# DHR Series and AR Series

## Peltier Concentric Cylinder

## Getting Started Guide

Revision E Issued November 2013

## Notice

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# Introduction

## Important: TA Instruments Manual Supplement

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## 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.**

**A WARNING indicates a procedure that may be hazardous to the operator or to the environment if not followed correctly.**

**Un AVERTISSEMENT indique une procédure qui peut être dangereuse pour l'opérateur ou l'environnement si elle n'est pas correctement suivie.**

## Regulatory Compliance

### *Safety Standards*

#### *For Canada*

CAN/CSA-C22.2 No. 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements.

CAN/CSA-C22.2 No. 61010-2-010 Particular requirements for laboratory equipment for the heating of materials.

#### 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.

#### For United States

UL61010-1:2004 Electrical Equipment for Laboratory Use; Part 1: General Requirements.

UL61010A-2-010:2002 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

Do not attempt to service this instrument, as it contains no user-serviceable components.

### *Required Equipment*

While operating this instrument, 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.

### *Instrument Symbols*

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

| Symbol | Explanation |
|---|---|
|  | This symbol indicates that a hot surface may be present. Take care not to touch this area or allow any material that may melt or burn come in contact with this hot surface.<br><br>Ce symbole indique la présence possible d'une surface chaude. Prenez soin de ne pas toucher cette zone ou de laisser un matériau susceptible de fondre ou de brûler entrer en contact avec cette surface chaude. |

Please heed the warning labels and take the necessary precautions when dealing with these areas. This *Getting Started Guide* contains cautions and warnings that must be followed for your own safety.

### *Cautions and Warnings*

**WARNING: The material used for the bore of the jacket is anosied aluminium. Therefore, use an appropriate cleaning material when cleaning.**

**AVERTISSEMENT: Le matériel utilisé pour l'alésage de la chemise est en aluminium anodisé. Par conséquent, utilisez l'équipement approprié pour le nettoyage du matériel.**

**WARNING: Take adequate precautions prior to heating of materials if it can lead to explosion, implosion or the release of toxic or flammable gases.**

**AVERTISSEMENT: Prenez des mesures de précaution adéquates avant de chauffer des matériaux, si cela peut entraîner l'explosion, l'implosion ou le dégagement de gaz toxiques ou inflammables.**

**CAUTION: The Peltier Cylinder may be damaged by operating the instrument without a flow of water through the Peltier Cylinder. There is a Peltier overheat protection device that will activate if the device becomes too hot.**

**MISE EN GARDE: Le cylindre Peltier peut être endommagé si l'instrument est utilisé sans écoulement d'eau dans le cylindre Peltier. Il existe un dispositif de protection contre la surchauffe qui s'active si le dispositif devient trop chaud.**

# Table of Contents

# *Chapter 1:*

# Introducing the Peltier Concentric Cylinder

## *The Peltier Concentric Cylinder*

The Peltier Concentric Cylinder system consists of a jacket (fitted to the instrument through the Smart Swap connection), an inner cylinder (or cup), and a rotor (or bob). As with the Peltier Plate, heating is through Peltier elements, and a circulating fluid is used as a heat sink. Refer to "About the Peltier Concentric Cylinder" on page 9 for more information.

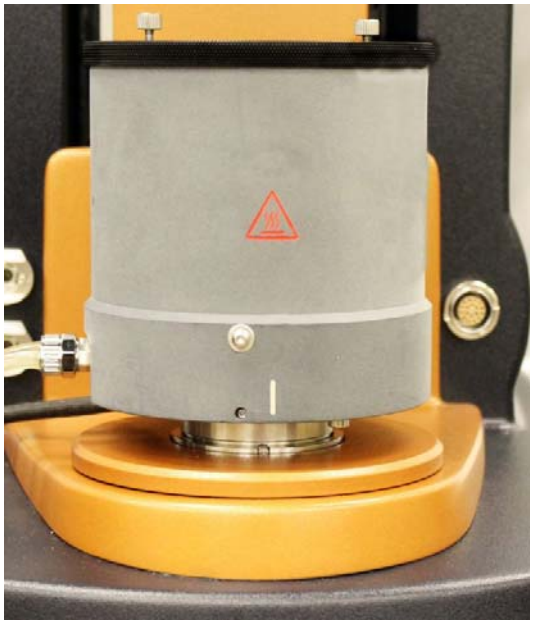

**Figure 1** Peltier Concentric Cylinder.

# *About the Peltier Concentric Cylinder*

The Peltier Concentric Cylinder system (schematic shown in the figure below) uses the Peltier thermoelectric effect to control the cup temperature accurately, with rapid heating and cooling. The Peltier elements in the base of the unit heat or cool the specially shaped inner jacket, which transfers the temperature to the top of the removable cup that sits inside.

The basis of the Peltier effect is this: When an electric current passes across the junction between two dissimilar metals or semiconductors, a temperature gradient across the junction results—the temperature will rise on one side and fall on the other. The direction of the current determines on which side the temperature rises.

