


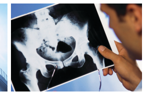
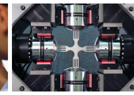

be certain.

Axial Extensometers Product Information

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Trademark information

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Technical Support 5

Preface 11

Introduction 15

Configuration 23

Calibration 41

Installation 51

Technical Support

How to Get Technical Support

Start with your manuals

The manuals supplied by MTS provide most of the information you need to use and maintain your equipment. If your equipment includes MTS software, look for online help and README files that contain additional product information.

If you cannot find answers to your technical questions from these sources, you can use the internet, e-mail, telephone, or fax to contact MTS for assistance.

Technical support methods

MTS provides a full range of support services after your system is installed. If you have any questions about a system or product, contact MTS in one of the following ways.

MTS web site www.mts.com

The MTS web site gives you access to our technical support staff by means of a Technical Support link:

www.mts.com > Contact Us > Service & Technical Support

E-mail

techsupport@mts.com

Telephone

MTS Call Center 800-328-2255

Weekdays 7:00 A.M. to 5:00 P.M., Central Time

Fax

952-937-4515

Please include “Technical Support” in the subject line.

Before You Contact MTS

MTS can help you more efficiently if you have the following information available when you contact us for support.

Know your site number and system number

The site number contains your company number and identifies your equipment type (material testing, simulation, and so forth). The number is usually written on a label on your MTS equipment before the system leaves MTS. If you do not have or do not know your MTS site number, contact your MTS sales engineer.

Example site number: 571167

When you have more than one MTS system, the system job number identifies which system you are calling about. You can find your job number in the papers sent to you when you ordered your system.

Example system number: US1.42460

Know information from prior technical assistance

If you have contacted MTS about this problem before, we can recall your file. You will need to tell us the:

- MTS notification number
- Name of the person who helped you

Identify the problem

Describe the problem you are experiencing and know the answers to the following questions:

- How long and how often has the problem been occurring?
- Can you reproduce the problem?
- Were any hardware or software changes made to the system before the problem started?
- What are the model numbers of the suspect equipment?
- What model controller are you using (if applicable)?
- What test configuration are you using?

Know relevant computer information

If you are experiencing a computer problem, have the following information available:

- Manufacturer's name and model number
- Operating software type and service patch information
- Amount of system memory
- Amount of free space on the hard drive in which the application resides
- Current status of hard-drive fragmentation
- Connection status to a corporate network

Know relevant software information

For software application problems, have the following information available:

- The software application's name, version number, build number, and if available, software patch number. This information is displayed briefly when you launch the application, and can typically be found in the "About" selection in the "Help" menu.
- It is also helpful if the names of other non-MTS applications that are running on your computer, such as anti-virus software, screen savers, keyboard enhancers, print spoolers, and so forth are known and available.

If You Contact MTS by Phone

Your call will be registered by a Call Center agent if you are calling within the United States or Canada. Before connecting you with a technical support specialist, the agent will ask you for your site number, name, company, company address, and the phone number where you can normally be reached.

If you are calling about an issue that has already been assigned a notification number, please provide that number. You will be assigned a unique notification number about any new issue.

Identify system type

To assist the Call Center agent with connecting you to the most qualified technical support specialist available, identify your system as one of the following types:

- Electromechanical materials test system
- Hydromechanical materials test system
- Vehicle test system
- Vehicle component test system
- Aero test system

Be prepared to troubleshoot

Prepare yourself for troubleshooting while on the phone:

- Call from a telephone when you are close to the system so that you can try implementing suggestions made over the phone.
- Have the original operating and application software media available.
- If you are not familiar with all aspects of the equipment operation, have an experienced user nearby to assist you.

Write down relevant information

Prepare yourself in case we need to call you back:

- Remember to ask for the notification number.
- Record the name of the person who helped you.
- Write down any specific instructions to be followed, such as data recording or performance monitoring.

After you call

MTS logs and tracks all calls to ensure that you receive assistance and that action is taken regarding your problem or request. If you have questions about the status of your problem or have additional information to report, please contact MTS again and provide your original notification number.

Problem Submittal Form in MTS Manuals

Use the Problem Submittal Form to communicate problems you are experiencing with your MTS software, hardware, manuals, or service which have not been resolved to your satisfaction through the technical support process. This form includes check boxes that allow you to indicate the urgency of your problem and your expectation of an acceptable response time. We guarantee a timely response—your feedback is important to us.

The Problem Submittal Form can be accessed:

- In the back of many MTS manuals (postage paid form to be mailed to MTS)
- www.mts.com > Contact Us > Problem Submittal Form (electronic form to be e-mailed to MTS)

Preface

Before You Begin

Safety first!

Before you attempt to use your MTS product or system, read and understand the *Safety* manual and any other safety information provided with your system. Improper installation, operation, or maintenance of MTS equipment in your test facility can result in hazardous conditions that can cause severe personal injury or death and damage to your equipment and specimen. Again, read and understand the safety information provided with your system before you continue. It is very important that you remain aware of hazards that apply to your system.

Other MTS manuals

In addition to this manual, you may receive additional MTS manuals in paper or electronic form.

If you have purchased a test system, it may include an MTS System Documentation CD. This CD contains an electronic copy of the MTS manuals that pertain to your test system, including hydraulic and mechanical component manuals, assembly drawings and parts lists, and operation and preventive maintenance manuals. Controller and application software manuals are typically included on the software CD distribution disc(s).

Conventions

Documentation Conventions

The following paragraphs describe some of the conventions that are used in your MTS manuals.

Hazard conventions

As necessary, hazard notices may be embedded in this manual. These notices contain safety information that is specific to the task to be performed. Hazard notices immediately precede the step or procedure that may lead to an associated hazard. Read all hazard notices carefully and follow the directions that are given. Three different levels of hazard notices may appear in your manuals. Following are examples of all three levels.

Note *For general safety information, see the safety information provided with your system.*

DANGER

Danger notices indicate the presence of a hazard with a high level of risk which, if ignored, *will* result in death, severe personal injury, or substantial property damage.

WARNING

Warning notices indicate the presence of a hazard with a medium level of risk which, if ignored, *can* result in death, severe personal injury, or substantial property damage.

CAUTION

Caution notices indicate the presence of a hazard with a low level of risk which, if ignored, *could* cause moderate or minor personal injury, equipment damage, or endanger test integrity.

Notes

Notes provide additional information about operating your system or highlight easily overlooked items. For example:

Note *Resources that are put back on the hardware lists show up at the end of the list.*

Special terms

The first occurrence of special terms is shown in *italics*.

Illustrations

Illustrations appear in this manual to clarify text. It is important for you to be aware that these illustrations are examples only and do not necessarily represent your actual system configuration, test application, or software.

Electronic manual conventions

This manual is available as an electronic document in the Portable Document File (PDF) format. It can be viewed on any computer that has Adobe Acrobat Reader installed.

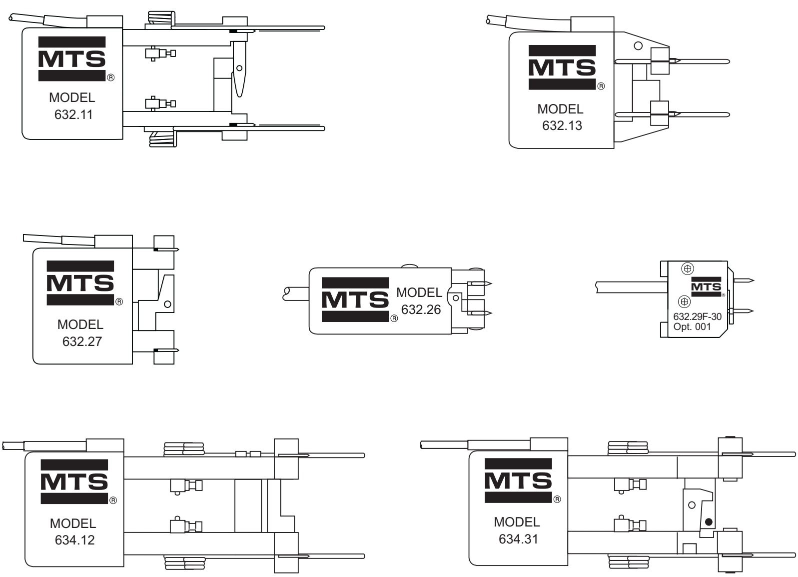
Hypertext links

The electronic document has many hypertext links displayed in a blue font. All blue words in the body text, along with all contents entries and index page numbers, are hypertext links. When you click a hypertext link, the application jumps to the corresponding topic.

