of 100 microns. Includes radiant furnace, fixtures and controlled atmosphere chamber.

Bend test fixture inside radiant furnace



Exterior view of system showing bend sensor

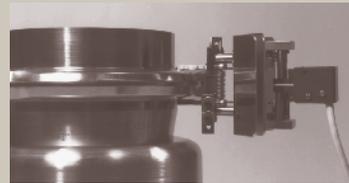


Ceramic bend fixture with deflection sensor



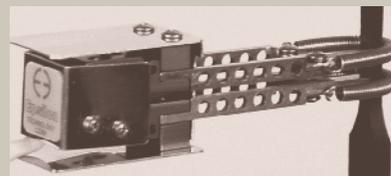
3640

High temperature 540 °C (1000 °F) capacitive based deflectometer. The model shown has 1 inch of measuring range.



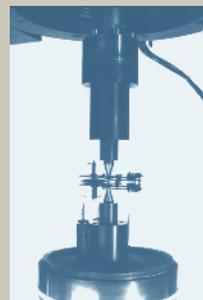
Clamp Test Unit

High temperature 540 °C (1000 °F) clamp expansion test extensometer



Special 3442, Heated Grips

Miniature Model 3442 extensometer modified for use with heated grips, to 300 °C (570 °F).



Capacitive in Hydrogen

Capacitive extensometer for use in hydrogen gas at 1800 °F and 5000 psi (1000 °C and 34 MPa).



3542 Special 1.5 Wide

Modified Model 3542 extensometer for 4 point contact on test sample 37.5 mm (1.5 inch) wide.



3542 on Very Large Sample

Modification to Model 3542 extensometer for mounting on large diameter test samples.



3542 on 250 mm Wide

Special mounting for Model 3542 extensometer on 250 mm wide test samples.

Knife Edges for Extensometers

All of the following knife edges will fit all models of Epsilon extensometers that use knife edges. The exceptions are high temperature extensometers that use ceramic rods, specialty extensometers that require conical point contacts, asphalt extensometers, clip-on gages, and deflectometers.



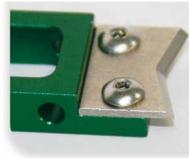
Standard Knife Edges

PART NO. 350210-01
Produced from hardened tool steel, these knife edges are used for a wide range of applications and can be used on both round and rectangular shaped specimens. These are the standard knife edges supplied with most Epsilon extensometers.



Wear-Resistant Carbide Knife Edges

PART NO. 9903-05-02
Designed as an alternative for customers who experience slipping or regularly wear out the standard knife edges when testing hard metals and ceramics, these ultra-hard, dual-bevel knife edges will retain a sharp edge and last much longer. They are extremely sharp and not suitable for specimens that are sensitive to stress concentrations such as soft plastics.



Vee Knife Edges

PART NO. 9903-01-01
Designed for use on round specimens, these knife edges will self-center the extensometer on the specimen. Due to the contact point variation that can occur between specimens of different diameters, units with these knife edges must be calibrated with posts of equal diameter. On extensometers with longer arms, errors created by this variation are not so pronounced, but on units with shorter arms lengths, this must be taken into consideration.



Corrosion-Resistant Stainless Steel Knife Edges

PART NO. 350210-02
These hardened knife edges are designed to be used in environments where corrosion resistance is required. Primary applications are in biomedical testing where the knife edges may be exposed to saline solutions.



Rounded Knife Edges

PART NO. 350210-BLUNT
Knife edges designed for use on transverse extensometers and applications where blunt edges are required. These are primarily used on transverse extensometers such as model 3575.



Three-Point Contact Knife Edges

PART NO. 354299
These knife edges are recommended for flat specimens. They ensure stable contact on flat test samples due to 3-point contact. For flat specimens <10 mm wide, one standard and one single-point knife edge may be used.



Knife Edges for Notch-Sensitive Materials

PART NO. 350210V2-01
The dual-bevel design and robust tool steel construction of these knife edges make them an ideal choice for applications that tend to cause chipping damage to standard or wear-resistant knife edges at failure. As they are not as sharp as their counterparts, these knife edges are also well-suited for working with notch-sensitive applications.



Extended Knife Edges

PART NO. 350210EXT-01
Knife edges for applications where the additional length is required, such as where the grips are very close together. Only available by special order. Requires recalibration when retrofitting an existing extensometer.



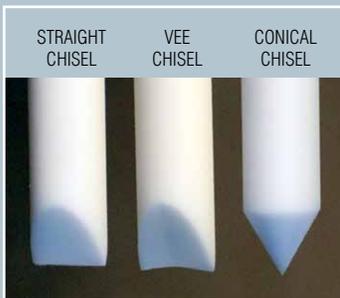
Ceramic Knife Edges

PART NO. 350210C2-01
These knife edges are typically used in low cycle fatigue applications on hard metals where metallic knife edges would likely experience undue wear. They are also used on the submersible Model 4030 extensometer to prevent galvanic corrosion between the extensometer and the test specimen.



Bolt-On Knife Edges for Fracture Mechanics

PART NO. BOLT-ON KNIFE EDGES
Reusable bolt-on knife edges for attaching COD gages to fracture mechanics and fatigue crack growth specimens. Sold in sets of two. 30° knife edge angle. Made of nickel-plated tool steel. Rated to 500 °C.

