

# DHR

## Electrorheological (ER) Accessory



### Getting Started Guide



## Notice

The material contained in this manual, and in the online help for the software used to support this instrument, is believed adequate for the intended use of the instrument. If the instrument or procedures are used for purposes other than those specified herein, confirmation of their suitability must be obtained from TA Instruments. Otherwise, TA Instruments does not guarantee any results and assumes no obligation or liability. TA Instruments also reserves the right to revise this document and to make changes without notice.

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# Introduction

## **Important: TA Instruments Manual Supplement**

Please click the [TA Manual Supplement](#) link to access the following important information supplemental to this Getting Started Guide:

- TA Instruments Trademarks
- TA Instruments Patents
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- TA Instruments End-User License Agreement
- TA Instruments Offices


## Notes, Cautions, and Warnings

This manual uses NOTES, CAUTIONS, and WARNINGS to emphasize important and critical instructions. In the body of the manual these may be found in the shaded box on the outside of the page.

**NOTE:** A NOTE highlights important information about equipment or procedures.

**CAUTION:** A CAUTION emphasizes a procedure that may damage equipment or cause loss of data if not followed correctly.

**MISE EN GARDE:** UNE MISE EN GARDE met l'accent sur une procédure susceptible d'endommager l'équipement ou de causer la perte des données si elle n'est pas correctement suivie.

	<p><b>A WARNING indicates a procedure that may be hazardous to the operator or to the environment if not followed correctly.</b></p> <p><b>Un AVERTISSEMENT indique une procédure qui peut être dangereuse pour l'opérateur ou l'environnement si elle n'est pas correctement suivie.</b></p>
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## Regulatory Compliance

### *Safety Standards*

#### **For European Economic Area**

(In accordance with Council Directive 2006/95/EC of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.)

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

EN 61010-2-010:2003 Particular requirements for laboratory equipment for the heating of materials + Amendments.

# Electromagnetic Compatibility Standards

## For Australia and New Zealand

AS/NZS CISPR11:2004 Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment.

## For Canada

ICES-001 Issue 4 June 2006 Interference-Causing Equipment Standard: Industrial, Scientific, and Medical Radio Frequency Generators.

## For the European Economic Area

(In accordance with Council Directive 2004/108/EC of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility.)

EN61326-1:2006 Electrical equipment for measurement, control, and laboratory use-EMC requirements-Part 1: General Requirements. Emissions: Meets Class A requirements per CISPR 11. Immunity: Per Table 1 - Basic immunity test requirements.

## For the United States

CFR Title 47 Telecommunication Chapter I Federal Communications Commission, Part 15 Radio frequency devices (FCC regulation pertaining to radio frequency emissions).

## Safety



**WARNING:** The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

**AVERTISSEMENT:** L'utilisateur de cet instrument est prévenu qu'en cas d'utilisation contraire aux indications du manuel, la protection offerte par l'équipement peut être altérée.



**WARNING:** To avoid potential injury or death, do not attempt to install or operate the ER Accessory until you have read this Getting Started Guide and amplifier documentation in their entirety. The documentation includes important information regarding safety and operation.

**AVERTISSEMENT:** Pour éviter d'éventuelles blessures ou la mort, n'essayez pas d'installer ou d'utiliser l'accessoire ER tant que vous n'avez pas entièrement lu le guide de démarrage et la documentation du générateur à formant et de l'amplificateur assortis. La documentation inclut d'importants renseignements relatifs à la sécurité et à l'utilisation.

The DHR ER Accessory works in conjunction with a high-voltage amplifier, an ER Interface Module, and the DHR. Refer to the *DHR Getting Started Guide* and the amplifier documentation for important information regarding safety and operation.

## High Voltage



**WARNING:** High voltage is used in the operation of the equipment described herein. Operating personnel must at all times observe all safety regulations governing the installation, operation, and calibration of equipment utilizing high voltage. Death on contact may result if operating personnel fail to observe safety precautions. Learn the area of high voltage connections, and exercise care not to contact these areas when installing, operating, or calibrating this equipment. Do not replace components or cables while power is applied. To avoid injuries or death, always remove power, and discharge and ground an electrical circuit before touching it. Prior to operating this equipment, remove all jewelry. Do not make physical contact with any high voltage connection while power is applied.

**AVERTISSEMENT:** Des tensions élevées sont utilisées dans le fonctionnement de l'équipement décrit dans le présent document. Le personnel d'exploitation doit toujours respecter toutes les règles de sécurité régissant l'installation, l'utilisation et l'étalonnage de l'équipement utilisant de la haute tension. Si le personnel d'exploitation ne respecte pas les précautions d'utilisation, il peut en résulter la mort au contact de cet instrument. Familiarisez-vous avec la zone des raccordements haute tension et faites preuve de prudence pour ne pas toucher ces zones lors de l'installation, l'utilisation ou l'étalonnage de cet équipement. Ne remplacez pas les composants ou les câbles lorsque l'instrument est sous tension. Pour éviter des blessures ou la mort, coupez toujours l'alimentation, déchargez et mettez le circuit électrique à la terre avant de le toucher. Avant d'utiliser cet équipement, retirez tous vos bijoux. N'établissez pas de contact physique avec un raccordement haute tension lorsque l'équipement est sous tension.



**WARNING:** The Trek amplifier is available in two configurations: 110V and 220V. Before operating the ER Accessory, refer to the power label on the rear panel of the Trek amplifier to ensure that the amplifier's configuration is correct for your building's line voltage. See page 12 for more information.

**AVERTISSEMENT:** L'amplificateur Trek est disponible en deux configurations: 110 V et 220 V. Avant d'utiliser l'accessoire ER, consultez l'étiquette des caractéristiques électriques apposée sur le panneau arrière de l'amplificateur TREK pour vous assurer que la configuration de l'amplificateur est appropriée à la tension de la ligne de votre bâtiment. Voir la page 12 pour plus de renseignements.



**WARNING:** DO NOT insert a digital enable shorting plug into the Trek amplifier (shown on page 11) when operating the ER Accessory. The ER Accessory is not safe to operate if the digital enable shorting plug is installed in the amplifier.



**AVERTISSEMENT:** N'insérez pas une fiche de court-circuit à activation numérique (illustrée sur la page 11) dans l'amplificateur Trek lors de l'utilisation de l'accessoire ER. L'accessoire ER ne peut pas être utilisé en toute sécurité si la fiche de court-circuit à activation numérique est installée dans l'amplificateur.

## Required Equipment

While operating this accessory, you must wear eye protection that either meets or exceeds ANSI Z87.1 standards. Additionally, wear protective clothing that has been approved for protection against the materials under test and the test temperatures.

## Accessory Symbols

The following label is displayed on the ER for your protection:

Symbol	Explanation
	<p>This symbol indicates that you should read this Getting Started Guide in its entirety. This guide contains important warnings and cautions related to the installation, operation, and safety of the accessory.</p> <p>Ce symbole indique que vous devez lire entièrement ce guide de démarrage. Ce guide contient d'importants avertissements et mises en garde relatifs à l'installation, à l'utilisation et à la sécurité de l'accessoire.</p>
	<p>This symbol on the polycarbonate ER shield indicates that extreme care should be taken when operating the ER Accessory; the ER operates using voltages up to 4,000 volts (AC or DC).</p> <p>If you are not trained in electrical procedures, do not remove the instrument covers unless specifically instructed to do so in the manual. Maintenance and repair of internal parts must be performed only by TA Instruments or other qualified service personnel.</p> <p>Ce symbole apposé à l'écran ER en polycarbonate indique que des précautions extrêmes doivent être prises lors de l'utilisation de l'accessoire ER ; l'ER fonctionne à l'aide de tensions de 4 000 volts (CA ou CC) maximum.</p> <p>Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'instrument sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par TA Instruments ou tout autre personnel d'entretien qualifié.</p>

Please heed the warning labels and take the necessary precautions when dealing with these areas. The *DHR Electrorheological (ER) Accessory Getting Started Guide* contains cautions and warnings that must be followed for your own safety.

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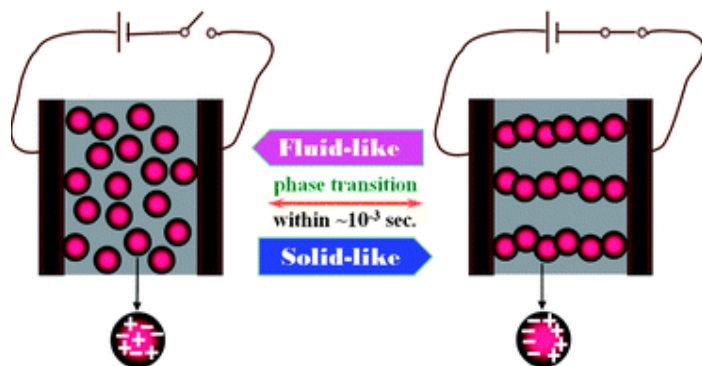
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# Chapter 1:

## Introducing the DHR ER Accessory

### Overview

Electrorheological (ER) fluids are suspensions of extremely fine non-conducting particles in an electrically insulating fluid, which show dramatic and reversible rheological changes when the electric field is applied. These changes in apparent viscosity can be up to five decades in magnitude. For example, a typical ER fluid can go from the consistency of a liquid to that of a solid, and back, with response times on the order of milliseconds. The change in rheological properties depends on the applied electric field, i.e. the potential divided by the distance between the plates. Another way to think of the effect is as an electric field-dependent shear yield stress. When activated, an ER fluid behaves as a Bingham plastic (a type of visco-elastic material), with a yield point that is determined by the electric field strength. After the yield point is reached, the incremental shear stress is proportional to the rate of shear (in a “Newtonian fluid” there is no yield point and stress is directly proportional to shear). Hence, the resistance to motion of the fluid can be controlled by adjusting the applied electric field. ER fluids were discovered around 1940, and today we can see significant improvements in performance and reliability of these materials. Additionally, we see a great deal of interest in characterizing ER fluids, as they have found more potential applications (damping devices, clutches, braking devices, actuators, optical devices, and polishing devices, to name a few).