Introduction

This manual describes the MTS axial extensometer family. Axial extensometers measure changes along the length of a specimen. Axial extensometers are suitable for a variety of static and dynamic testing applications including tension/compression testing, low and high cycle fatigue, creep/stress relaxation testing, and strain rate testing. Several accessories are available such as gage length extenders, gage length de-extenders, knife edges, and attachment methods. Not all accessories are available for all models.

Contents



Assorted Extensometers

What you need to know

This manual assumes that you know how to use your system controller. See the appropriate manual for information about performing any controller-related step in this manual's procedures. You are expected to know how to:

- Select a control mode.
- Manually adjust the actuator position.
- Zero a sensor output.
- Install a specimen.

Related documentation

This manual covers topics that are common among all axial extensometers. Specific information about a given extensometer is available from the drawings that are included with it.

Each extensometer may include the following documents:

- An installation drawing provides the specifications for your extensometer. It also includes detailed drawings and notes related to setting up and installing the extensometer.
- A Final Inspection card provides information such as the serial number, as tested excitation voltage, and other performance data.
- An Extensometer Calibration Data sheet is included when MTS calibrates the extensometer.
- You may have drawings for optional kits for your extensometer. These drawings include specifications and installation information for the given option.
- You may have a model application drawing that lists the family of extensometers for the model number you purchased. It lists the specification differences among the extensometer family. The drawing also includes the part number of the installation drawing for your extensometer and the wiring diagram of the connector.

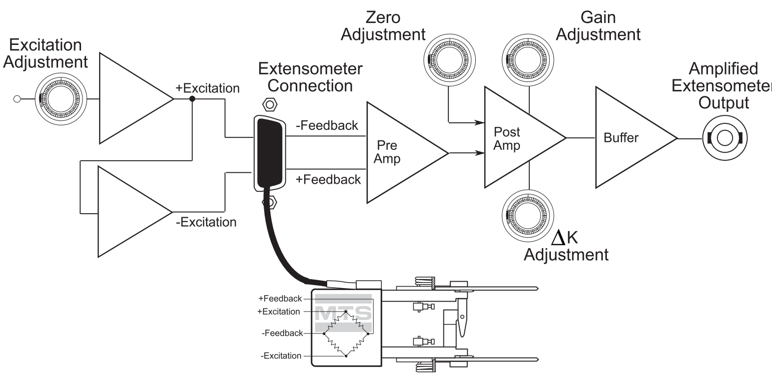
This manual is designed to be used with these documents.

Axial Extensometer Functional Description

An axial extensometer is a sensor attached to a specimen that measures a dimensional change (gage length or strain) that occurs in the specimen while being tested. Extensometers use a Wheatstone bridge circuit to detect the dimensional changes. Because they are DC devices, they require a DC conditioner for signal processing. The following paragraphs describe the functions of the axial extensometers.

About DC Conditioning

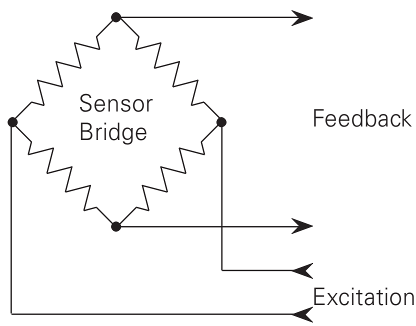
The transducer requires a DC conditioner to process the transducer signal. A DC conditioner provides a DC excitation voltage to the transducer. Any changes to the gage length of the transducer change the excitation signal. The changed signal is output to the DC conditioner as feedback. The DC conditioner processes the signal and makes it available to the controller where the signal may be used.



Typical Conditioning Circuit

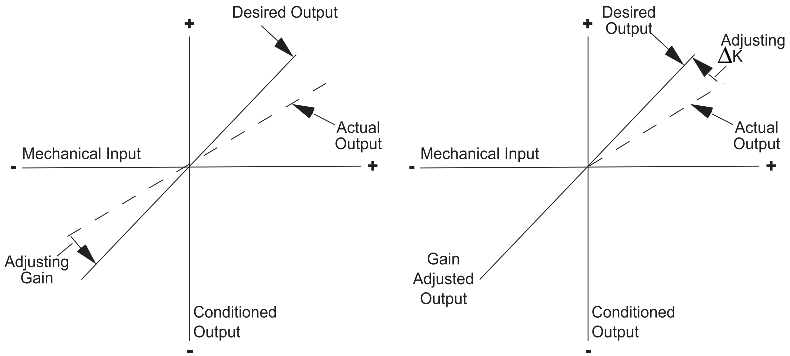
About Wheatstone Bridge

The axial transducer uses precision, resistance-type, foil strain gages bonded to a metallic element to form a Wheatstone bridge. Two knife edges on the transducer arms contact the specimen. Elongation or compression of the specimen causes movement of the transducer arms. This movement bends the metallic element, changing the resistance of the strain gages. The change in the balance of the Wheatstone bridge produces an electrical output that is proportional to the displacement of the transducer arms.



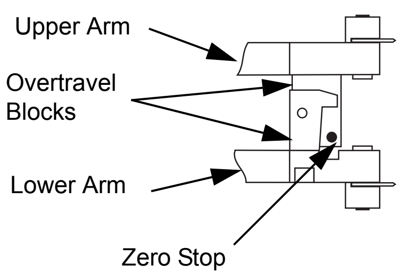
Transducer Calibration

The DC conditioner and the transducer signal must be calibrated. Calibration ensures that the transducer signal accurately represents the gage length measure by the transducer. Calibration involves adjusting the excitation voltage and gain of the DC conditioner to achieve the desired transducer signal. The purpose of calibration is to equate a specific transducer displacement to a specific voltage. When the transducer is calibrated, it is matched to a DC conditioner. If either component of the matched pair is changed, recalibration is required.



Axial Extensometer Overtravel Protection

When a specimen fails, the extensometer arms can be subjected to movement beyond the rated travel. Overtravel protection is accomplished with a pair of overtravel blocks. One block limits the tension travel and the other limits the compressive travel to the rated range of the extensometer.



Extensometer Zero Reference

There are three zero reference methods used by MTS's extensometers: zero pin, zero stop, and fixture. The zero reference position is important when calibrating the extensometer output signal or when mounting an extensometer to a specimen.

Zero pin

Some extensometers includes a zero pin that can be inserted into a zero reference hole. This locks the extensometer arms in the zero reference position. This is useful for specimen installation.

Zero stop

Some extensometers include a zero stop block built into the arms of the extensometer. A zero stop block works like overtravel blocks. When installing a specimen, pinch the two arms of the extensometer together. This stops the extensometer's arms in the zero position.

Fixture

Some extensometers require special fixtures that set the arms of the extensometer into the proper zero reference positon.

Axial Extensometer Accessories

Note *Not all accessories are available for all extensometers. Check with MTS Systems Corporation for a list of possible accessories for your extensometer.*

Accessories available for the axial extensometers include the following:

- Gage length extenders increase the gage length of the extensometer without changing its travel. An extension bracket is mounted to one arm of an extensometer to increase the gage length.
- Gage length de-extenders decrease the gage length of the extensometer without changing its travel. De-extender hardware is mounted to both arms of an extensometer to decrease the gage length.
- Cable connectors from the extensometer can be an Amphenol or a PT connector.
- A Model 650.03 Extensometer Calibrator can help with the local calibration of any extensometer.

- A variety of knife edges allow the extensometer to be used with different specimen shapes:
  - Straight knife edge sets for round specimens. Kits are available for standard, heavy duty, and extended length straight knife edges.
  - Three-point contact knife edge sets for flat specimens. Kits are available for standard, heavy duty, and extended length three-point contact knife edges.
- Specimen attachment kits offer a variety of extensometer mounting options:
  - Quick attachment springs are available in shapes that allow an extensometer to easily clip onto a flat or round specimen.
  - Elastic bands are available in different lengths to accommodate different specimen dimensions. Elastic bands should be used at room temperatures.
  - Metal extension springs are available in different lengths to accommodate different specimen dimensions. Metal springs can be used over a range of temperatures.

Configuration

This section describes how to configure an axial extensometer with quick attachment springs, elastic bands, or metal extension springs. It also describes how to change the knife edges, gage length of the extensometer, and how to connect it to a controller.

Contents

Configuring an extensometer

Each extensometer includes tools and special fittings to configure the extensometer for a variety of uses. To configure an extensometer, determine the following and perform the appropriate installation procedures.

- Type of specimen mounting
- Type of knife edges
- Gage length

After you have configured the extensometer you need to perform the following:

- Connect the cable to your controller.
- Calibrate the extensometer.