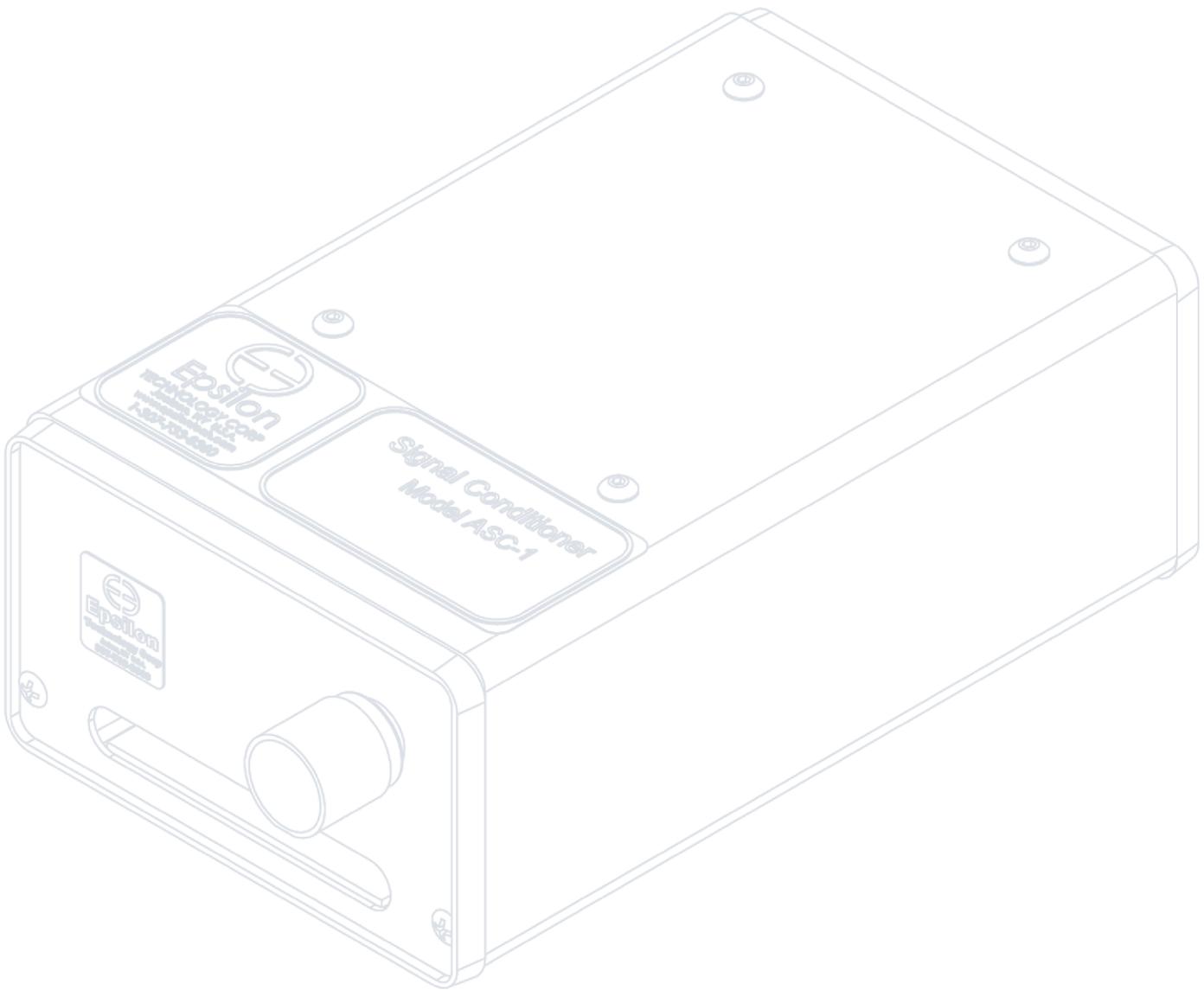


Available Ceramic Rod Tip Styles

Specify rod tip style desired.

Straight chisel tips are the most versatile, since they can be used with round or flat specimens.

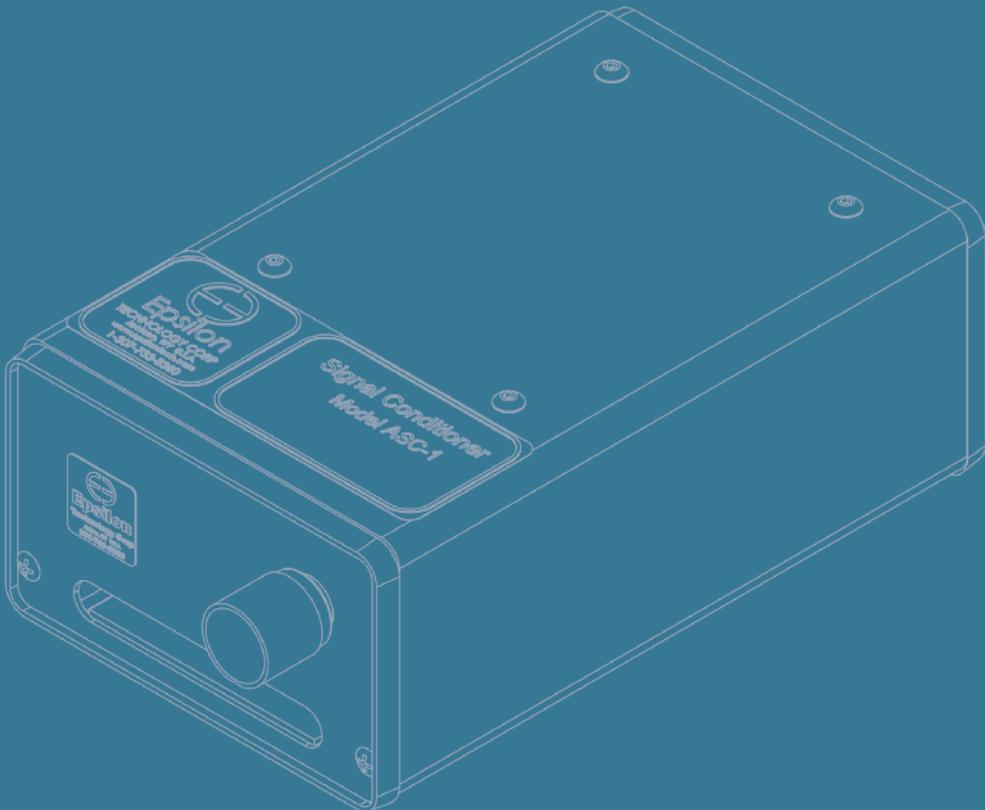
EXTENSOMETER
NOTES



SGA Analog Signal Conditioners

DSCUSB USB Extensometer Interface

Electronics



The SGA series signal conditioners are ideal for cyclic and high speed testing where no display is needed. Available in single and dual channel versions, they provide the signal conditioning electronics needed for a strain gage based extensometer.