**Figure 1** Example diagram of phase transition when voltage is applied.

The DHR ER Accessory provides the ability to apply up to 4,000 volts during the course of an experiment using either parallel plate or couette geometry. The temperature range of the ER Accessory depends upon the environmental system used (the widest range,  $-40^{\circ}\text{C}$  to  $200^{\circ}\text{C}$ , is achieved using a Peltier Plate). The voltage is applied via a Trek Amplifier through a special high-voltage cable into the test station that connects onto an insulator block underneath the motor bracket. The voltage is applied to the upper geometry with a spring loaded brush. A special insulator block is placed in the geometry shaft, effectively isolating the motor from the voltage being applied across the geometry to the sample. The bottom environmental option is grounded to complete the circuit. Tests are run either with the Peltier Plate system or the concentric cylinder jacket installed. Due to friction imposed to the upper geometry by the spring loaded brush, testing below  $10\ \mu\text{N}\cdot\text{m}$  (transient and steady) or  $100\ \mu\text{N}\cdot\text{m}$  (oscillation) is not possible when the ER Accessory is used. When performing oscillation tests at small strain amplitude, the spring brush can be removed and replaced by a thin wire to reduce the friction at the upper geometry.

## ER Components

The following section describes the components included with the DHR ER Accessory.

### ER Interface Module

The ER Interface Module is a 10KHz function generator with built-in sine, triangle and square waveform and pulse capabilities. The ER Interface Module is used to generate the AC and/or DC input signal into the Trek Amplifier via the TRIOS software. The Module also monitors the voltage and current signals from the Amplifier and handles the operation of the interlocks.



Figure 2 ER Interface Module.

### Trek Amplifier

The Trek Model 609E-6 generates the high voltage signal to the DHR upper geometry. The signal can range from 0 to 4000 VDC or 4000 VAC (8000 volts peak to peak).

For more information on this unit, including important safety information, refer to the amplifier user guide.



**DO NOT** operate the ER Accessory with a digital enable shorting plug installed. For your safety, remove the shorting plug supplied with the amplifier.

Figure 3 Trek amplifier.



**WARNING: DO NOT** insert a digital enable shorting plug into the Trek amplifier when operating the ER Accessory. The ER Accessory is not safe to operate if the digital enable shorting plug is installed in the amplifier.

**AVERTISSEMENT: N'insérez pas** une fiche de court-circuit à activation numérique dans l'amplificateur Trek lors de l'utilisation de l'accessoire ER. L'accessoire ER ne peut pas être utilisé en toute sécurité si la fiche de court-circuit à activation numérique est installée dans l'amplificateur.



**WARNING:** The Trek amplifier is available in two configurations: 110V and 220V. Before operating the ER Accessory, refer to the power label on the left side of the Trek amplifier rear panel to ensure that the amplifier's configuration is correct for your building's line voltage.

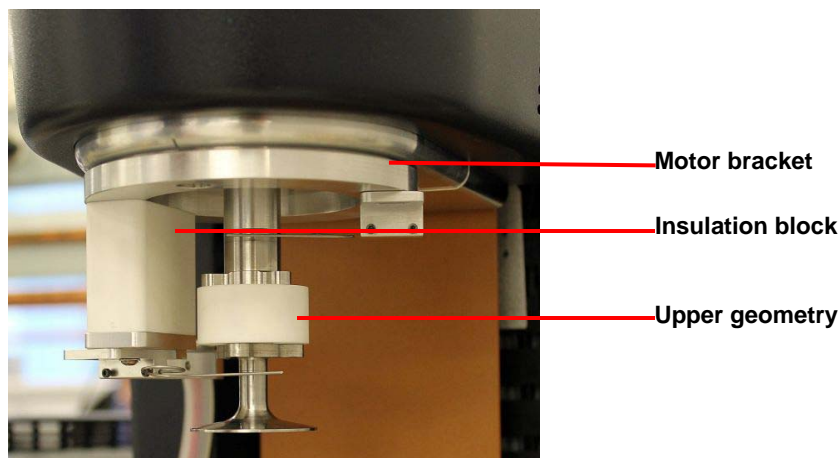
**AVERTISSEMENT:** L'amplificateur Trek est disponible en deux configurations: 110 V et 220 V. Avant d'utiliser l'accessoire ER, consultez l'étiquette des caractéristiques électriques apposée sur le panneau arrière de l'amplificateur TREK pour vous assurer que la configuration de l'amplificateur est appropriée à la tension de la ligne de votre bâtiment.



**Figure 4** Power label on the left side of the Trek amplifier rear panel.

## Insulation Block and Insulated Geometries

The insulation block is mounted on the underside of the motor bracket and is used in conjunction with the special ER upper geometries.



**Figure 5** Insulation block and insulated ER geometry installed on DHR.



**WARNING:** DO NOT use standard geometries with the ER Accessory.

**AVERTISSEMENT:** N'utilisez pas de géométries standard avec l'accessoire ER.

## Polycarbonate ER Shield and Interlocks

The polycarbonate ER shield is a mandatory component of the ER Accessory; as a safety feature, the ER Accessory will not function unless the shield is installed properly and the interlocks are in place.



**Figure 6** ER shield (left); ER shield installed on the DHR (right).

For more information, see [“Installing the Polycarbonate ER Shield” on page 26.](#)

## *ER Accessory Specifications*

**Table 1: ER Accessory Specifications**

Item/Area	Specification
Geometry	25 and 40 mm ER parallel plate and 28 mm ER Conical DIN bob
Temperature system compatibility	Peltier Plate and Peltier Concentric Cylinder
Temperature range	Depends on environmental system; widest possible range of -40 to 200°C for Peltier Plate and -1 to 150°C for Concentric Cylinder—see the <i>Getting Started Guides</i> for these accessories for full specifications.
ER Interface Module	Internal to instrument
High-voltage power amplifier	TREK Model 609E-6
Maximum voltage	0 to 4,000 VDC; 4,000 VAC peak (8,000 peak-peak)
Output current range	0 to $\pm 20$ mA
Safety	Polycarbonate ER shield cover with interlock switch

# Chapter 2:

## Installing the ER Accessory

This chapter briefly describes the installation of the ER Accessory on the DHR.

The ER Accessory is used in conjunction with a Trek amplifier and the Interface and wave generator module. For safety and other important information related to your amplifier, refer to the appropriate documentation.



**WARNING:** High voltage is used in the operation of the equipment described herein. Operating personnel must at all times observe all safety regulations governing the installation, operation, and calibration of equipment utilizing high voltage. Death on contact may result if operating personnel fail to observe safety precautions. Learn the area of high voltage connections, and exercise care not to contact these areas when installing, operating, or calibrating this equipment. Do not replace components or cables while power is applied. To avoid injuries or death, always remove power, and discharge and ground an electrical circuit before touching it. Prior to operating this equipment, remove all jewelry. Do not make physical contact with any high voltage connection while power is applied.

**AVERTISSEMENT:** Des tensions élevées sont utilisées dans le fonctionnement de l'équipement décrit dans le présent document. Le personnel d'exploitation doit toujours respecter toutes les règles de sécurité régissant l'installation, l'utilisation et l'étalonnage de l'équipement utilisant de la haute tension. Si le personnel d'exploitation ne respecte pas les précautions d'utilisation, il peut en résulter la mort au contact de cet instrument. Familiarisez-vous avec la zone des raccordements haute tension et faites preuve de prudence pour ne pas toucher ces zones lors de l'installation, l'utilisation ou l'étalonnage de cet équipement. Ne remplacez pas les composants ou les câbles lorsque l'instrument est sous tension. Pour éviter des blessures ou la mort, coupez toujours l'alimentation, déchargez et mettez le circuit électrique à la terre avant de le toucher. Avant d'utiliser cet équipement, retirez tous vos bijoux. N'établissez pas de contact physique avec un raccordement haute tension lorsque l'équipement est sous tension.

**NOTE:** Refer to TRIOS software Online Help for operation of the ER Accessory.

### *Preparing the DHR*

**NOTE:** Refer to your instrument documentation for detailed procedures on removing and reassembling components.

- 1 Raise the stage to maximum height.
- 2 Remove all upper test geometries as well as the lower Smart Swap™ base.
- 3 Thoroughly inspect the geometry mounting surfaces and clean off any material that may interfere with mounting the upper geometry and the lower temperature control accessory.



## *Installing the ER Accessory on the DHR*

The ER Accessory can be used in conjunction with the Peltier Plate or Peltier Concentric Cylinder Jacket. This section details the installation for these two configurations.

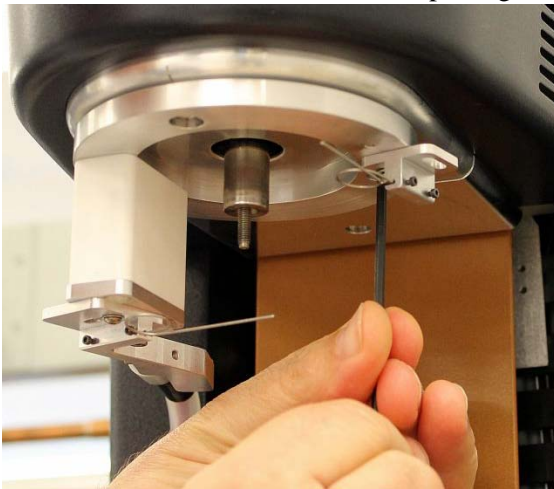
To install the ER Accessory, follow the instructions below:

- 1** Install the upper ring assembly with the insulation block and the spring loaded brushes below the motor as follows:
  - a** Locate the threaded holes on the accessory mounting plate below the stress head (see [Figure 7](#) below). This will be the location for the ER ring assembly with the insulation block.