About Quick Attachment Spring Installation

Quick attachment springs let you quickly and easily mount an extensometer to a specimen. The shape of the springs depends on the extensometer model. This section includes two procedures to install the quick attachment springs. Some extensometers use anchored springs while others use sliding springs.

CAUTION

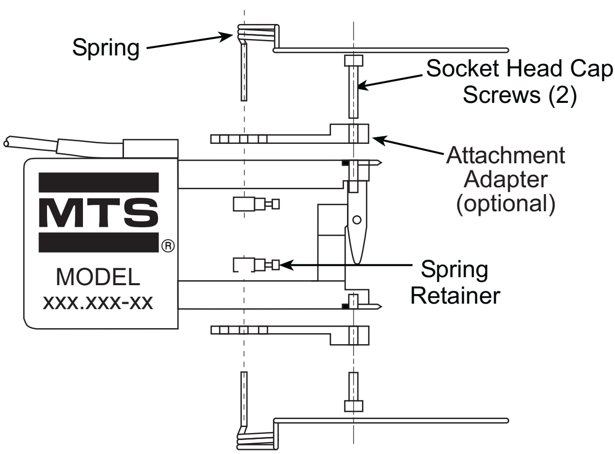
Excessive torque on the extensometer arms can damage the extensometer.

The extensometer arms can be damaged when mishandled.

Do not hold the extensometer case when loosening or tightening the socket head cap screws. Use an adjustable wrench to hold the extensometer arm or attachment adapter. Loosen or tighten only those socket head cap screws on the arm being held with the wrench.

How to Install Anchored Springs

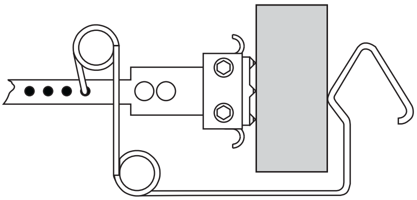
Perform the following procedure to install the anchored quick attachment springs on an extensometer. They can be also be installed onto gage length extenders.



Quick Attachment Spring Mounting

The extensometer arms have several anchor holes for the spring. The holes allow the extensometer to be mounted on specimens of different thicknesses. See the installation drawing that came with your extensometer for information about which anchor hole should be used for a given specimen thickness.

1. Check your installation drawing. If your extensometer needs an attachment adapter, perform the appropriate procedure before proceeding.
2. Separate the spring retainers from the springs by loosening (do not remove) the socket head cap screws.
3. Mount one spring in the appropriate hole in the attachment adapter as determined by the specimen dimensions (see the installation drawing).

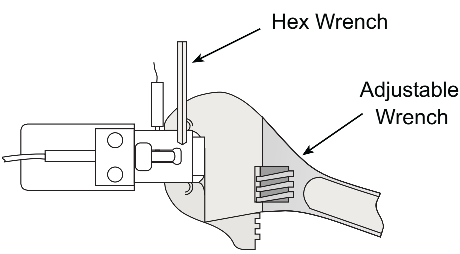


4. Slide the spring retainer over the end of the spring and tighten the socket head cap screw. Orient the spring retainer in such a way that it will not interfere with movement of the extensometer arm.
5. Select the matching spring and repeat Step 3 and Step 4 for the other extensometer arm.

How to Install an Attachment Adapter

Some extensometers do not have anchor holes in their upper and lower arms and require attachment adapters to be mounted. Others may need an attachment adapter when an extender is used.

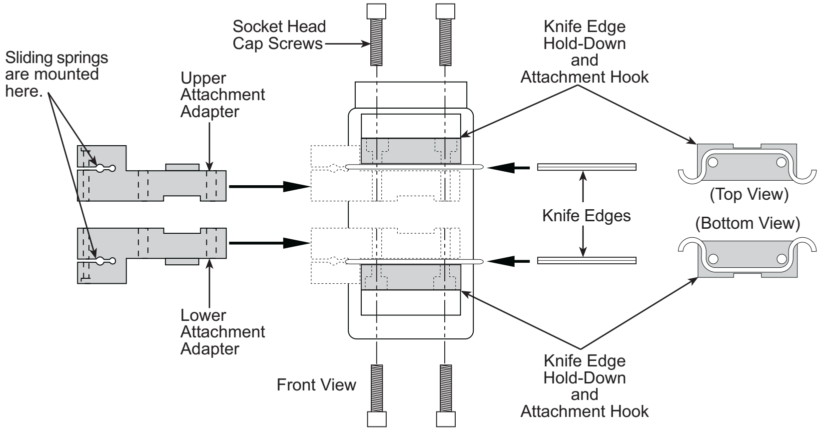
1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.



2. Using a small adjustable wrench, grasp the sides of the upper arm.
3. Loosen the socket head cap screws with a hex wrench.
4. Repeat Step 2 and Step 3 to loosen the socket head cap screws on the lower arm.
5. With the attachment hook in place, loosely attach the quick attachment spring attachment adapter to the extensometer arm. Repeat this step for the other arm.
6. Slide the selected knife edge under the attachment adapter and between the two socket head cap screws on each extensometer arm.
   - Use straight knife edges for round specimens. If straight knife edges are being used, place the flat surface of a machinist's square or similar object across the face of both knife edges to ensure that they are parallel to each other.
   - Use three-point knife edges for flat specimens. Ensure that the single-point contact knife edge is in the upper arm and the two-point contact knife edge is in the lower arm.
7. Tighten the socket head cap screws on both extensometer arms.

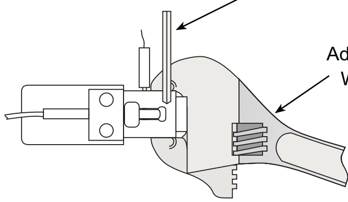
How to Install Sliding Springs

Installing the sliding quick attachment springs on an extensometer involves removing the existing knife edge hold-down from each arm of the extensometer and replacing it with the adapter attachment.



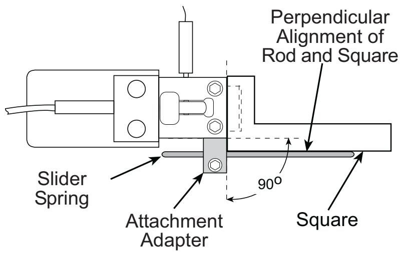
Slide Spring Components

1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.
2. Using a small adjustable wrench, grasp the sides of the upper arm.

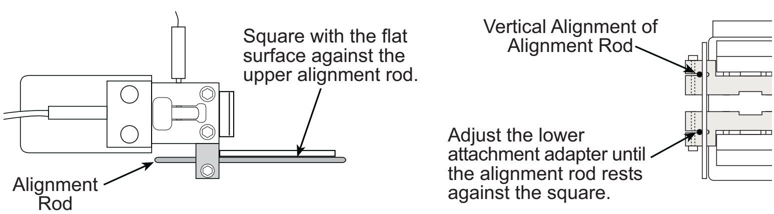


3. While securely holding the extensometer arm, loosen the socket head cap screws with a hex wrench.
4. Repeat Step 2 and Step 3 to loosen the socket head cap screws on the lower arm.
5. Remove the knife edge hold-downs, knife edges, and attachment hooks by removing both socket head cap screws from each extensometer arm.
6. Loosely attach the upper and lower attachment adapters to the respective extensometer arm using the socket head cap screws removed in Step 5.
7. Slide the knife edge between the extensometer arm and the attachment adapter and between the two socket head cap screws.
   - Use straight knife edges for round specimens.
   - Use three-point knife edges for flat specimens. Ensure that the single-point contact knife edge is in the upper arm and the two-point contact knife edge is in the lower arm.
8. Tighten the socket head cap screws only enough to secure the knife edges.
9. Insert the alignment rod into the attachment adapter as shown in the Attachment Adapter Alignment figure.

10. Place one edge of a machinist's square against the front edge of the top extensometer arm. Adjust the attachment adapter until the alignment rod contacts the perpendicular edge of the square.



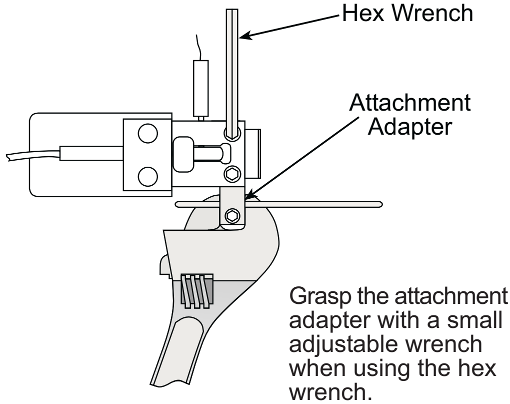
11. To align the alignment rods vertically, place the flat surface of the machinist's square against the alignment rod in the upper attachment adapter. Adjust the lower attachment adapter until both alignment rods are resting against the surface of the square.