Model SGA channel signal conditioner

The SGA has adjustable excitation voltage and a high accuracy amplifier to provide a high level DC voltage output. An offset adjustment potentiometer is easily accessible on the front panel.

The output is ideal for direct connection to data acquisition boards or test controllers which require high level voltage or current inputs.

All models are supplied with a universal power supply and adapters for your country: specify regional adapters when ordering. A 2.5 m (8 ft) output cable is included to connect to external systems. Calibration with an extensometer (for each channel) is included.

SPECIFICATIONS

- Zero Adjustment**
- Knob(s):* On front panel. Fine ($\pm 5\%$ FS) and coarse ($\pm 80\%$ FS) adjustment ranges
- Selectable*
- Output Ranges:* $\pm 5V$, $\pm 10V^*$, 0-10V, 0-20 mA, etc.
- Bridge Excitation:* 5V or 10V* DC
- Bridge Sensitivity*
- Range:* 0.06 to 30.0 mV/V
- Linearity:* 0.03% FS typical
- Filtering:* 8 settings, 1-5000 Hz, plus secondary 800 Hz filter. 1 kHz* default
- Operating*
- Temperature Range:* -10 to +50 °C
- Zero Temperature*
- Coefficient:* 0.009%/C (90 ppm/°C)
- 90 Day Output*
- Stability:* ~330 ppm
- Output Noise:* 10-100 μV (1-100 ppm), depending on filter, DAQ, and gain. 50 μV typical
- Input Power:* 100-240 VAC, 50-60 Hz. Specify regional power plug type required. Includes: power supply, connection for extensometer(s), output cable(s) and calibration with extensometer

*default setting

Model SGA Available Versions:
 Model SGA-1 Single channel signal conditioner
 Model SGA-2 Dual channel signal conditioner



Model SGA single channel signal conditioner

Model SGA single channel rear panel



Model SGA dual channel signal conditioner

Model SGA dual channel rear panel

The **DSCUSB** provides **USB plug-and-play capability to any strain gauged extensometer. They are useful when you wish to acquire data directly to your computer without the need for a controller.**



Model DSCUSB Digital Extensometer Interface

Provides an inexpensive solution for digitally recording extensometer output.

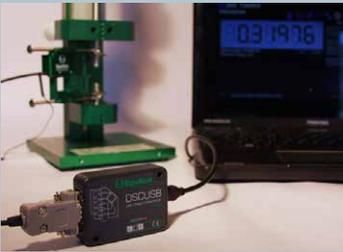
The DSCUSB is a signal conditioner that provides a digital interface to a computer via USB. This allows direct data capture without the need for additional acquisition electronics or an input channel on your controller. Calibration of an extensometer is handled within the DSCUSB with up to 7 linearization points and output readings in units of mV/V, mm, or inches. The simple software interface displays the current value as well as providing a trend chart and data logging capabilities.

If you wish to interface the DSCUSB with your existing software solution, the DSCUSB can be controlled using a set of ASCII commands through its virtual COM port.

A USB cable is included with the DSCUSB.

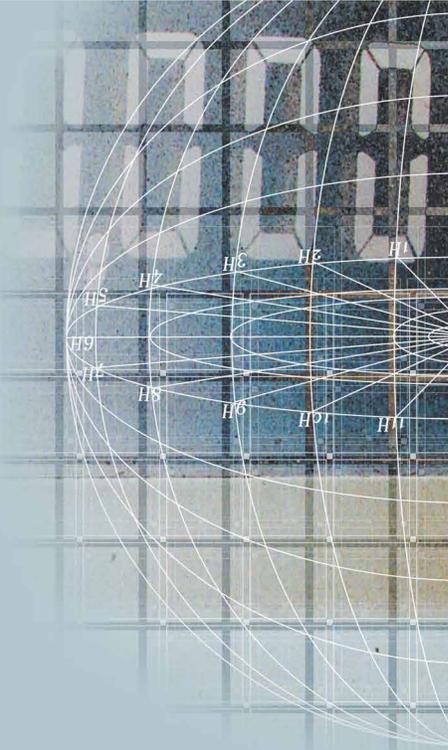
SPECIFICATIONS

- Power supply: USB powered (5V)
- Excitation voltage: 5V
- Temperature stability: <5ppm/°C
- A/D resolution: 16 Million counts (24 bits)
- Effective resolution: 200,000 counts @ 1Hz; 120,000 counts @ 10Hz; 50,000 counts @ 100Hz
- Data rate: 1-200 samples/second, 9 settings
- Selectable low pass filter
- Capture software included
- ASCII command set available for custom software development
- Multiple DSCUSBs may be used simultaneously for multiple channel measurements