**Figure 7** Mounting plate with three screw holes for the ER ring assembly.

- b** Install the upper ER ring assembly by aligning the holes in the support ring with the threads in the mounting ring. Insulation block is oriented to the left. Tighten the socket head screws using a number three Allen wrench to properly secure the support ring in place. Note that the spring brushes and the thin wire for frictionless contact are packaged separately.



**Figure 8** ER ring assembly being installed on the mounting plate. The ring with the insulation block is oriented to the left.



**2** Install the ER (insulated) draw rod:

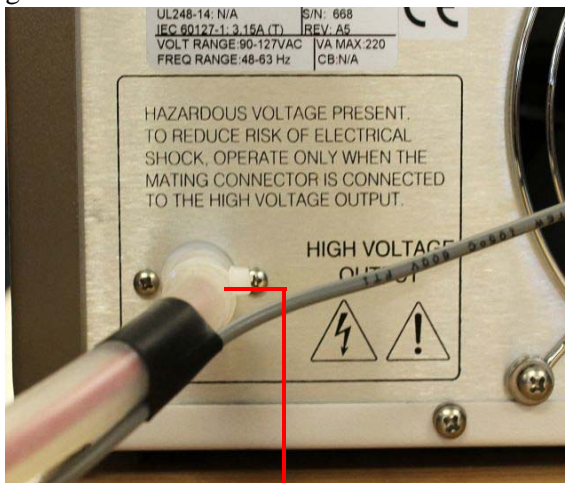
- a** Remove the standard draw rod from the motor shaft and replace it with the insulated (black top) draw rod included in the ER Accessory kit.



**Figure 9** Insulated draw rod.

**3** Place the amplifier on a bench or table that is in close proximity to the instrument.

**4** Plug the high-voltage cable into the rear of the amplifier and connect the ground cable to the amplifier ground connector.



**High-voltage cable**



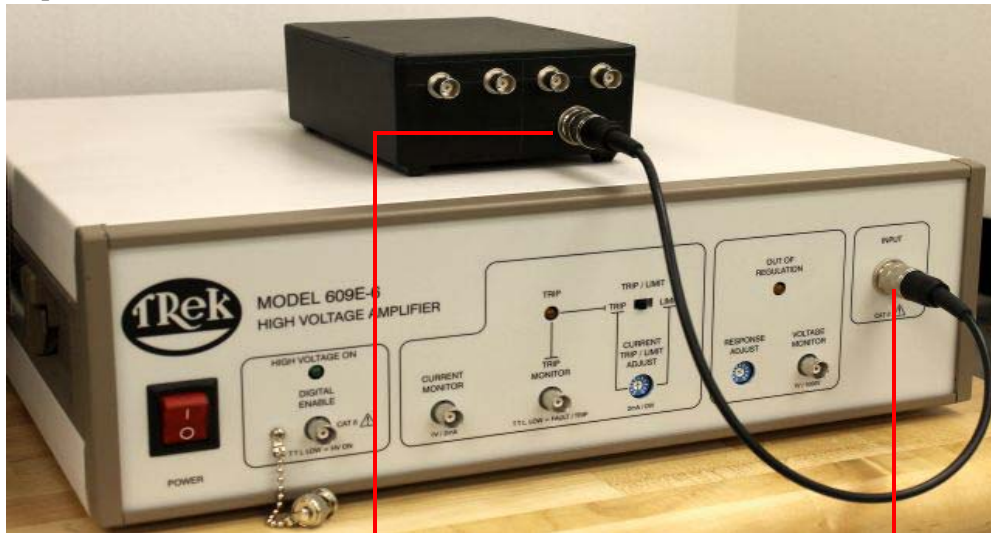
**Ground cable connection**

**Power cable**

**Figure 10** Amplifier high-voltage cable and ground connections.

**5** Plug the power cable into the back of the amplifier (see [Figure 10](#) above).

- 6 Place the ER Interface Module on top of the amplifier, and connect the power supply at the rear.
- 7 Obtain the amplifier input cable. Plug one end of the cable connector into the **Interface Output** connector on the front panel of the ER Interface Module and plug the other end into the **INPUT** connector on the amplifier.

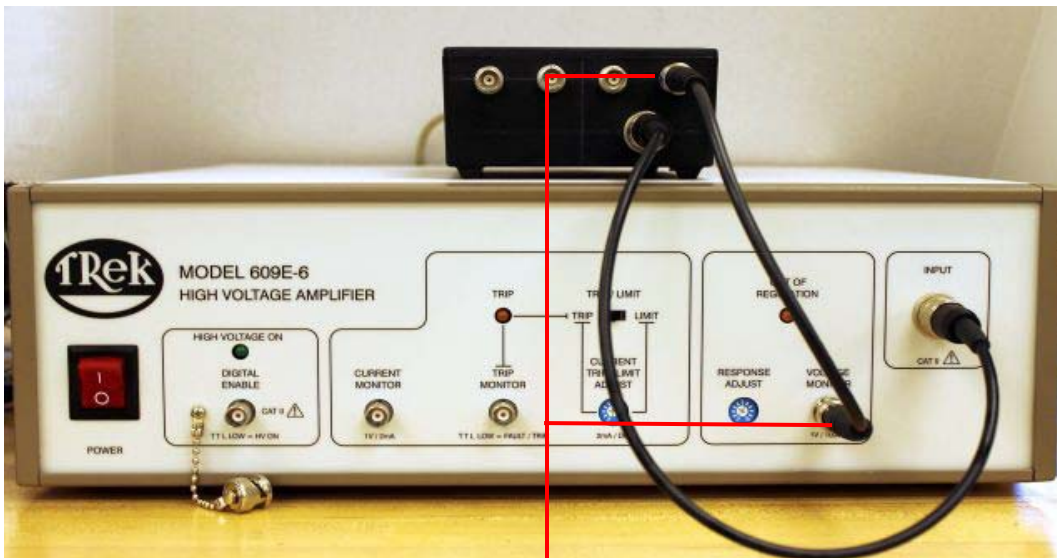


Output connector on ER Interface box

Input connector on amplifier

**Figure 11** Amplifier input cable connections.

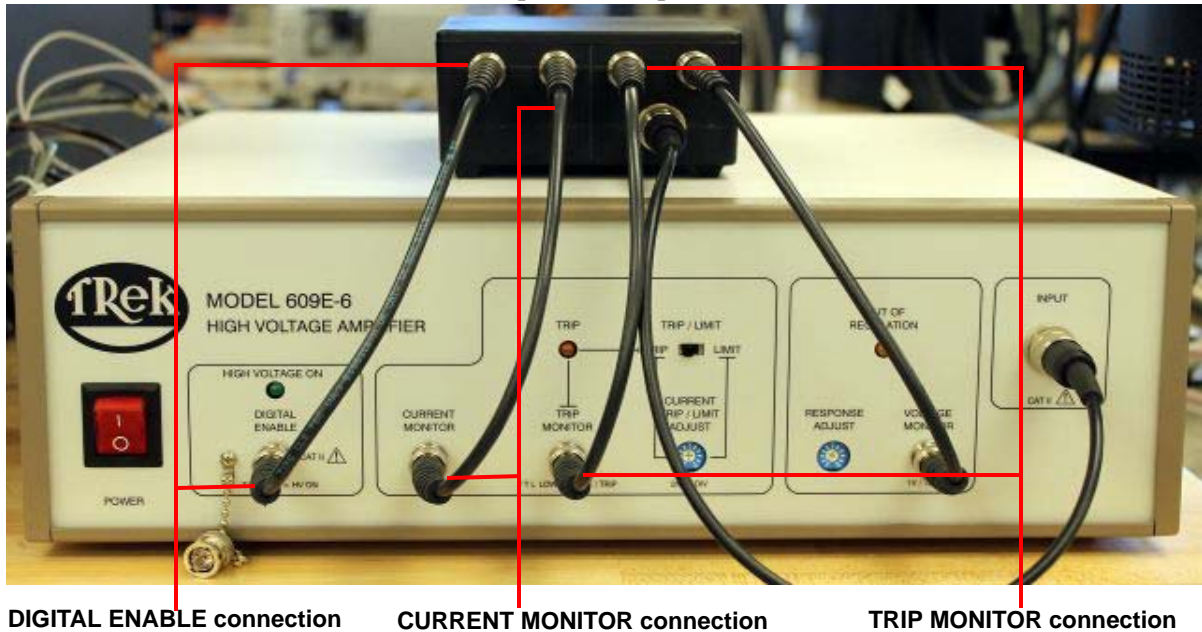
- 8 Connect a BNC cable from the **VOLTAGE MONITOR** connector on the amplifier front panel to the **VOLTAGE MONITOR** connector on the ER Interface Module.



VOLTAGE MONITOR connection

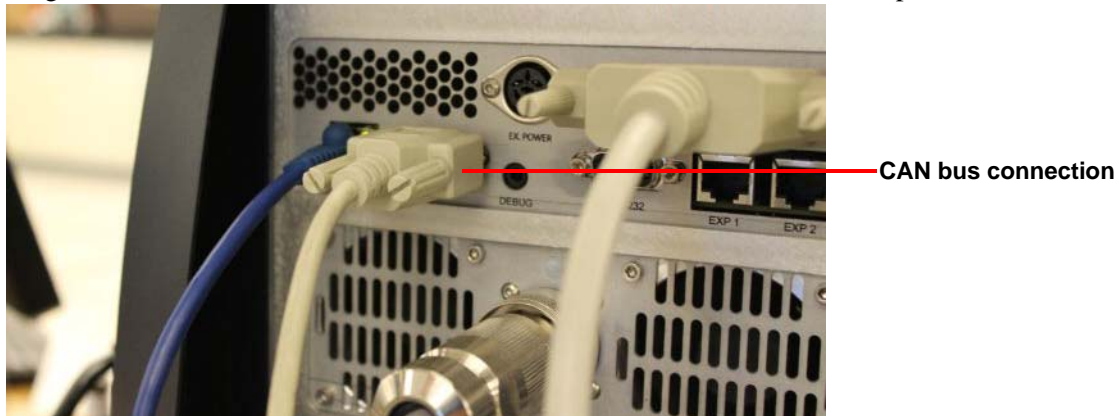
**Figure 12** BNC cable connections from amplifier to Interface Module front panel.