Attachment Adapter Alignment

12. If straight knife edges are being used, place the flat surface of the machinist's square across the face of both knife edges to ensure that both edges are parallel to each other.

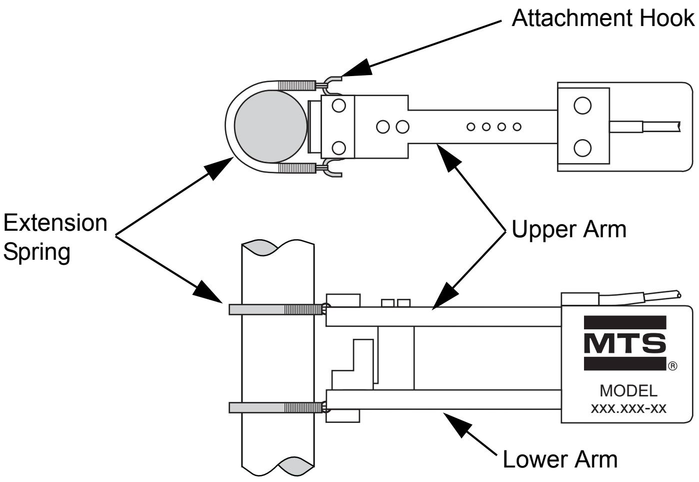
13. Being careful not to change the attachment adapter alignment, use a small adjustable wrench to grasp the attachment adapter.



14. While securely holding the attachment adapter, fully tighten the socket head cap screws in that arm of the extensometer with a hex wrench.
15. Repeat Step 13 and Step 14 to tighten the other attachment adapter.
16. Remove the alignment rod from the attachment adapter. Insert the selected spring type (as determined by the shape of the specimen—round or flat) in each attachment adapter.

How to Install Extension Springs or Elastic Bands

Installing the extension spring or elastic band attachment system involves replacing the quick attachment spring attachment adapters on each arm of the extensometer with knife edge hold-downs and attachment hooks.



Component Identification

⚠ CAUTION

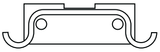
Excessive torque on the extensometer arms can damage the extensometer.

The extensometer arms can be damaged when mishandled.

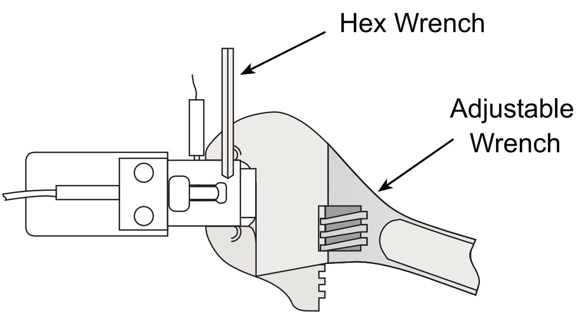
Do not hold the extensometer case when loosening or tightening the socket head cap screws. Use an adjustable wrench to hold the extensometer arm or attachment adapter. Loosen or tighten only those socket head cap screws on the arm being held with the wrench.

The attachment hooks are usually always installed between the knife edge and knife hold-down on each arm of the extensometer. Depending on the model of the extensometer and the type of mounting required, the hooks are sometimes removed.

To install the attachment hooks:



1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.
2. Using a small adjustable wrench, grasp the sides of the upper arm.



3. While securely holding the extensometer with the wrench, loosen the socket head cap screws with a hex wrench.
4. Repeat Step 2 and Step 3 to loosen the socket head cap screws on the lower extensometer arm.
5. Remove the knife edge holddown and knife edge by removing both socket head cap screws from each extensometer arm.
6. Slide the knife edge between the extensometer arm and the knife edge hold-down.
   - Use straight knife edges for round specimens.
   - Use three-point knife edges for flat specimens. Ensure that the single-point contact knife edge is in the upper arm and the two-point contact knife edge is in the lower arm.
7. Place the attachment hook between the upper knife edge hold-down of the upper extensometer arm knife edge.

8. Loosely attach the upper knife edge hold-down to the upper extensometer arm using the two socket head cap screws removed in Step 5. Ensure that the attachment hook is behind both socket head cap screws.

9. Repeat Step 7 and Step 8 for the lower arm.

10. Tighten the socket head cap screws only enough to secure the knife edges.

11. If straight knife edges are being used, place the flat surface of a machinist's square or similar object across the face of both knife edges to ensure that both edges are parallel to each other.

12. Use a small adjustable wrench to grasp the sides of the upper arm.

13. While securely holding the extensometer arm, fully tighten the socket head cap screws with a hex wrench.

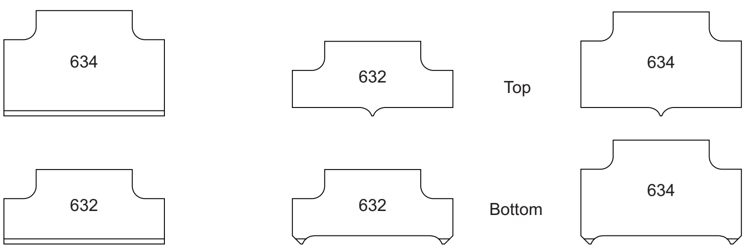
14. Repeat Step 12 and Step 13 to tighten the socket head cap screws on the lower arm.

How to Change Knife Edges

Knife edges are available in straight or three-point contact sets:

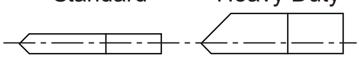
- Straight knife edges are used for testing round specimens.
- Three-point contact knife edges are used for testing flat specimens. One knife edge has a single point and the other knife edge has two points.

Note *The knife edges for the Series 632 Extensometers and the Series 634 Extensometers are not interchangeable. The differences are shown in the following figure.*



Straight Knife Edge **Three-Point Knife Edge Set**

Knife edges are available in the standard size, in a heavy duty size, and in an extended length size. The heavy duty and extended length knife edges are approximately twice as thick as the standard ones. To maintain the proper gage length, the contact edge is off center. Heavy duty and extended length knife edges also require special knife edge hold-downs or special attachment adapters for quick attachment springs. Extended length knife edges provide more clearance between the specimen and the ends of the extensometer arms.



⚠ CAUTION

Excessive torque on the extensometer arms can damage the extensometer.

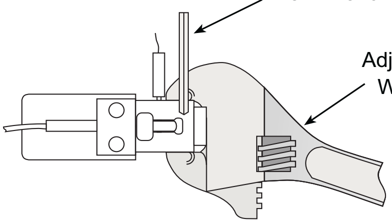
The extensometer arms can be damaged when mishandled.

Do not hold the extensometer case when loosening or tightening the socket head cap screws. Use an adjustable wrench to hold the extensometer arm or attachment adapter. Loosen or tighten only those socket head cap screws on the arm being held with the wrench.

To change knife edges:

1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

2. Use a small adjustable wrench to grasp the upper arm or attachment adapter.

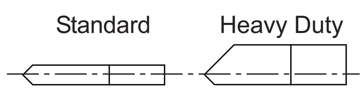


3. While securely holding the extensometer arm or attachment adapter, loosen the socket head cap screws with a hex wrench just enough to remove the knife edges.

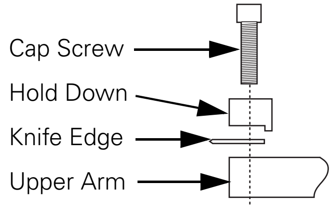
4. Repeat Step 2 and Step 3 to loosen the socket head cap screws in the lower arm.

5. Slide out the existing knife edge.

Note *When using heavy duty or extended length knife edges, the contact edges are off center to maintain the proper gage length. The orientation of the knife edges will vary depending on the extensometer model being used. See the knife edge installation drawing that accompanied the knife edge kit for the proper orientation.*



6. Slide the knife edge between the extensometer arm and the knife edge hold-down or attachment adapter



- Use straight knife edges for round specimens.
- Use three-point knife edges for flat specimens. Ensure that the single-point contact knife edge is in the upper arm and the two-point contact knife edge is in the lower arm.

7. Tighten the socket head cap screws only enough to secure the knife edges.

   If straight knife edges are being used, place the flat surface of a machinist's square or similar object across the face of both knife edges to ensure that both edges are parallel to each other.

8. If necessary, use a small adjustable wrench to grasp the sides of one extensometer arm or attachment adapter (see the figure in Step 2).

9. While securely holding the extensometer arm or attachment adapter, fully tighten the socket head cap screws in that arm with a hex wrench.