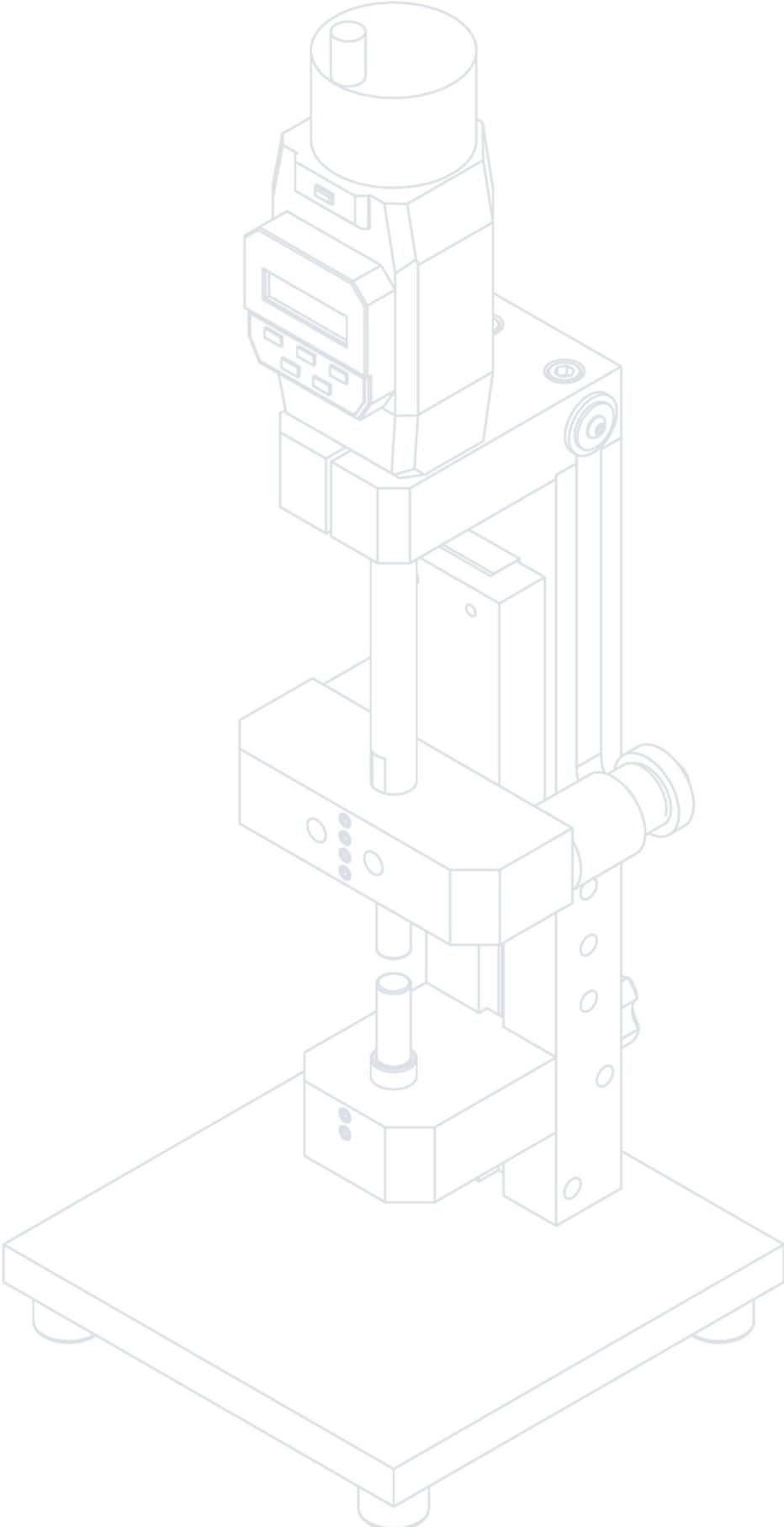


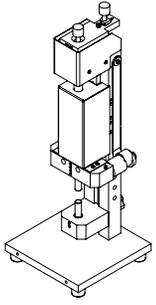
Model DSCUSB with monitor

EXTENSOMETER NOTES

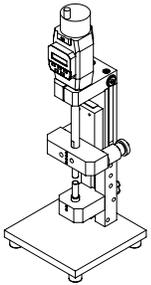


EXTENSOMETER NOTES

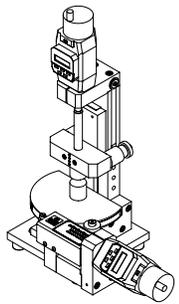




3590VHR Very High Resolution Digital Electronic Calibrators

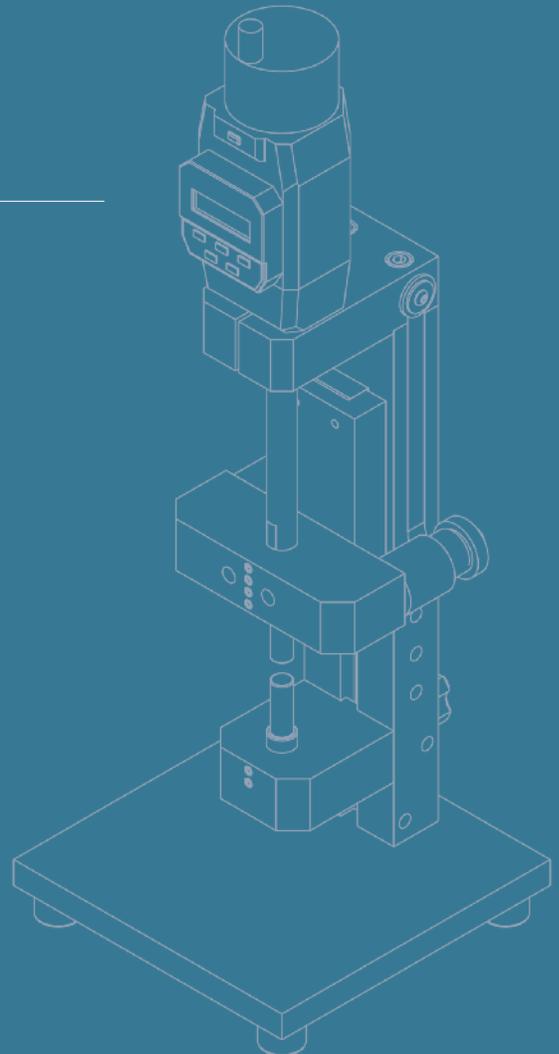


3590 Digital Electronic Calibrators



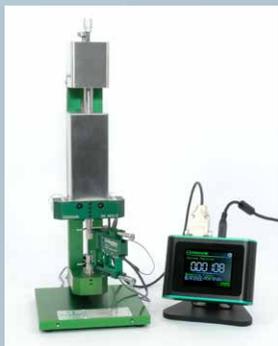
3590AT Axial/Torsional Digital Electronic Calibrators

Calibrators





Epsilon's very high resolution calibrator features **20 nanometers (0.8 microinches) resolution** and has **50 mm (2 inches) of measuring range**. The 3590VHR calibrator meets the accuracy and resolution requirements for **ASTM E83 Class B-1** for extensometers with gauge lengths ≥ 6 mm, and meets **ISO 9513 Class 0,5**, both over the full measuring range of the calibrator. The 3590VHR includes a **Touch Display digital readout and PC software**.