- 9 Connect the remaining BNC cables (**DIGITAL ENABLE**, **CURRENT MONITOR**, and **TRIP MONITOR**) from the connectors on the amplifier front panel to the connectors on the Interface module.



**Figure 13** All cables connected.

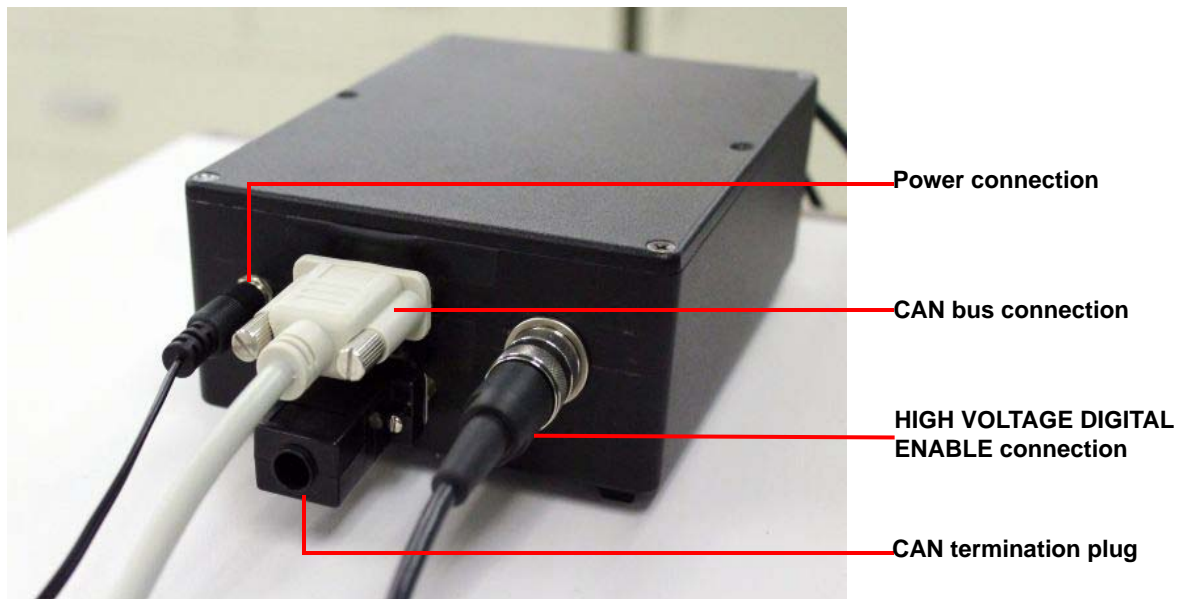
- 10 Plug one end of the CAN bus cable into the CAN bus connector on the rear panel of the DHR.



**Figure 14** CAN bus connection on rear panel of the DHR.

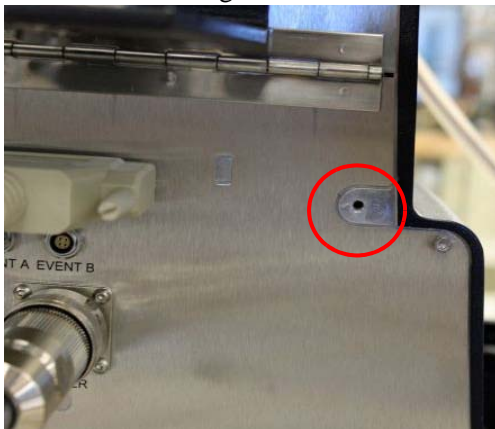


- 11 Plug the other end of the CAN bus cable into the CAN bus connector labeled **CAN IN** on the rear panel of the ER Interface Module interface box. Then plug the interlock cable (attached to the interlock bracket) into the **HIGH VOLTAGE DIGITAL ENABLE** connector, also on the rear panel of the ER Interface Module. Plug the CAN termination plug into the rear of the ER Interface Module. Finally, plug the Power connection from the rear of the ER Interface Module into a wall outlet.



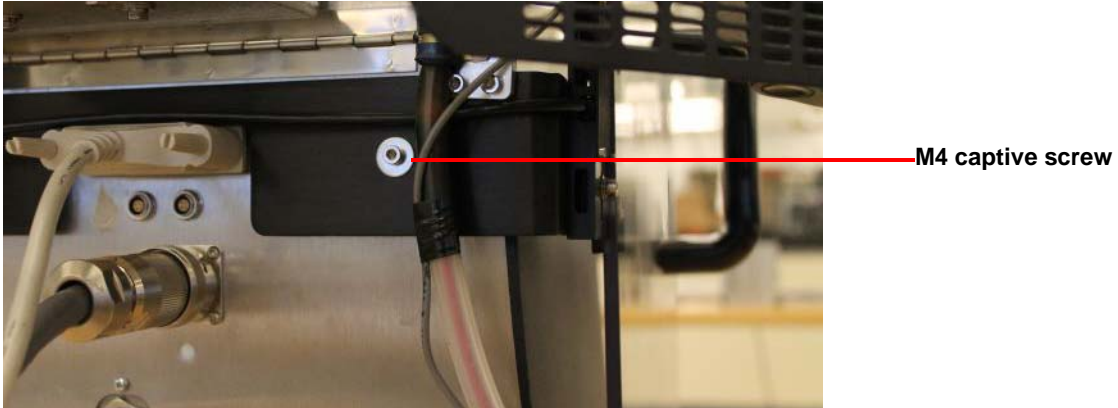
**Figure 15** Connections on rear panel of the ER Interface Module.

- 12 Install an interlock bracket at the back side of the DHR using the two screw holes at the left and right of the DHR casting.



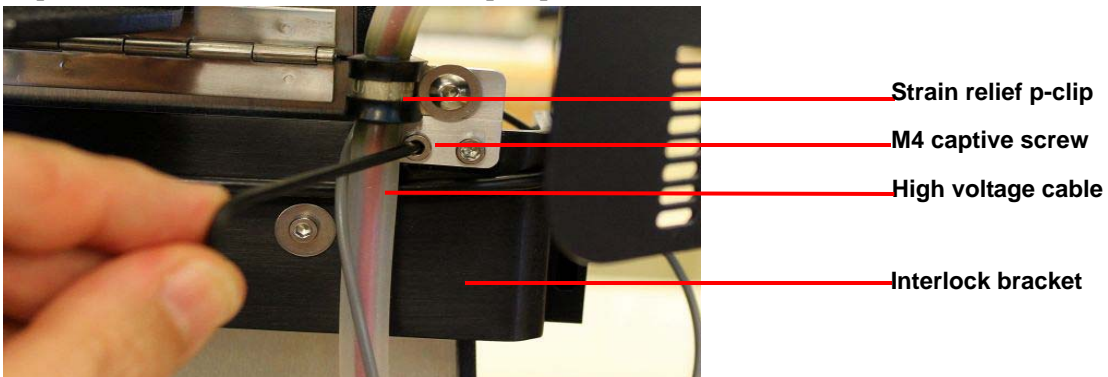
**Figure 16** Rear right side of the DHR showing the screw hole to mount the interlock bracket.

- a** Mount the bracket with interlocks for the safety shield so that the cutout is oriented downwards. Tighten the M4 captive screws.



**Figure 17** Interlock bracket mounted on the back of the DHR.

- b** Secure the strain relief clip with high voltage cable to the interlock bracket. Tighten the two M4 captive screws to secure the strain relief p-clip.



**Figure 18** Securing the strain relief p-clip with high voltage cable to the interlock bracket.

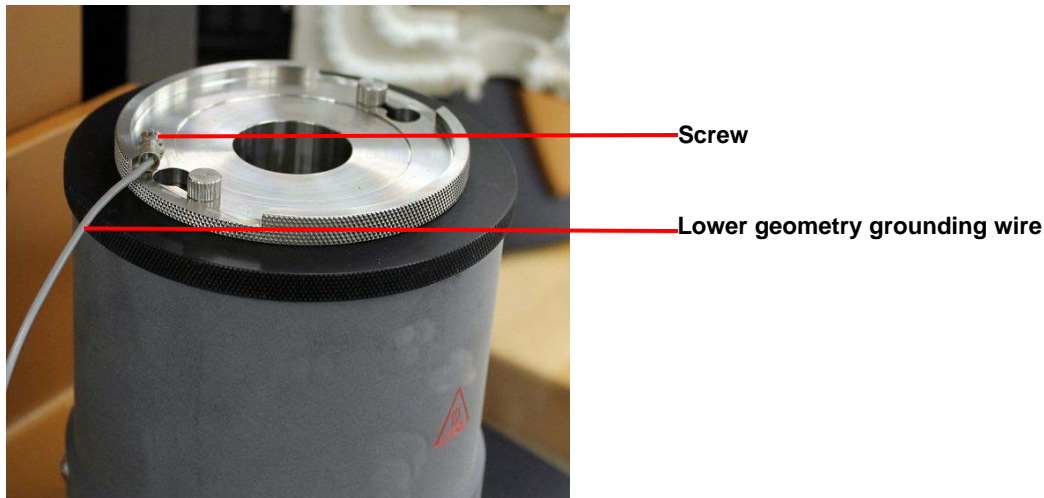
Proceed with the installation that is applicable to your configuration:

- If you are installing the ER Accessory with the Concentric Cylinder Jacket, see [“Installing the ER Accessory with the Peltier Concentric Cylinder Jacket”](#).
- If you are installing the ER Accessory with the Peltier Plate, see [“Installing the ER Accessory with the Peltier Plate”](#).