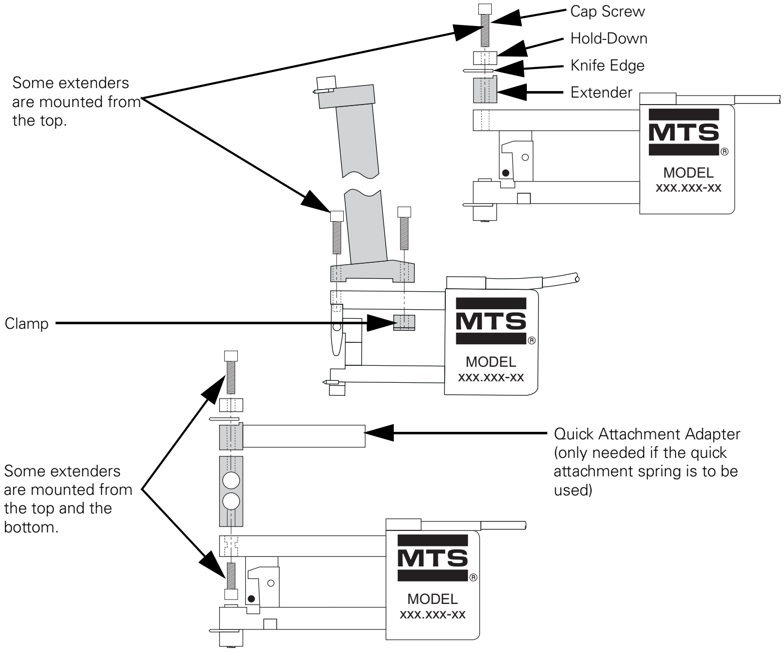
10. Repeat Step 8 and Step 9 to tighten the socket head cap screws in the other extensometer arm.

About Gage Lengths

The gage length of an extensometer can be changed by installing gage length extenders or gage length de-extenders. Changing the gage length does not change the travel of the extensometer.

How to Use Gage Length Extenders

Gage length extenders let you change where the extensometer contacts the specimen. The following figure shows several of the most common methods to install gage length extenders.



The following procedure describes a typical gage length extender installation. Actual installation may vary, see the installation drawing accompanying the gage length extender for specific details.

1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.
2. Remove the existing knife edge hold-down or quick attachment adapter from the upper arm of the extensometer. Take care not to loosen the spring attachment hooks and knife edges.

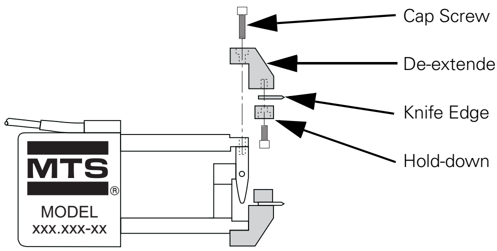
Note *A knife edge hold-down and spring attachment hook for small diameter specimens is already attached to the gage length extender.*

3. Attach the gage length extender to the upper arm of the extensometer using the socket head cap screws provided in the kit.
4. Install the knife edge hold-down to the top of the extender.
   - If you are using metal extension springs or elastic bands, the knife edge hold-down has a spring attachment hook mounted to it.
   - If you are using quick attachment springs, the knife edge hold-down may be part of the quick attachment adapter.
5. Follow the appropriate procedure to recalibrate the extensometer.

How to Use Gage Length De-Extenders

Gage length de-extenders let you change where the extensometer contacts the specimen. The following figure shows a typical gage length de-extender.

Each gage length de-extender comes with a knife edge hold-down, knife edge and spring attachment hook already installed.



The following procedure describes a typical gage length de-extender installation. Actual installation may vary. See the installation drawing accompanying the gage length de-extender for specific details.

1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

2. Remove the existing knife edge hold-down or quick attachment adapter from the upper arm of the extensometer. Take care not to loosen the spring attachment hooks and knife edges.

Note *A knife edge hold-down and spring attachment hook for small diameter specimens are already attached to the de-extender.*

3. Loosely attach a gage length de-extender to one arm of the extensometer. Use the socket head cap screws which secured the fixtures removed in Step 2.

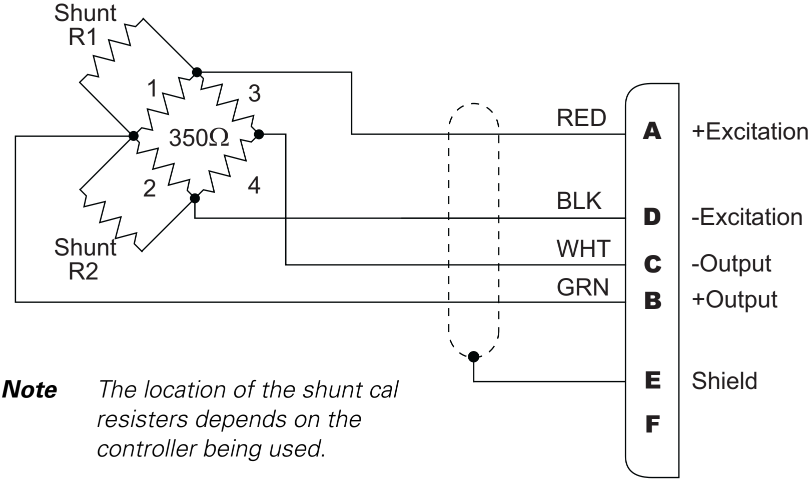
4. While pressing the de-extender against the end of the extensometer arm, tighten the two socket head cap screws.

5. Repeat Step 3 and Step 4 for the other extensometer arm.

6. Follow the appropriate procedure and recalibrate the extensometer.

How to Connect the Cable

The extensometer cable connects to the system controller via an extension cable. The extensometer has a small cable and connector built in. An extension cable is installed between the extensometer connector and the system controller. Ensure that the extensometer is connected to the appropriate controller connector. The controller connector must be associated with a DC conditioning circuit. The following figure shows the circuitry and connector pin assignments from the extensometer.



Note *The location of the shunt cal resisters depends on the controller being used.*

Extensometer Electrical Connections

The following information pertains to your system controller:

- The location of the shunt resistors differs with each controller. See your controller manual for more information about the shunt calibration resistors.
- The location of the bridge balancing circuitry differs with each controller. See your controller manual for more information about the bridge balancing circuitry.
- Extensometer connector = PT01A-10-6P (or equivalent)
- Mating connector = PT06A-10-6S

1. Attach the plastic connector holder, provided with the extensometer, to the load unit column.

2. Connect the connector, attached to the cable extending from the extensometer, to the mating connector on the appropriate system cable.

Note *An adapter cable (MTS part number 039-704-601) is available which allows connection between the PT connector on the extensometer cable and an Amphenol connector on an existing system cable.*

3. Mount the connector assembly in the plastic holder.

Calibration

This section describes how to calibrate an axial extensometer with a controller. Calibration ensures that the output from the extensometer accurately represents the displacement measured by the extensometer. Three adjustment methods are described.

Contents

Calibration Overview

The calibration process coordinates the interaction between the transducer, a DC conditioning circuit, and a cable. Calibration of a transducer is a two step process:

- First, a specific output of the conditioner is adjusted to a specific displacement of the transducer. This is performed by adjusting the excitation voltage and amplification (gain) of the conditioner.
- The second step verifies the output the transducer/ conditioner versus a known standard displacement over the entire range of measurement.

Certified Calibration

MTS Systems Corporation offers a transducer calibration service. The service offers full calibration (including verification) of your transducer to ASTM E83. Further information on the verification procedure can be found in the two predominant standards for transducers, ASTM E83 and ISO 9513.

Gain

The conditioner is designed to have an output of approximately ±10 V at the full-scale displacement of the desired range. Most transducers may be used with this conditioner to obtain full-scale ranges down to 10% of the full travel range of the transducer. (Full-scale ranges of 5% may be possible, but some increase in drift and noise will result.)

In most transducers, the best linearity is obtained by setting the gain between 70% and 90% of the desired travel range instead of 100%. The adjustment procedures in this manual use 80% full scale as the reference value.

Delta K

Delta K is a feature of DC conditioners manufactured by MTS Systems Corporation. Delta K compensates for differences in symmetry between the positive and negative outputs of the transducer. Gain is usually adjusted to calibrate the compression half of the transducer range. Use Delta K to calibrate the tension half of the transducer range.

Symmetrical versus Asymmetrical Extensometers

Typical extensometers may have only positive output (tension only), or may have both positive and negative output (tension and compression). It is also possible that the extensometer has asymmetrical travel (such as +10 mm and -2 mm). It is important that you determine the full scale travel range of the extensometer before proceeding.