Model 3590VHR calibrator with Touch Display digital readout



Model 3590VHR calibrator with included Touch Display digital readout and software (computer optional)

The 3590VHR calibrator has the high resolution and accuracy required to calibrate and verify extensometers to ASTM E83 Class B-1 and to ISO 9513 Class 0,5. The 3590VHR's resolution is 20 nanometers.

Like all of Epsilon's extensometer calibrators, the 3590VHR is itself calibrated using a laser interferometer at our ISO 17025 accredited facility.

The 3590VHR is provided with a calibration that is traceable to NPL in the UK, which has equivalency to NIST and many other national standards organizations. A calibration certificate is included.

These calibrators are fast and easy to use due to the simple controls and large digital readouts. The 3590VHR has coarse positioning adjustment for large displacements and fine adjustment that allows positioning to approximately 0.02 μm (0.8 μin). They have enough measuring range to calibrate nearly all extensometers and the resolution necessary to calibrate extensometers with low measuring ranges.

A Touch Display digital readout and software for a PC are included. The calibrator can be used with either, or both. The Touch Display and software both provide readouts in millimeters, inches or % strain and have tap-to-zero or click-to-zero functions. The digital displays can reduce operator errors compared to calibrators with mechanical vernier scales.

A wide range of adapters are available to allow use with axial, transverse, shear, and many other specialized extensometers. The calibrator comes with round adapters (9.52 mm [0.375 inches] diameter) that work with many typical axial extensometers. Specialized adapters are available. For very long gauge length extensometers, optional extension posts are available.



Coarse and fine adjustment knobs for fast and accurate positioning



Model 3590VHR calibrator storage case

▶ See the Model 3590VHR extensometer videos

Supplied with ISO 17025 accredited calibration

Model 3590 Adapters

Enables use with a wide variety of extensometer models.



Features

- Scale calibration traceable to NIST.
- System fully calibrated traceable to NPL (UK standards organization).
- Touch Display with digital readout is included.
- Software for Windows-based PC is included.
- Wide range of extensometer adapters available.
- Provided with a foam lined case for storage.

SPECIFICATIONS

- Measuring Range:** 50 mm (2 inch) maximum displacement
- Max. Clearance:** 125 mm (0-5 inch) (maximum extensometer gauge length + calibration displacement)*
- Accuracy Class:** Better than ISO 9513 class 0,5 requirements for verification apparatus for all extensometer gauge lengths, and ASTM E83 class B-1 requirements for verification apparatus for extensometers with gauge lengths ≥ 6 mm; both classes apply over the full measuring range of the calibrator
- Accuracy:** Better than: $\pm 0.2 \mu\text{m}$ [0-0.12 mm], $\pm 0.167\%$ [0.12-0.60 mm], $\pm 1.0 \mu\text{m}$ [0.6-5.0 mm], $\pm 0.02\%$ of value [5.0-25mm], $\pm 5 \mu\text{m}$ max [$>25\text{mm}$]
- Resolution:** 20 nm (0.8 μin)
- Temperature Range:** 18 °C to 28 °C (64 °F to 82 °F) operation**, -10 °C to 60 °C (14 °F to 140 °F) storage
- Relative Humidity:** <90% (non-condensing)
- Connectivity:** USB 2.0+ interface; includes USB cable; requires 5W min. power via USB-A connector from a computer or power adapter (not included)
- Weight:** 3.6 kg (8 lbs.) (standard configuration)
- Adapters:** $\varnothing 9.52$ mm (0.375 inch) adapter set included*
- EMC Compliance:** BS EN 61326-1: 2006

* A range of extension columns and extensometer adapters are available - contact Epsilon

**Recommended range



OPTIONS

Optional extensometer adapter sets, extension posts, and horizontal configuration kit (partial list below, see website for complete list):

- 3590-01** Smooth, round 6.35 mm (0.25 inch) diameter adapters
 - 3590-02** Flat adapters
 - 3590-3549** Adapters for Model 3549
 - 3590-3648** Adapters for Model 3648
 - 3590-03** Adapters for clip-on fracture mechanics gages
 - 3590-04** Transverse extensometer adapters (Model 3560-BIA)
 - 3590-11** Transverse extensometer adapters (Models 3575, 3475, 3575AVG, 3580, 3565, 3544, 3911 & 3975)
 - 3590-11-KIT** Horizontal conversion kit for transverse extensometers – consists of legs for horizontal configuration, additional springs, and 3590-11 adapters; enables verification of transverse extensometers in the orientation that will be used for testing, as required by some calibration and verification standards
 - 3590-06** Adapters for large averaging extensometers (Models 3542RA and 3442RA1)
 - 3590-4013** Shear adapters for Model 4013
 - 3590-3421** Shear adapters for Model 3421
 - 3590-07** 100 mm (4 inch) extension post for long gauge length extensometers
 - 3590-55-10** 250 mm (10 inch) extension post for long gauge length extensometers
 - 3590-55-24** 600 mm (24 inch) extension post for long gauge length extensometers
- Custom – contact Epsilon for adapters to fit Models 7650A, 7650, 7651, and 3567
 Note: Model 3590VHR and 3590 calibrators include 9.52 mm (0.375 inch) diameter smooth round adapters

Optional temperature and humidity sensor for the Touch Display

WITH EPSILON'S IN-HOUSE LASER INTERFEROMETER SYSTEM, THE FULL CALIBRATOR SYSTEM CAN BE CALIBRATED TRACEABLE TO NPL. NO LONGER DO CUSTOMERS HAVE TO RELY ON MICROMETER HEAD ONLY OR POTENTIALLY ERROR-PRONE GAUGE BLOCK CALIBRATIONS FOR FULL SYSTEM CALIBRATIONS.