## Installing the ER Accessory with the Peltier Concentric Cylinder Jacket

Follow the instructions below to complete the ER Accessory installation for use with a Peltier Concentric Cylinder Jacket:

- 1 Install the Peltier Concentric Cylinder Jacket as described in the *DHR Series and AR Series Peltier Concentric Cylinder Getting Started Guide*.
- 2 Insert the ER 30 mm cup and connect the attached wire to the ground lead connected at the rear of the Trek amplifier (attached to the HV cable).



**Figure 19** Ground wire connecting the ER 30 mm cup to the Trek amplifier.



**WARNING: Never use the standard 30 mm cup in conjunction with the ER Accessory. The ER Accessory is not safe to operate without the ground connection**

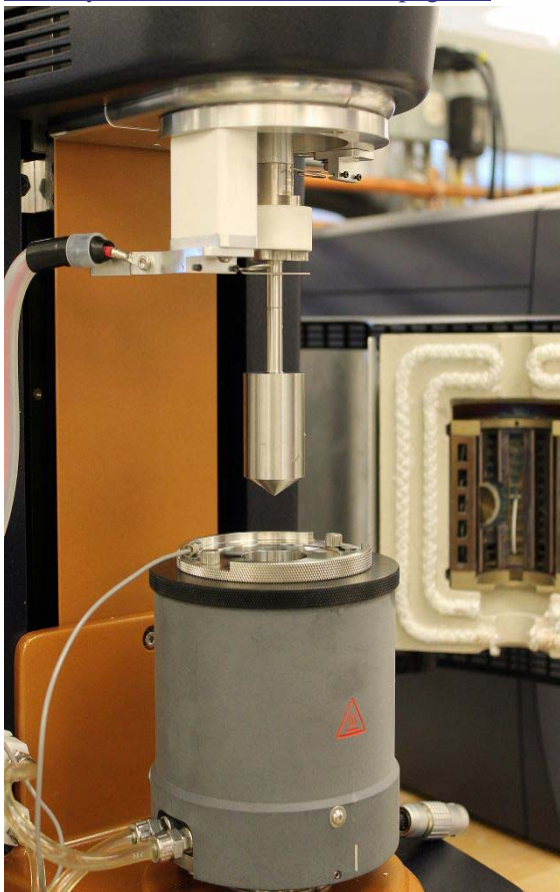
**AVERTISSEMENT: N'utilisez jamais la coupelle standard de 30 mm conjointement avec l'accessoire ER. Il n'est pas sécurisé d'utiliser l'accessoire ER sans la mise à la terre.**

**NOTE:** If this is the first installation, install the spring brushes or the thin wire harness (for oscillation tests only) before proceeding (see [“Operating and Maintaining the ER Accessory” on page 28](#)).

- 3 Install the upper ER 28 mm DIN bob.
  - a Loosen the set screw of the brush holder and slide it backwards as far as possible.
  - b Push the spring loaded brush backwards with the thumb to free enough space for the insulation block to pass while sliding the geometry onto the motor shaft.
  - c Tighten the draw rod to secure the insulated DIN bob.
  - d Bring the brush holder forward and secure with the set screw.

**NOTE:** Only the insulated ER draw rod can be used to hold the ER geometries.

- 4 The figure below shows a typical ER cup and bob configuration. To complete installation, see [“Installing the Polycarbonate ER Shield”](#) on page 26.



**Figure 20** ER Peltier Concentric Cylinder configuration.

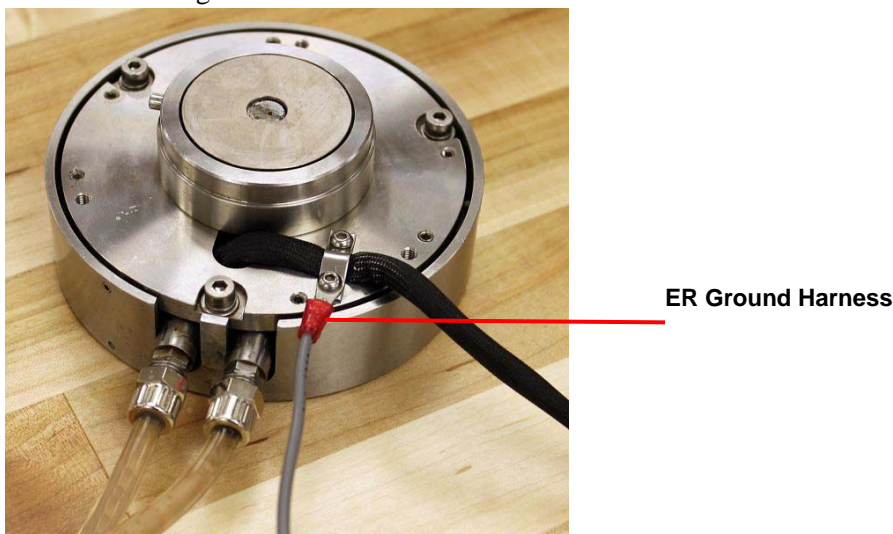
## Installing the ER Accessory with the Peltier Plate

**CAUTION:** If the ER Accessory is being installed on an existing system that uses a Peltier Plate, make sure the ground wire has been connected. Failure to do so may lead to system damage.

**MISE EN GARDE:** Si l'accessoire ER est installé sur un système existant qui utilise une plaque Peltier, assurez-vous que le conducteur de terre a été connecté. Le non-respect de cette précaution risque d'endommager le système.

Follow the instructions below to attach the ground wire and complete the ER Accessory installation for use with a Peltier Plate:

- 1 Turn the Peltier plate and remove the outer screw from the strain relief flange. Then slide the screw through the ring terminal of the ground wire provided with the ER kit. Reset the screw to secure the strain relief flange.



**Figure 21** Cable ground wire connection on Peltier Plate.

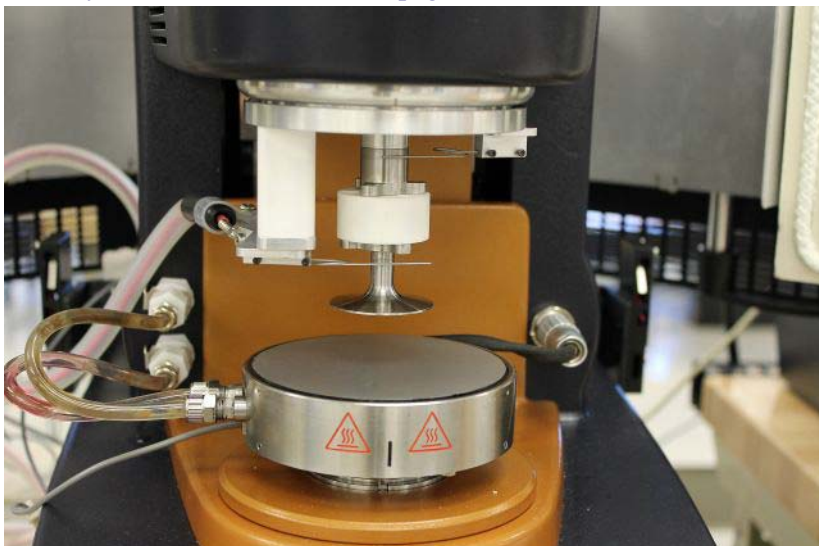
**NOTE:** If this is the first installation, install the spring brushes or the thin wire harness (for oscillation tests only) before proceeding (see [“Maintaining the DHR ER Accessory” on page 37](#)).

- 2 Install the Peltier Plate onto the Smart Swap™ base and plug in the accessory cable as described in the *DHR Series and AR Series Peltier Plate Getting Started Guide*.
- 3 Connect the necessary hoses to the Peltier Plate.
- 4 Connect the attached ground wire to the ground lead connected at the rear of the Trek amplifier (attached to the HV cable).
- 5 Install the upper ER 25 or 40 mm plate.
  - a Loosen the set screw of the brush holder and slide it backwards as far as possible.
  - b Push the spring loaded brush backwards with the thumb to free enough space for the insulation block to pass while sliding the plate onto the motor shaft.
  - c Tighten the draw rod to secure the upper plate.

**NOTE:** Only the insulated ER draw rod can be used to hold the ER geometries.



- 6 The figure below shows a typical ER Peltier Plate configuration. To complete installation, see [“Installing the Polycarbonate ER Shield”](#) on page 26.

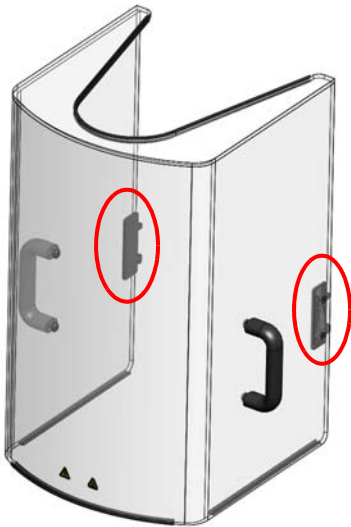


**Figure 22** Typical ER Peltier Plate configuration.

## *Installing the Polycarbonate ER Shield*

The ER shield is a mandatory safety component of the ER Accessory. Without the safety shield interlock, the Trek amplifier will not be enabled. See the instructions below to assemble and install the ER shield.

- 1 Using the handles on the shield, place the shield over the DHR stage. Carefully route the high-voltage cable between the instrument and the shield.
- 2 Complete the installation by inserting the shield interlock tabs (identified below) into the interlock brackets located on both sides of the DHR.

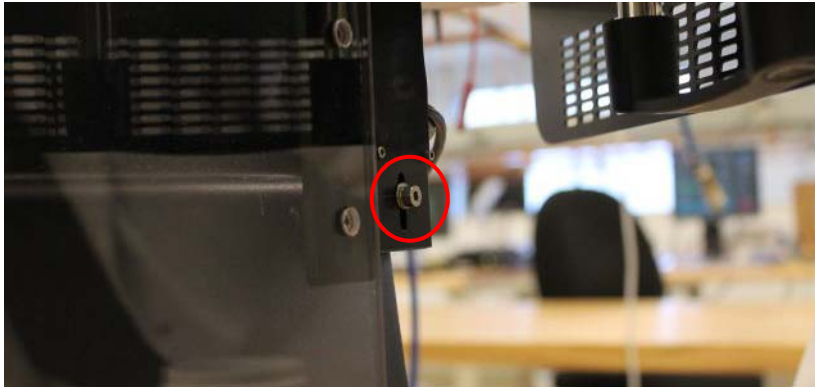


**Figure 23** ER shield interlock tabs.

**NOTE:** The ER Accessory will not function unless these interlock tabs are properly inserted into the interlock brackets.