For example

Suppose you have an extensometer with an asymmetrical travel of +10 mm and -2 mm. It is desired to adjust the conditioner to have a full-scale output equal to the full travel range of the extensometer. In this case +10 mm would approximately equal +10 V, and -2 mm would have an output of -2 V. Gain would be adjusted so that -2mm would yield -2 V, and delta K would be adjusted so that +8 mm would yield +8 V while adjustments to zero are made to keep the null position of the extensometer at zero.

In all cases, the actual displacement should be used to determine the calculated output.

$$\left(\frac{\text{Actual Displacement}}{\text{Full-Scale Range}}\right) \times 10\text{ V} = \text{Calculated Output}$$

Note *It may be difficult to obtain a displacement value of exactly 80% full scale. In those cases, find a displacement you can achieve* *and calculate the new conditioner output value for the displacement. For example, suppose the calibration block is set for 7.94 mm. Then your desired output would be 7.94 V.*

The following table shows the proper conditioner output for each extensometer displacement of the preceding example.

.

% Full Scale	Actual Displacement	Output
100%	10 mm	+10 V
80%	8 mm	+8 V
60%	6 mm	+6 V
40%	4 mm	+4 V
20%	2 mm	+2 V
Zero	0 mm	0 V
-20%	-2 mm	-2 V

Adjust gain/ΔK for ±80% travel of a symmetrical extensometer. Adjust gain for 80% or maximum negative travel (whichever is greater) and ΔK for 80% of positive travel of an asymmetrical extensometer.

How to Use a Vernier Caliper

This method requires a tool such as vernier caliper, micrometer, or other precision measuring device. Use this procedure as a guideline to adjust the gain for other sensors that can use the DC conditioner.

Note *This is not the most accurate method, but may be used depending upon your needs.*

1. Set up the controller.

   Your test controller must be configured to use the extensometer signal.

   A. Connect the extensometer to your controller.

   B. Monitor the excitation voltage.

   C. Monitor the extensometer signal.

D. Prepare to use the calibration controls on your controller.

E. Adjust the excitation control to set the excitation to +6 V DC or the voltage specified in the extensometer documentation.

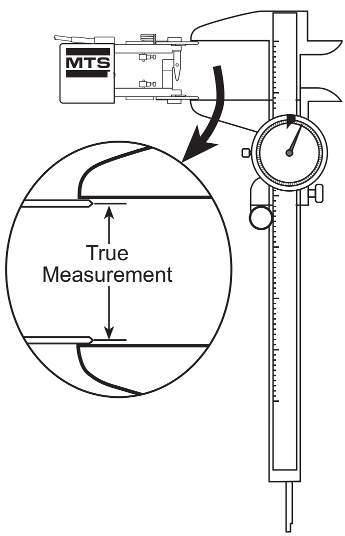
2. Zero the conditioner output.

The arms of the extensometer must be in the zero reference position. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

Adjust the zero control to set the extensometer signal to 0.00 V DC.

Note *Several extensometers have asymmetrical outputs. This means that the compression and tension outputs are not equal. Ensure that you are aware of the maximum ratings of the extensometer you are calibrating.*

3. Adjust compression.



Because a true measurement is from the middle of each extensometer arm, you must subtract the thickness of one of the arms.

A. Remove the zero pin, fixture, or release the zero stop and measure the extensometer arms as shown.

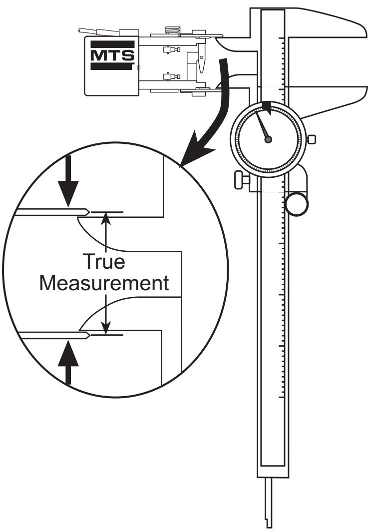
B. Adjust the caliper for a 80% compression displacement (remember to subtract the thickness of one knife edge).

C. Adjust the gain control to set the extensometer signal to -8 V DC (or 80% of your calculated output).

4. Readjust the zero and compression.

   Repeat Step 2 and Step 3 until the zero and gain outputs can be measured without readjustment.

5. Adjust tension.



Since a true measurement is from the middle of each extensometer arm knife edge, you must add the thickness of one of the knife edges.

A. Measure the extensometer arms as shown. You will need to pinch the extensometer arms to contact the caliper.

B. Adjust the caliper for a 80% tension displacement (or the maximum positive travel). Remember to add the thickness of one arm.

C. Check the meter reading.

- If the extensometer signal is above +8 V DC (or 80% of your calculated output), adjust delta K for an extensometer signal of +8 V DC.

- If the extensometer signal is below +8 V DC (or your calculated output), the ΔK adjustment cannot be made. Return the ΔK adjustment to its original setting and use the gain control to increase the voltage halfway from its present value to +8 V DC (this splits the difference between compression and tension).

How to Use a Calibration Block

MTS recommends using a calibration block to establish the initial gain setting of the conditioner. The calibration block is a metal block with grooves cut into it. The grooves allow you to adjust the gain for specific displacements. The calibration block is usually provided by the manufacturer of the extensometer. Use this procedure as a guideline to calibrate other extensometers.

1. Set up the controller.

   Your test controller must be configured to use the extensometer signal.

   A. Connect the extensometer to your controller.

   B. Monitor the excitation voltage.

   C. Monitor the extensometer signal.

   D. Prepare to use the calibration controls on your controller.

   E. Adjust the excitation control to set the excitation to +6 V DC or the voltage specified in the extensometer documentation.

2. Zero the conditioner output.

   The arms of the extensometer must be in the zero reference position. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

   Adjust the zero control to set the extensometer signal to 0.00 V DC.

Note *Several extensometers have asymmetrical outputs. This means that the compression and tension outputs are not equal. Ensure that you are aware of the maximum ratings of the extensometer you are calibrating.*

3. Adjust compression.

A. Remove the zero pin, fixture, or release the zero stop and install the extensometer on the calibration block so that the extensometer arms are in the grooves that represent about 80% compression displacement.

B. Adjust the gain control to set the extensometer signal to -8 V DC (or 80% of your calculated output).

4. Readjust the zero and compression.

   Repeat Step 2 and Step 3 until the zero and gain outputs can be measured without readjustment.

5. Adjust tension.

   Remove the extensometer from the calibration block and reinstall it so arms of the extensometer are in the grooves that represent the 80% tension displacement (or the maximum positive travel).

   - If the extensometer signal is above +8 V DC (or your calculated output), adjust the ΔK (delta K) control for an extensometer signal of +8 V DC.

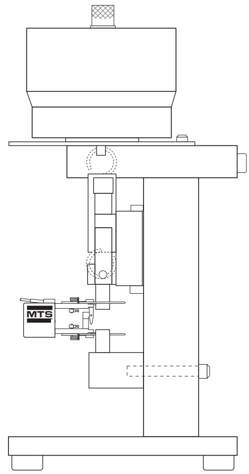
   - If the extensometer signal is below +8 V DC (or your calculated output), the ΔK adjustment cannot be made. Return the ΔK adjustment to its original setting and use the gain control to increase the voltage halfway from its present value to +8 V DC (this splits the difference between compression and tension).

How to Use a Calibration Stand

This method requires a tool such as the Model 650.03 Calibrator from MTS Systems Corporation. Use this procedure as a guideline to calibrate other extensometers.

1. Set up the controller.

   Your test controller must be configured to use the extensometer signal



A. Connect the extensometer to your controller.

B. Monitor the excitation voltage.

C. Monitor the extensometer signal.

D. Mount the extensometer onto the calibrator. Install it for the zero position. Use the zero pin if it is available.

   This figure shows a typical installation. Each extensometer can use a variety of extensions, attachments, and other mounting accessories.

E. Prepare to use the calibration controls on your controller.

F. Adjust the excitation control to set the excitation to +6 V DC or the voltage specified in the extensometer documentation.

2. Zero the conditioner output.

   The arms of the extensometer must be in the zero reference position. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

   Adjust the zero control to set the extensometer signal to 0.00 V DC.

Note *Several extensometers have asymmetrical outputs. This means that the compression and tension outputs are not equal. Ensure that you are aware of the maximum ratings of the extensometer you are calibrating.*

3. Adjust compression.

   A. Remove the zero pin, fixture, or release the zero stop.

   B. Adjust the calibrator between zero and 100% compression of the extensometer's full-scale range three times. This exercises the extensometer to remove any hysteresis.