Epsilon is one of the only companies in the world with the capability to perform full system calibrations on high resolution extensometer calibrators.

With Epsilon high resolution systems, you are assured compliance. When looking for a calibrator to meet ASTM and ISO specifications, the accuracy of the device is key for compliance, which is why full system calibration is essential to meet ISO 9513 and ASTM E83 requirements.

Standards Labs in most countries have signed a Mutual Recognition Arrangement, "CIPM MRA", www.bipm.org/en/cipm-mra, making the Standards Labs effectively equivalent and traceable to each other. This includes NIST in the USA, the NPL in the UK and many others. Services of the NPL are equivalent to those offered by NIST and are recognized by NIST through this agreement of reciprocity.

See more about extensometer calibration at www.epsilontech.com
 Contact us for your special testing requirements.



Epsilon's standard calibrator features 0.001 mm (50 microinches) resolution and has 50 mm (2 inches) of measuring range. The autozero button and digital display greatly simplify calibration of extensometers. The 3590 calibrator is useful for extensometer calibration and verification with test systems.



Model 3590 calibrator with Model 3542 axial extensometer



Model 3590 calibrator

When it comes time to calibrate your extensometers, these calibrators are easier to use and faster than any others on the market. They have enough measuring range to calibrate nearly all extensometers.

The digital display reads mm and changes to inches at the touch of a button. The autozero button is a great help in calibrating. Just press the button to start readings from zero. The digital display reduces operator error.

A wide range of adapters are available. The calibrator comes with round adapters (9.52 mm [0.375 inches] diameter) that work with many typical axial extensometers. Specialized adapters are available. For very long gauge length extensometers, a optional extension posts are available. An option is available for digital SPC output for interfacing with PCs. The calibrator is provided with a calibration traceable to NPL (UK standards organization).



Model 3590 calibrator storage case

Model 3590 Adapters

Enables use with a wide variety of extensometer models.



Supplied with ISO 17025 accredited calibration

Features

- Digital display
- Autozero button simplifies readings
- Adapters and extension posts available for nearly any extensometer
- Foam lined case for storage included
- System fully calibrated traceable to NPL (UK standards organization)

SPECIFICATIONS

<i>Measuring Range:</i>	50 mm (2 inch) maximum displacement
<i>Maximum Range:</i>	125 mm (0-5 inch) (maximum gauge length + displacement)*
<i>Accuracy:</i>	±0.004 mm/25 mm (±0.00015 in/in) Meets ASTM E83 Class B-2 for extensometers with gauge lengths ≥33 mm, and ASTM E83 Class C for extensometers with gauge lengths ≥7 mm; use model 3590VHR to meet ISO 9513 class requirements
<i>Resolution:</i>	0.001 mm (50 µin)
<i>Temperature Range:</i>	18 °C to 28 °C (64 °F to 82 °F) operation**, -10 °C to 60 °C (14 °F to 140 °F) storage
<i>Relative Humidity:</i>	<90% (non-condensing)
<i>Power Supply:</i>	2x SR44 Batteries (included), ~2 year life
<i>Weight:</i>	2.7 kg (6 lbs.) (standard configuration)
<i>Adapters:</i>	Ø9.52 mm (0.375 inch) adapter set included*

* A range of extension columns and extensometer adapters are available - contact Epsilon

**Recommended range



OPTIONS

Optional extensometer adapter sets, extension posts, and horizontal configuration kit (partial list below, see website for complete list):

- 3590-01** Smooth, round 6.35 mm (0.25 inch) diameter adapters
 - 3590-02** Flat adapters
 - 3590-3549** Adapters for Model 3549
 - 3590-3648** Adapters for Model 3648
 - 3590-03** Adapters for clip-on fracture mechanics gages, for example Models 3541 and 7641
 - 3590-3548** Mounting bracket for Model 3548COD (requires 3590-03 adapters)
 - 3590-11** Transverse extensometer adapters (Models 3575, 3475, 3575AVG, 3580, 3565, 3544, 3911 & 3975)
 - 3590-11-KIT** Horizontal conversion kit for transverse extensometers – consists of legs for horizontal configuration, additional springs, and 3590-11 adapters; enables verification of transverse extensometers in the orientation that will be used for testing, as required by some calibration and verification standards
 - 3590-3580** Mounting bracket for Model 3580 transverse extensometer (includes 3590-11 adapters)
 - 3590-04** Transverse extensometer adapters (Model 3560-BIA)
 - 3590-04 KIT** Horizontal conversion kit for Model 3560-BIA – consists of legs for horizontal configuration, additional springs, and 3590-04 adapters; enables verification of Model 3560-BIA in the orientation that will be used for testing, as required by some calibration and verification standards
 - 3590-06** Adapters for large averaging extensometers (Models 3542RA and 3442RA1)
 - 3590-08** Adapters for Models 3910 and 3909
 - 3590-4013** Shear adapters for Model 4013
 - 3590-3421** Shear adapters for Model 3421
 - 3590-07** 100 mm (4 inch) extension post for long gauge length extensometers
 - 3590-55-10** 250 mm (10 inch) extension post for long gauge length extensometers
 - 3590-55-24** 600 mm (24 inch) extension post for long gauge length extensometers
- Custom – contact Epsilon for adapters to fit Models 7650A, 7650, 7651, and 3567
 Note: Model 3590VHR and 3590 calibrators include 9.52 mm (0.375 inch) diameter smooth round adapters

WITH EPSILON'S IN-HOUSE LASER INTERFEROMETER SYSTEM, THE FULL CALIBRATOR SYSTEM CAN BE CALIBRATED TRACEABLE TO NPL. NO LONGER DO CUSTOMERS HAVE TO RELY ON MICROMETER HEAD ONLY OR POTENTIALLY ERROR-PRONE GAUGE BLOCK CALIBRATIONS FOR FULL SYSTEM CALIBRATIONS.