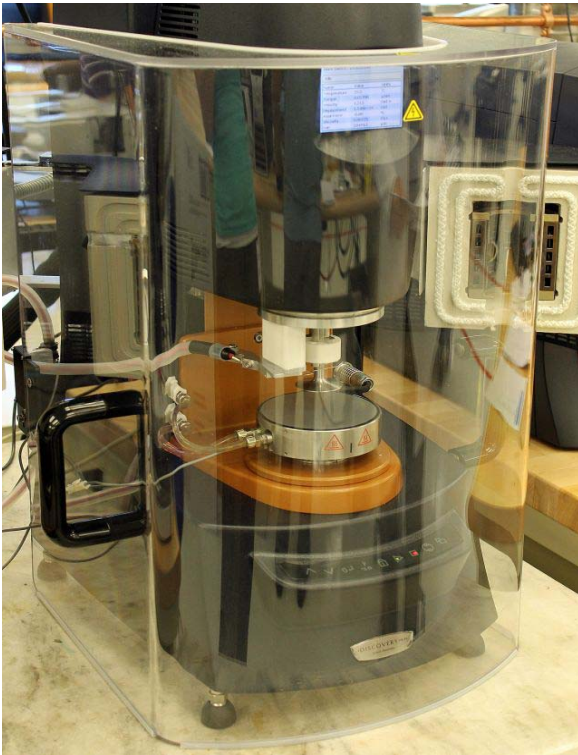
**NOTE:** Depending on the height of the DHR after it had been levelled, the vertical position of the interlocks on the interlock bracket may need to be adjusted. The hooks on the shield must be safely secured while the base of the shield rests on the tabletop.

In order to adjust the vertical position of either of the two interlocks, loosen the M3 screw ([Figure 24](#) and shift the interlock upwards to the maximum position while the shield is in place and the hooks well inserted in the interlock. Tighten the screw when the interlock is in position.



**Figure 24** M3 screw for adjusting the height of the interlock on the interlock bracket (view from front right side of DHR).

The image below shows a typical ER Accessory setup, complete with parallel plate geometries and the ER shield.



**Figure 25** ER Accessory Peltier Plate configuration.

- 3 This completes installation of the ER Accessory. Proceed to the next chapter for operational and maintenance information.

# Chapter 3:

## Operating and Maintaining the ER Accessory

---

This chapter briefly describes the operation and maintenance of the DHR ER Accessory.

### *Establishing Connection with TRIOS*

In order to operate the ER Accessory, you must first establish a connection through the instrument control software (TRIOS software).

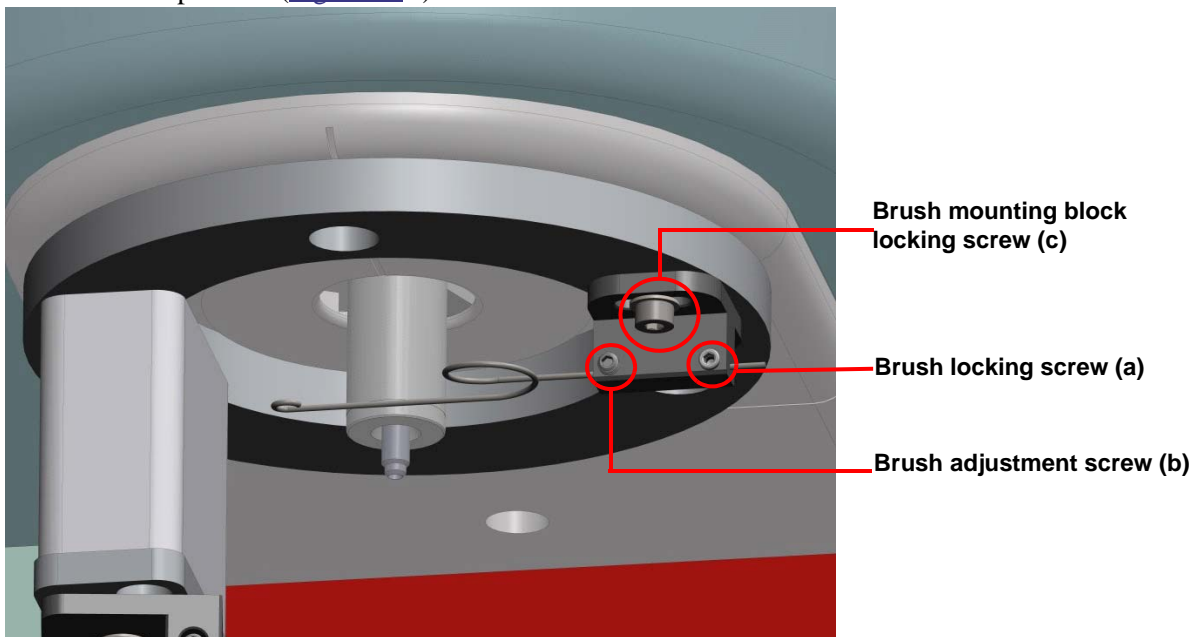
- 1 Power on the ER Interface Module and amplifier.
- 2 TRIOS automatically connects to the ER Accessory and an “ElectroRheology: Not Ready” message displays to the right of the Status bar.

### *Installing Spring Brushes*

The ER Accessory is supplied with the spring brushes un-installed. Follow the instructions below to install the brushes for the first time or to exchange defective or used brushes.

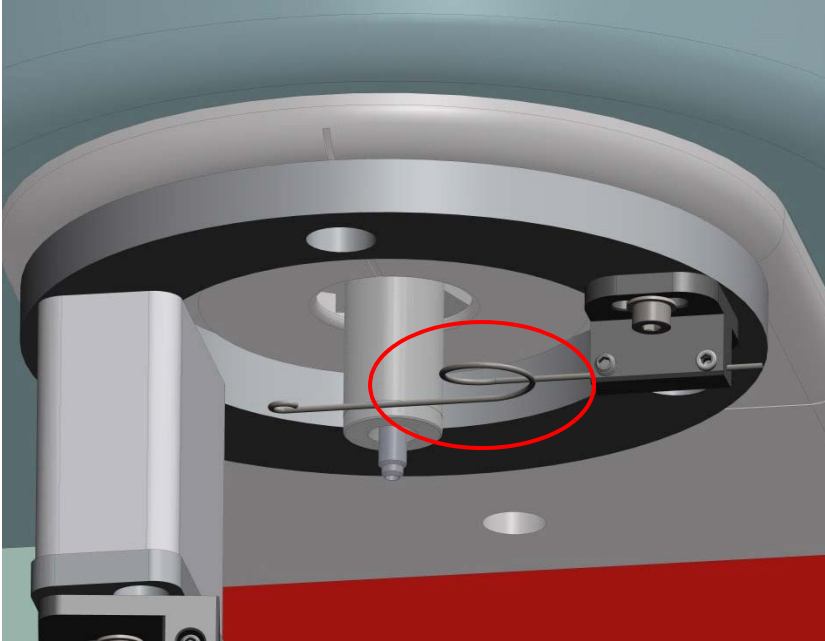
**NOTE:** For clarity, the figures below are shown without the geometry fitted. It is perfectly acceptable to perform this procedure with the geometry in place.

- 1 Loosen the two screws on the upper brush mounting block ([Figure 26 a and b](#)), and the screw that locks the block into position ([Figure 26 c](#)).



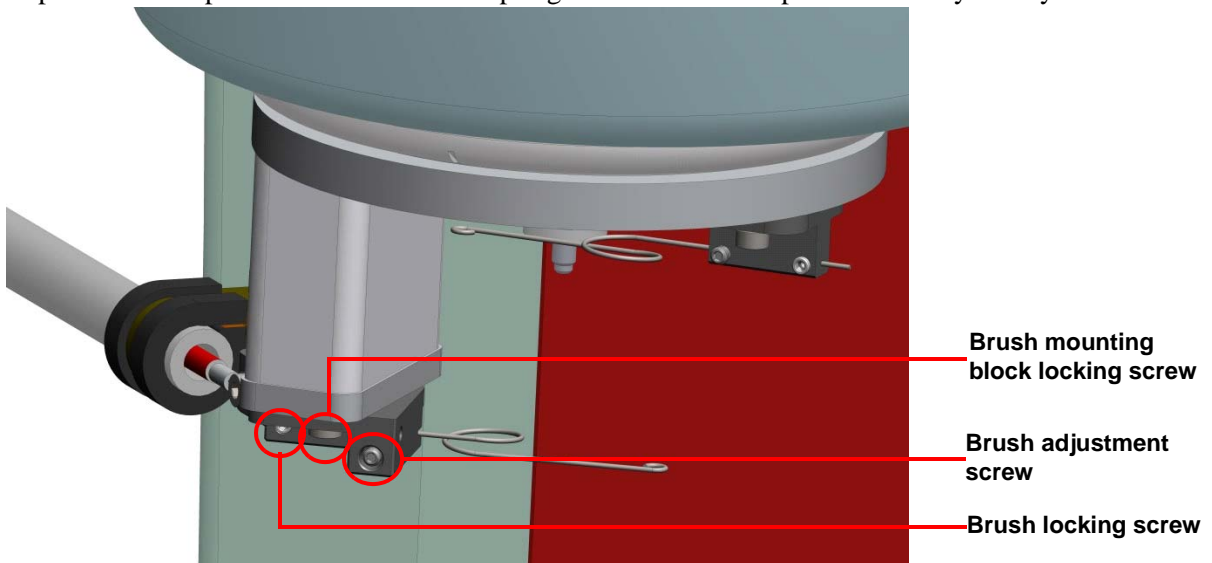
**Figure 26** Loosen the screws.