   C. Adjust the calibrator for the 80% compression setting (or the range being calibrated) and note the voltmeter reading.

   - If the meter reading is less than -8 V DC you can adjust gain. Adjust the gain control to set the extensometer signal to -8 V DC (or 80% of your calculated output).

   - If you cannot adjust the gain control to set the extensometer signal to -8 V DC, you can change the excitation voltage.

4. Readjust the zero and compression.

   Repeat Step 2 and Step 3 until the zero and gain outputs can be measured without readjustment.

5. Adjust tension.

   A. Adjust the calibrator between zero and 100% tension of the extensometer’s full-scale range three times. This exercises the extensometer to remove any hysteresis.

   B. Adjust the calibrator for 80% tension (or for the maximum positive travel) of the range you are calibrating. Note the meter reading.

   - If the extensometer signal is above +8 V DC (or your calculated output), adjust the ΔK (delta K) control for an extensometer signal of +8 V DC.

   - If the extensometer signal is below +8 V DC (or your calculated output), the ΔK adjustment cannot be made. Return the ΔK adjustment to its original setting and use the gain control to increase the voltage halfway from its present value to +8 V DC (this splits the difference between compression and tension).

Installation

This section describes how to mount the extensometer to a specimen and zero the extensometer output.

Contents

WARNING

Handling the extensometer while it is selected as the active control mode can cause the actuator to move unpredictably.

Unpredictable actuator movement can cause personnel injury or damage to the test equipment.

Ensure that the extensometer is not active when installing it to a specimen.

The shield of the Extensometer (pin E for PT style connector and pin A for Amphenol style connector) must be connected to the controllers chassis ground. This is typically accomplished by using a metal or metalized plastic connector and a braided shielded cable from the controller to the Extensometer cable, see MTS cable part numbers 50-120-0xx PT style or 56-233-6xx Amphenol style for an example.

Zero Extensometer Output

The purpose of zeroing the extensometer output is to identify the starting position of the extensometer to the system controller. An extensometer usually needs to be zeroed (at least checked) after it has been installed.

For example, suppose the extensometer is installed and is a bit off from its calibrated zero position. The controller can be programmed to accept the current output from the extensometer as the zero output.

See your controller manual for information on establishing the extensometer zero output signal. The electrical output of the extensometer is adjusted so that zero strain equals zero volts output.

Depending on the extensometer, the zero reference can be accomplished using the zero pin, stop block, or a special fixture.

- Some extensometers includes a zero pin that can be inserted into a zero reference hole. This locks the extensometer arms in the zero reference position. This is useful for specimen installation.
- Some extensometers have a zero stop built into the arms of the extensometer. A zero stop works like an overtravel block. When installing a specimen, pinch the two arms of the extensometer together. This stops the extensometer's arms in the zero position.
- Some extensometers require special fixtures that set the arms of the extensometer into the proper zero reference position.

How to Mount an Extensometer

Axial extensometers can be installed using quick attachment springs, extension springs, or elastic bands.

- There are two types of quick attachment springs: a sliding spring and an anchored spring.
- Extension springs and elastic bands mount the extensometer to a specimen in the same way.

Prerequisites

The extensometer must be configured with the appropriate attachments for the specimen and test.

The extensometer must also be calibrated for use. Every range defined for the extensometer should be calibrated.

Procedure

When installing an axial extensometer on a specimen, the arms of the extensometer must be in the zero reference position.

1. Zero the arms of the extensometer. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

2. Hold the extensometer so that its knife edges contact the specimen.

3. Secure the upper arm around of the extensometer the specimen.

   - If you are using an anchored spring mount, clip the spring around the specimen. If you need to change the anchor position, see the appropriate procedure.

   - If you are using a sliding spring mount, see the appropriate procedure.

   - If you are using extension springs, connect one end of the extension spring to the hook attachment of the upper arm. Use the small utility hook to grab the other spring and pull it around the specimen to the other attachment hook.

   - If you are using an elastic band, connect one end of the elastic band to the hook attachment for the upper arm. Use the small utility hook to grab the other elastic band and pull it around the specimen to the other attachment hook.

4. Repeat Step 3 for the lower arm of the extensometer.

5. Zero the extensometer's output.

   A. Remove the zero pin, fixture, or release the zero stop.

   B. Check the extensometer output at your controller.

   C. If necessary, zero the extensometer output at your controller.

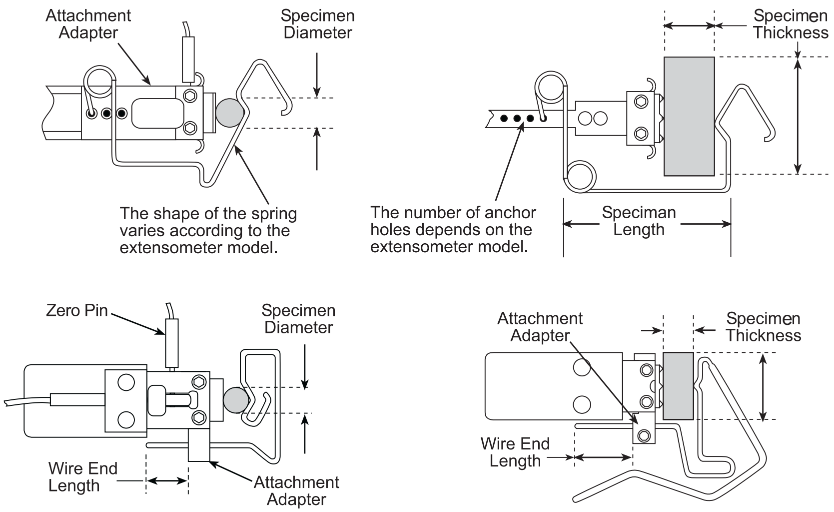
About Quick Attachment Springs

Quick attachment springs hold the extensometer onto the specimen with a pair of special springs that clip around the specimen (see the following figure).

Each extensometer is provided with one spring set for round specimens and two spring sets for flat specimens (one spring set with a short spring length and one spring set with a long spring length).

Quick attachment springs can be adjusted to accommodate different specimen thicknesses. They can be adjusted by sliding the spring in or out of the attachment adapter or by anchoring the spring in a different hole on the attachment adapter.

Note *If the specimen dimension is outside the range of the quick attachment springs, other attachment methods must be used, such as metal extension springs or elastic bands (an assortment is provided with the extensometer), half disks, or wireform springs.*



A Variety of Quick Attachment Springs

Two types of springs

There are two types of quick attachment springs: sliding springs (the upper examples in the preceding figure) and anchored springs (the lower examples in the preceding figure). Sliding springs also accommodate the specimen thickness along with adjusting the clamping pressure on the specimen. Anchored springs have several preset holes to anchor the spring to accommodate the specimen thickness.

How to Adjust the Sliding Spring Length

To mount an extensometer that has a sliding quick attach spring:

1. The arms of the extensometer must be in the zero reference position. Depending on the extensometer, this can be accomplished using the zero pin, stop block, or a special fixture.

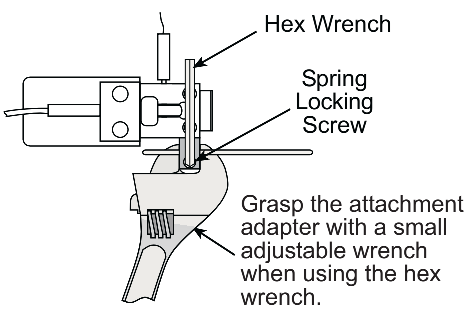
⚠ CAUTION

The extensometer arms can be damaged when mishandled.

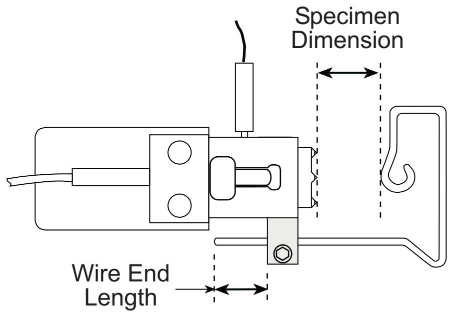
Excessive torque on the extensometer arms can damage the extensometer.

Use an adjustable wrench to hold the extensometer arm or attachment adapter. Loosen or tighten only those socket head cap screws on the arm being held with the wrench. Do not hold the extensometer case when loosening or tightening the socket head cap screws.

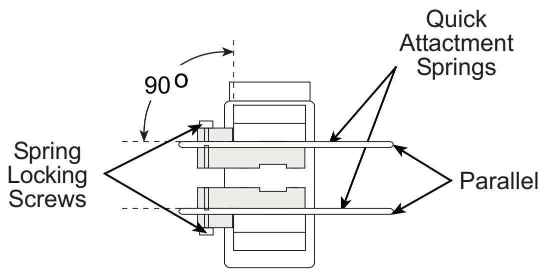
2. Using a small adjustable wrench, grasp the sides of one attachment adapter.