Standards Labs in most countries have signed a Mutual Recognition Arrangement, "CIPM MRA", www.bipm.org/en/cipm-mra, making the Standards Labs effectively equivalent and traceable to each other. This includes NIST in the USA, the NPL in the UK and many others. Services of the NPL are equivalent to those offered by NIST and are recognized by NIST through this agreement of reciprocity.

Visit our website at www.epsilontech.com
 Contact us for your special testing requirements.



Epsilon's axial/torsional calibrator features 0.001 mm (50 microinches) resolution, and has 50 mm (2 inches) of measuring range axial and torsional rotation where 1.27 mm (0.050 inch) of linear motion equates to 1° angle of twist. The autozero button and digital display greatly simplify calibration of extensometers. The 3590AT calibrator is designed to be used with the Model 3550 and 7650 axial/torsional extensometers.



Model 3590AT axial/torsional calibrator

The digital display reads mm and changes to inches at the touch of a button. The autozero button is a great help in calibrating. Just press the button to start readings from zero. The digital display reduces operator error.

Features

- 0.001 mm (50 microinches) resolution
 - ± 0.004 mm/25 mm (± 0.00015 in/in) accuracy
 - Full 50 mm (2 inches) axial measuring range
 - Digital display
 - Autozero button simplifies readings
- Foam lined case for storage included
 - System fully calibrated traceable to NPL (UK standards organization)

The 3590AT can be converted into a standard Model 3590 calibrator with the optional 3590AT-3590 adapter.

Standards Labs in most countries have signed a Mutual Recognition Arrangement CIPM MRA. This includes the NPL in the UK, NIST in the USA and many others. This makes them effectively traceable to each other. Services of the NPL are equivalent to those offered by NIST and are recognized by NIST through this agreement of reciprocity. www.bipm.org/en/cipm-mra/



EXTENSOMETER NOTES

ESCS Epsilon Shunt Calibration System

Calibration References

VREF Modules

Designed to allow Epsilon's extensometer calibration to be easily

transferred to a customer's electronics, the Epsilon Shunt Calibration

System is available for any strain-gaged extensometer.

What is shunt calibration?

The Epsilon Shunt Calibration System provides an easy way to calibrate an extensometer and signal conditioning electronics without using a mechanical calibrator. Shunt calibration enables performing on-site electrical calibration with nearly all types of controllers and electronics. It also makes it easy to periodically "spot check" the calibration of the electronics, which will help ensure that the extensometer and electronics are calibrated correctly.

Note that the Epsilon Shunt Calibration System does not replace the need for on-site verification using a mechanical extensometer calibrator such as the Epsilon model 3590VHR. On-site verification is required by many labs and testing standards.

Which extensometers include the Epsilon Shunt Calibration System?

The Epsilon Shunt Calibration System is included with every new Epsilon strain-gaged extensometer. Customers who would like Epsilon to add the Epsilon Shunt Calibration System to an existing extensometer that does not have it can send the extensometer to Epsilon for re-calibration. Epsilon will install the Epsilon Shunt Calibration System, perform a calibration, and return the retrofitted extensometer with a new Epsilon Test Certificate.

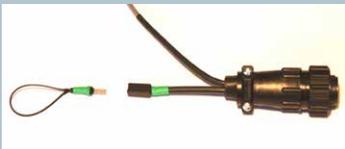
How does shunt calibration work?

The Epsilon Shunt Calibration System is used for two-point calibrations.

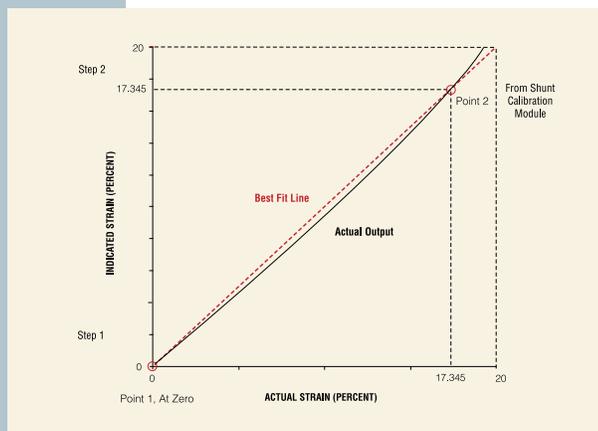
The first point is the extensometer's gauge length.

The second point is the shunt calibration point. When the Epsilon Shunt is plugged into the Shunt Connector, the shunt resistor, which is located in the Shunt Connector, is electrically connected across one arm of the extensometer's Wheatstone bridge. The result is that the extensometer's output is electrically set to a known calibration point without having to mechanically displace the extensometer's arms. The known calibration point is shown on the extensometer's Test Certificate as the Shunted Reading, which was set at Epsilon using traceable mechanical calibrators and an accredited ISO 17025 calibration process.

To complete the shunt calibration, the signal conditioning electronics or software are adjusted so that the extensometer's readout matches the Shunted Reading shown on the extensometer's Test Certificate.



Epsilon Shunt Calibration System



Using the Epsilon Shunt Calibration System is a simple two-step process.