- 2 Insert the spring brush into the mounting block so that the wire is visible on the exit side and the loop is oriented towards you. Ensure that the adjustment screw ([Figure 26 a](#)) is not touching the brush.



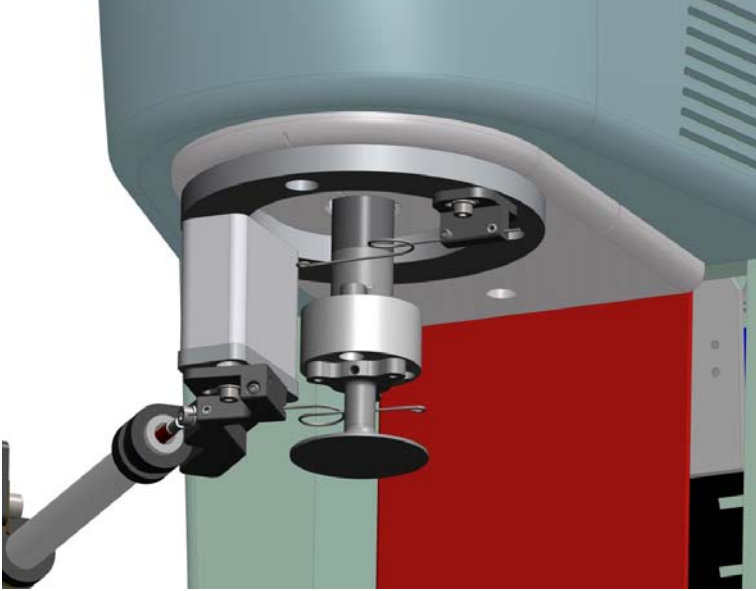
**Figure 27** Insert the spring brush, loop oriented towards you.

- 3 Lock the brush in place using the right-hand screw ([Figure 26 b](#)). You can swivel the mounting block to improve access.
- 4 Repeat the same procedure for the lower spring brush with the loop oriented away from you..



**Figure 28** Lower spring mounted on the left.

- 5 If not already in place, attach the geometry so that the system is configured as show below in [Figure 29](#).



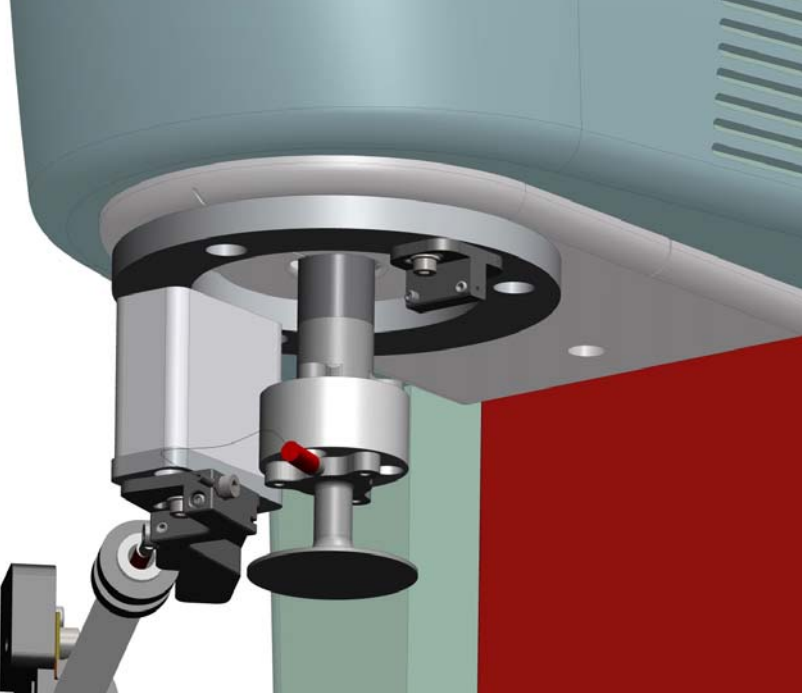
**Figure 29** Geometry attached.

- 6 Adjust the upper swivel mount (course adjustment) into a position so that the spring brush is 1–2 mm from the geometry. Then tighten the swivel mount screw ([Figure 26 c](#)) to lock the brush block in position. The adjustment screw ([Figure 26 a](#)) can then be used for the fine adjustment procedure described in the next section.
- 7 Repeat the procedure for the lower spring brush mounting block, but in this case position the spring so that it is under light compression against the geometry, but still within the location groove in the mounting block.

## *Installing the Thin Wire Harness*

When only small amplitude oscillation experiments are performed, the spring brushes can be replaced with a frictionless installed thin wire harness. Do not use the thin wire harness for flow or large amplitude oscillatory testing. Follow the instructions below to install the thin wire harness:

- 1 Un-install the spring brushes. Loosen the clamping screws and slide out the spring brush. Install the upper test geometry. Secure the geometry using the insulated draw rod.
- 2 Loosen the socket head cap screw on the right side of the high voltage cable holder (see [Figure 30](#)). Insert the U-shaped terminal of the thin wire harness and tighten the screw. Handle the wire with care to avoid breakage.



**Figure 30** Thin wire harness installed.

- 3 Lock the bearing by pressing the **Bearing Lock** button on the DHR keypad. Insert the banana plug into the designated hole beneath the geometry insulation on the upper geometry. Remove the bearing lock and let the geometry move to its preferred angular position. Lock the bearing in the new position. This should be the zero position for the oscillatory testing.

**NOTE:** For sensitive mechanical measurements it will be necessary to remove the high voltage as well as the grounding spring brush. The grounding brush provides additional protection for the motor/bearing. Removing this the grounding brush does not affect operator safety.



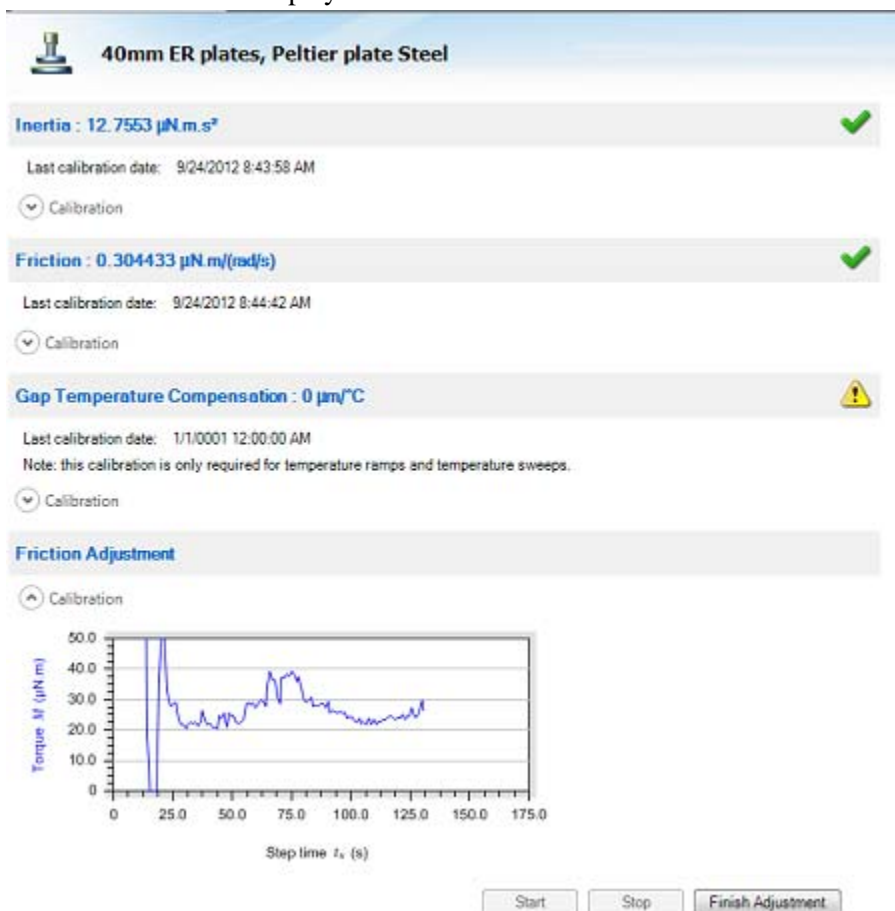
## Compensate for Friction of the Spring-Loaded Brushes

The DHR ER Accessory has two spring loaded brushes in contact with the upper test geometry. The lower brush touches the geometry shaft below the insulation block and is used to transfer the high voltage onto the geometry. The upper brush is a safety brush, grounding the geometry to protect the motor/bearing.

The brushes generate a friction torque which degrades the low end torque performance of the DHR. The spring force of the brushes can be adjusted and the friction torque is mapped and corrected for during the measurement. The spring loaded brushes generate a lower friction torque when operated in tension (clockwise rotation) instead of compression (counterclockwise rotation). Because of the friction torque difference between clock and counter clockwise operation, oscillatory mapping should be used when running oscillatory tests. The friction of the spring brushes can be eliminated by replacing the brushes with a thin wire harness, which is tightly fixed to the geometry and the high voltage cable holder. Note that the thin wire harness can only be used for small strain amplitude oscillation.