3. While securely holding the attachment adapter, loosen the spring locking screw on that attachment adapter with a hex wrench.
4. Repeat Step 2 and Step 3 to loosen the spring locking screw on the other attachment adapter.
5. While measuring the wire end length, slide the spring in or out as required for the specimen diameter or thickness.



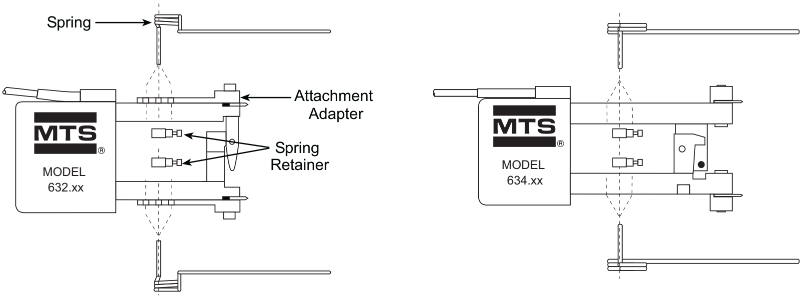
6. Ensure that the plane of the spring end is perpendicular to the side of the extensometer.
7. While securely holding the attachment adapter with the adjustable wrench, tighten the spring locking screw on that attachment adapter.
8. Repeat Steps 1–6 for the other spring.
9. Check to ensure that both springs are parallel to each other and perpendicular to the side of the extensometer.



How to Select an Anchor Position

You will need the installation drawing that came with the extensometer for this procedure.

1. Separate the spring retainers from the springs by loosening (do not remove) the socket head cap screws.



2. Mount one spring in the appropriate hole in the attachment adapter as determined by the specimen dimensions (see the installation drawing).

3. Slide the spring retainer over the end of the spring and tighten the socket head cap screw. Orient the spring retainer in such a way that it will not interfere with movement of the extensometer arm.

About Metal Extension Springs

Metal extension springs may be used for testing throughout the temperature range of the extensometer. The metal extension springs are stainless steel with an outside diameter of 3.18 mm (0.125 in). The spring wire is 0.41 mm (0.016 in) thick. More than one spring can be connected end-to-end to accommodate large specimens.

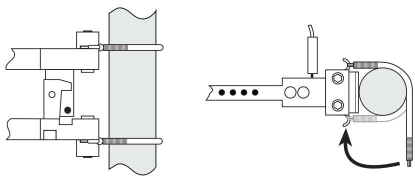
Spring length is selected based on specimen size and required contact force. The recommended contact force is approximately 600 grams.

- Greater contact force will provide a more secure attachment under conditions where slippage may occur such as operating at high cyclic frequencies. The knife edges can damage the specimen at high contact forces.

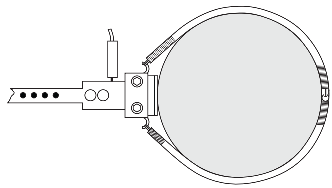
- Less contact force will reduce the possibility of damage to soft specimens; however, the possibility of slippage increases.

Round specimens

An extension spring attachment method can be used for large and small diameter round specimens. It can be used by all axial extensometers.



One spring can be used on smaller diameter specimens.

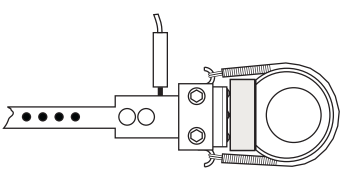


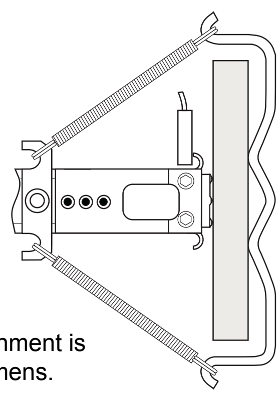
Two springs can be used for larger diameter specimens.

Flat specimens

An extensometer can be mounted to a flat specimen with extension springs using a disk or wireform attachment. When using a wireform attachment, it is necessary to replace the attachment adapters with knife edge hold-downs.

The disk attachment is for narrow, flat specimens.





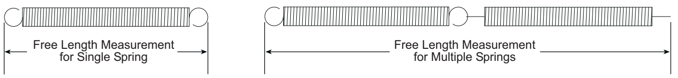
The wireform attachment is for wide, flat specimens.

Extension Spring Table

Use the following table to determine which extension spring to use for a specific specimen diameter. Depending on the specimen diameter, you can select between different spring lengths and specimen contact forces. The table shows the recommended spring lengths for a specific specimen diameter and the contact force on the specimen for each spring length.

Note *The recommended contact force is approximately 600 grams.*

SPRING FREE LENGTH MM (IN)



SPECIMEN DIAMETER MM (IN)	12.7 (0.50)	15.9 (0.62)	19.0 (0.75)	22.2 (0.87)	25.4 (1.00)	28.6 (1.12)	31.8 (1.25)	34.9 (1.37)	38.1 (1.50)
2.0 (0.08)	340								
3.0 (0.12)	670								
4.0 (0.16)	950	440							
5.0 (0.20)		660	300						
6.0 (0.24)		840	480						
7.0 (0.28)		1000	640	340					
8.0 (0.32)			780	495					
9.0 (0.35)			925	620	360				
10.0 (0.39)			1080	750	500	315			
11.0 (0.43)				880	620	470			
12.0 (0.47)				1000	705	585	360		
13.0 (0.51)					825	685	470		
14.0 (0.55)					910	780	580	380	
15.0 (0.59)					1000	865	670	510	415
16.0 (0.63)						950	760	620	505
17.0 (0.67)						1030	840	725	580
18.0 (0.71)							920	815	650
19.0 (0.75)							990	900	720
20.0 (0.79)							1035	960	800

CONTACT FORCE (GRAMS)

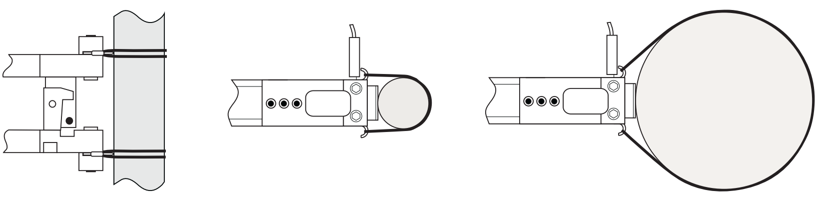
About Elastic Bands

Elastic bands are commonly used for testing at near room temperature. The contact force may be varied by the cross-section size of the elastic band and its overall length. Elastic bands can be used by all axial extensometers.

- Elastic bands (rubber bands) of the type provided with the extensometer are available from stationery supply stores.
- Orthodontic elastic bands may also be used and are available from medical supply houses.

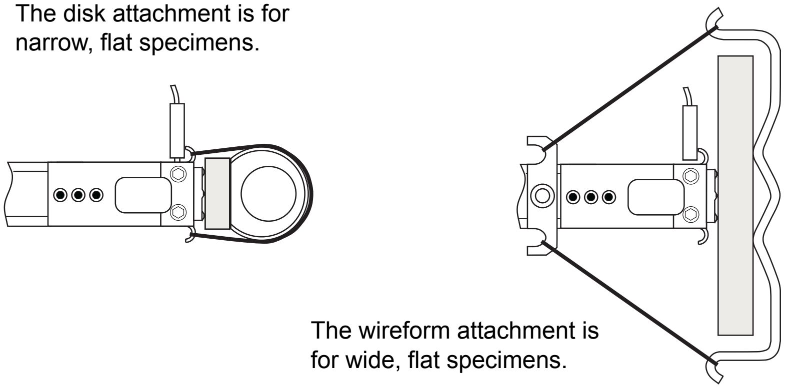
Round specimens

An elastic band attachment method can be used with round specimens. Each knife edge requires a band to secure it to the specimen.



Flat specimens

An extensometer can be mounted to a flat specimen with elastic bands using a disk or wireform attachment. When using a wireform attachment, it is necessary to replace the attachment adapters with knife edge hold-downs.



Contact force

Determining the specimen contact force when using elastic bands is difficult.

- Greater contact force will provide a more secure attachment under conditions where slippage may occur such as operating at high cyclic frequencies. The knife edges can damage the specimen at high contact forces.
- Less contact force will reduce the possibility of damage to soft specimens; however, the possibility of slippage increases.

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