1. Set the extensometer to its gauge length and zero its output. This sets point 1 in the example graph.
2. Plug the Epsilon Shunt into the Shunt Connector and adjust the signal conditioning electronics or software so that the extensometer's readout matches the Shunted Reading on the extensometer's Test Certificate. This sets point 2 in the example graph.

That's all it takes.

This process works for almost any combination of strain-gaged extensometer and signal conditioning electronics or software. It works even if the test controls have their own internal shunt calibration capability. It is useful for digital test machine controllers, analog controllers, data acquisition systems and stand-alone extensometer signal conditioning electronics.

Additionally, periodic recalibration of the extensometer may be accomplished by sending the extensometer to Epsilon for recalibration service.

Contact Epsilon about recalibration and Epsilon Shunt Calibration System retrofits.



10V calibration reference for high level devices.



VREF module

Like the shunt calibration module for strain gaged extensometers, the VREF module is used to transfer Epsilon's calibration to a customer's electronics.

VREF works with Epsilon's Model 3648 high temperature capacitive extensometers, and is compatible with both the 3603 and 3604 signal conditioners. The high-precision 10V reference in the VREF module ensures calibrations are spot on every time. One VREF module may be used to calibrate several high level output extensometers by using the 10V extension value for each extensometer.



VREF Module

Calibration only requires these simple steps:

1. With the VREF module connected to the testing machine's strain channel input, set VREF to 0V and zero the testing machine's strain channel. This is the zero reference.
2. Set VREF to 10V and calibrate the full scale extensometer value on the testing machine's strain channel. This is the calibrated full scale.
3. If your testing machine requires returning to 0V after setting full scale, set VREF back to 0V and zero the testing machine's strain channel.
4. Reconnect the extensometer's signal conditioner to the testing machine and you're ready to go.

That's all it takes.



Accreditations

EPSILON is accredited by A2LA to the ISO/IEC 17025 international standard and certified by DNV to the ISO 9001 international quality management system standard.

The proven compliance with these standards demonstrates the accuracy and consistency of our measurements and calibrations and represents our commitment to quality.

To receive accreditation to ISO/IEC 17025 international standard, our laboratory has conducted comprehensive testing and documentation of all of our processes and ensured that the uncertainty in our measurements is both documented and reduced to the lowest amount possible. During the accreditation process, the robustness of our quality system is evaluated as well as our laboratory's technical proficiency to make measurements to our stated degree of accuracy.



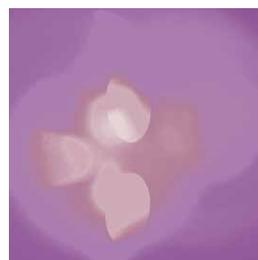
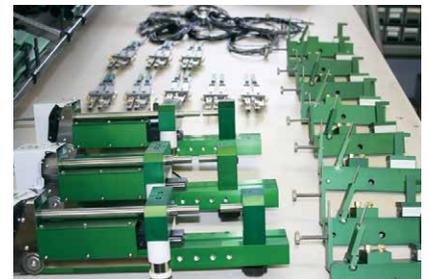
Epsilon Technology's A2LA accreditation scope covers all measurements made during calibration. This means that all calibration stands and extensometers sold with electronics come with a fully accredited calibration that you can rely upon to be accurate and traceable. If you are buying an extensometer to use with existing electronics you are still receiving an accredited calibration, however, you will need to calibrate your system as a whole. If you have any questions about this, please do not hesitate to contact us.

To become certified to ISO 9001, we further documented our processes starting in the design and development phase and following the product through manufacturing, calibration and shipment with a strong focus on quality throughout. These improvements to our quality management system allow us to better track ways to improve our products and services and continue to provide our customers with products to fulfill their materials testing needs.

Our certificates and scope of accreditation can be viewed on our website at: www.epsilontech.com/accreditations-and-certifications.



accreditation
quality
accuracy



Epsilon Tech: Our Warranty

1. Limited Warranty

Epsilon warrants all products of our manufacture ("Products") to be free of defects in materials or workmanship for a period of one year from date of shipment. This warranty covers both parts and labor. Epsilon reserves the right to determine if defects are covered by warranty. This warranty does not cover items subject to wear. Specifically, this does not cover knife edges or ceramic rods. Upon return of item (shipping prepaid) for repair, Epsilon will determine whether the item is covered by warranty, and repair or replace it at our option.

The warranty period for any product is not extended from its original date by virtue of having been repaired or replaced under the original warranty.

2. Other Limits

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Epsilon does not warrant against damages or defects arising out of improper or abnormal use or handling of the Products, against defects or damages arising from improper installation (where installation is by persons other than Epsilon), against defects in products or components not manufactured by Epsilon, or against damages resulting from such non-Epsilon made products or components. Epsilon passes on to Buyer the warranty it received (if any) from the maker thereof of such non-Epsilon made products or components. This warranty also does not apply to Products which have been repaired or disassembled by any person who is not authorized in writing by Epsilon.

3. Exclusive Obligation

THIS WARRANTY IS EXCLUSIVE. The sole and exclusive obligation of Epsilon shall be to repair or replace the defective products in the manner and for the period provided above. Epsilon shall not have any other obligation with respect to the products or any part thereof, whether based on contract, tort, strict liability or otherwise. Under no circumstances, whether based on this Limited Warranty or otherwise, shall Epsilon be liable for incidental, special, or consequential damages.

4. Other Statements

Epsilon's employees or representatives' ORAL OR OTHER WRITTEN STATEMENTS DO NOT CONSTITUTE WARRANTIES, shall not be relied upon by Buyer, and are not a part of the contract for sale or this limited warranty, unless agreed to in writing by a corporate officer of Epsilon.

5. Entire Obligation

This Limited Warranty states the entire obligation of Epsilon with respect to the Products. If any part of this Limited Warranty is determined to be void or illegal, the remainder shall remain in full force and effect.

Strain measurement for materials testing is
our only business at Epsilon.

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