Proceed as follows to adjust the friction torque of the spring loaded brushes:

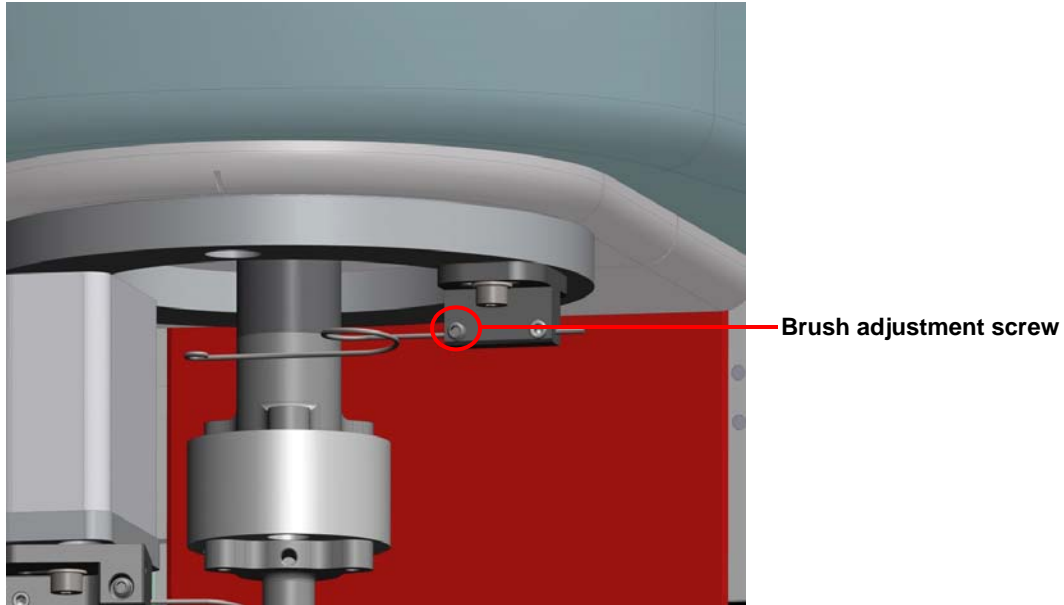
- 1 Without the brushes being in contact with the shaft of the installed geometry, perform the friction adjustment. In TRIOS software, select the **Instrument** tab and then click **Friction adjustment**. Click **Calibration** and then click **Start** to begin the spring friction adjustment. A plot showing the motor torque as a function of time displays.



**Figure 31** Friction adjustment.



- 2 While the upper geometry is rotating, first adjust the upper spring by turning the fine adjustment screw counter clockwise. Adjust stepwise until a friction torque between 10 and 15  $\mu\text{N.m}$  is obtained.



**Figure 32** Upper Spring Brush with adjustment holder.

- 3 Next, adjust the lower spring brush by turning the fine adjustment screw clockwise. Adjust stepwise until the friction torque is between 25 and 35  $\mu\text{N.m}$ . Click **Finish adjustment** to stop the test.

- 4 Perform a new rotational map using the settings in [Figure 33](#). Once completed, verify the mapping by running a peak hold test at 0.1 rad/s. Variations after mapping within  $\pm 2 \mu\text{N.m}$  are typical. Refer to “Setting Up a Flow Peak Hold Test” in TRIOS Help for more information.

The screenshot shows a software interface for rotational mapping settings. It includes sections for Inertia, Friction, Gap Temperature Compensation, Friction Adjustment, and Rotational Mapping. The Rotational Mapping section is expanded, showing mapping settings and options.

**Inertia** : 12.7553  $\mu\text{N.m.s}^2$  ✓  
Last calibration date: 9/24/2012 8:43:58 AM  
Calibration

**Friction** : 0.304433  $\mu\text{N.m/(rad/s)}$  ✓  
Last calibration date: 9/24/2012 8:44:42 AM  
Calibration

**Gap Temperature Compensation** : 0  $\mu\text{m}/^\circ\text{C}$  ⚠  
Last calibration date: 1/1/0001 12:00:00 AM  
Note: this calibration is only required for temperature ramps and temperature sweeps.  
Calibration

**Friction Adjustment**  
Calibration

**Rotational Mapping** ✓  
Last calibration date: 9/24/2012 10:07:11 AM  
Calibration

Mapping settings  
Bearing mapping type: fast  
Number of iterations: 2  
Mapping may take up to 3 minutes to complete.

Options  
☒ Display mapping prompt when the geometry changes

Calibrate Cancel

**Figure 33** Rotational mapping settings.

## Operating the ER Accessory.



**WARNING: DO NOT** insert a digital enable shorting plug into the Trek amplifier when operating the ER Accessory. The ER Accessory is not safe to operate if the digital enable shorting plug is installed in the amplifier.

**AVERTISSEMENT:** N'insérez pas une fiche de court-circuit à activation numérique dans l'amplificateur Trek lors de l'utilisation de l'accessoire ER. L'accessoire ER ne peut pas être utilisé en toute sécurité si la fiche de court-circuit à activation numérique est installée dans l'amplificateur.



**WARNING:** The Trek amplifier is available in two configurations: 110V and 220V. Before operating the ER Accessory, refer to the power label on the rear panel of the Trek amplifier to ensure that the amplifier's configuration is sufficient for your building's power capabilities. See page 12 for more information.

**AVERTISSEMENT:** L'amplificateur Trek est disponible en deux configurations : 110 V et 220 V. Avant d'utiliser l'accessoire ER, consultez l'étiquette des caractéristiques électriques apposée sur le panneau arrière de l'amplificateur TREK pour vous assurer que la configuration de l'amplificateur est appropriée à la tension de la ligne de votre bâtiment. Voir la page 12 pour plus de renseignements.



**WARNING:** High voltage is used in the operation of the equipment described herein. Operating personnel must at all times observe all safety regulations governing the installation, operation, and calibration of equipment utilizing high voltage. Death on contact may result if operating personnel fail to observe safety precautions. Learn the area of high voltage connections, and exercise care not to contact these areas when installing, operating, or calibrating this equipment. Do not replace components or cables while power is applied. To avoid injuries or death, always remove power, and discharge and ground an electrical circuit before touching it. Prior to operating this equipment, remove all jewelry. Do not make physical contact with any high voltage connection while power is applied.

**AVERTISSEMENT:** Des tensions élevées sont utilisées dans le fonctionnement de l'équipement décrit dans le présent document. Le personnel d'exploitation doit toujours respecter toutes les règles de sécurité régissant l'installation, l'utilisation et l'étalonnage de l'équipement utilisant de la haute tension. Si le personnel d'exploitation ne respecte pas les précautions d'utilisation, il peut en résulter la mort au contact de cet instrument. Familiarisez-vous avec la zone des raccordements haute tension et faites preuve de prudence pour ne pas toucher ces zones lors de l'installation, l'utilisation ou l'étalonnage de cet équipement. Ne remplacez pas les composants ou les câbles lorsque l'instrument est sous tension. Pour éviter des blessures ou la mort, coupez toujours l'alimentation, déchargez et mettez le circuit électrique à la terre avant de le toucher. Avant d'utiliser cet équipement, retirez tous vos bijoux. N'établissez pas de contact physique avec un raccordement haute tension lorsque l'équipement est sous tension.

Operating the ER Accessory on the DHR requires the following steps:

- 1 Selecting and preparing the sample.
- 2 Selecting and installing the geometry.
- 3 Setting up your experiment through TRIOS software.
- 4 Zeroing the gap at the subsequent, initial experimental temperature.
- 5 Loading and trimming the sample, as required.
- 6 Installing the safety shield and starting the test.

For more information on setting up and running ER Accessory experiments in TRIOS software, refer to TRIOS Help.

## Maintaining the DHR ER Accessory



**WARNING:** High voltage is used in the operation of the equipment described herein. Operating personnel must at all times observe all safety regulations governing the installation, operation, and calibration of equipment utilizing high voltage. Death on contact may result if operating personnel fail to observe safety precautions. Learn the area of high voltage connections, and exercise care not to contact these areas when installing, operating, or calibrating this equipment. Do not replace components or cables while power is applied. To avoid injuries or death, always remove power, and discharge and ground an electrical circuit before touching it. Prior to operating this equipment, remove all jewelry. Do not make physical contact with any high voltage connection while power is applied.

**AVERTISSEMENT:** Des tensions élevées sont utilisées dans le fonctionnement de l'équipement décrit dans le présent document. Le personnel d'exploitation doit toujours respecter toutes les règles de sécurité régissant l'installation, l'utilisation et l'étalonnage de l'équipement utilisant de la haute tension. Si le personnel d'exploitation ne respecte pas les précautions d'utilisation, il peut en résulter la mort au contact de cet instrument. Familiarisez-vous avec la zone des raccordements haute tension et faites preuve de prudence pour ne pas toucher ces zones lors de l'installation, l'utilisation ou l'étalonnage de cet équipement. Ne remplacez pas les composants ou les câbles lorsque l'instrument est sous tension. Pour éviter des blessures ou la mort, coupez toujours l'alimentation, déchargez et mettez le circuit électrique à la terre avant de le toucher. Avant d'utiliser cet équipement, retirez tous vos bijoux. N'établissez pas de contact physique avec un raccordement haute tension lorsque l'équipement est sous tension.

The maintenance required for the DHR ER Accessory consists of the following tasks:

- Routinely check the cabling connections to ensure proper connections and cable integrity. If any of the cables become worn or frayed, DO NOT attempt to operate the system. Contact TA Instruments Service immediately.
- Thoroughly clean the geometries if they become visibly soiled.



**WARNING:** To ensure a proper ground connection, routinely clean the spring loaded brushes and the contact surface on the test geometry. If you are unsure about the acceptable cleanliness of the ground spring clips, use the spares provided in the kit.

**AVERTISSEMENT:** Pour assurer une mise à la terre appropriée, nettoyez systématiquement les brosses à ressort et la surface de contact de la géométrie d'essai. Si vous n'êtes pas certain du niveau de propreté acceptable des attaches à ressort de terre, utilisez les pièces de rechange fournies dans le kit.

- If the polycarbonate shield becomes soiled, wet a cloth with warm, soapy water and wipe the shield clean. DO NOT use acetone to clean the shield.

## *Replacement Parts*

The table below lists the replacement parts available on the DHR ER Accessory.

**Table 2: Replacement Parts for DHR ER Accessory**

<b>Part Number</b>	<b>Description</b>
546764.901	REPLACEMENT BRUSHES FOR DHR ER ACCESSORY
546719.901	ER GROUND HARNESS
546763.901	THIN WIRE HARNESS

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