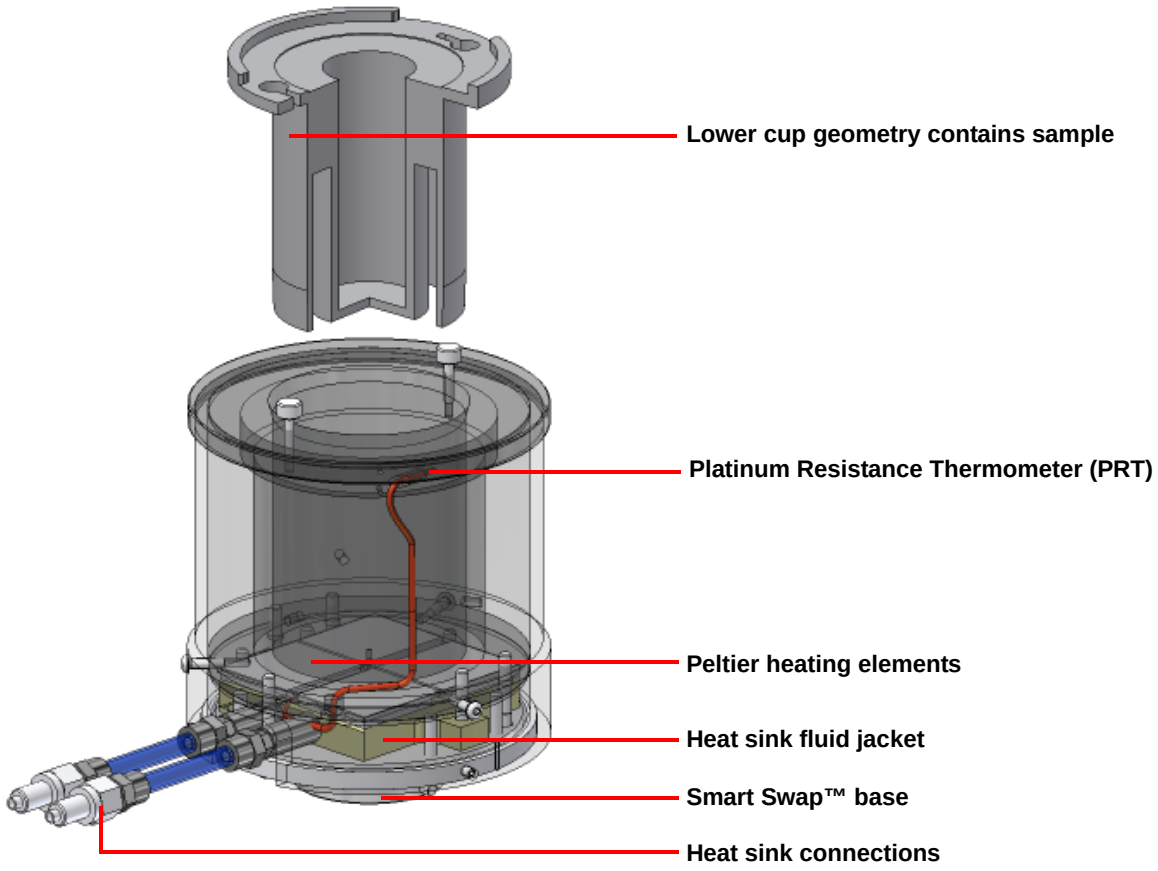


**Figure 2** Peltier Concentric Cylinder system schematic diagram.

Since a temperature gradient can only be maintained by the input of energy, the Peltier Concentric Cylinder system requires a heat sink to remove any waste heat. This is provided by a coolant fluid, normally water, passing through a fluid jacket situated below the Peltier elements. If the fluid circulating through the fluid jacket is from a closed reservoir, then its temperature will rise unless it is actively cooled, particularly when the Peltier plate is operating at temperatures below ambient.

The flow rate of the fluid through the bath does not need to be high. A flow rate of at 0.5 liters per minute is usually adequate, although this should be increased to 1 liter per minute when working at very low temperatures. If this flow rate is not maintained, the Peltier will lose the ability to provide cooling.

## Available Rotors for Peltier Concentric Cylinder System

The following rotors are available for use with the Peltier Concentric Cylinder system:

- Standard size DIN (conforms to DIN 53019)
- Recessed end
- Double gap (conforms to DIN 54453)
- Standard vane
- Wide gap vane

**NOTE**: A grooved cup is also available.

# *System Specifications*

Refer to the table below for Peltier Concentric Cylinder system specifications:

**Table 1: Peltier Concentric Cylinders System Specifications**

| | |
|---|---|
| **Temperature range**<br>with tap water supply<br>Air cooled circulator (PN 403209.901)<br>Thermo Cube (PN 403258.901) | <br>-10°C to 150°C<br>0°C to 150°C<br>-10°C to 150°C |
| **Ramp rate** | See section below. |
| **Pt100 internal resolution** | 0.01°C |

## Ramp Rate

The maximum sustainable ramp rate will depend on a number of factors such as the start and end temperature and the temperature / flow rate of circulation fluid. To determine the maximum sustainable heating/ cooling rate, perform the following test and analysis:

**1** Equilibrate to start temperature.

Perform a time sweep or peak hold test with the temperature set (if possible) to a few degrees in excess of the end temperature. Set the time much longer than you expect; the test can be aborted when the temperature has reached a stable value.

**2** Plot a graph of temperature vs. time (min) and take the derivative.

Inspect the derivative curve over your temperature range of interest. The maximum sustainable rate will be the lowest value on the derivative curve.

# *Chapter 2:*

# Installing the Peltier Concentric Cylinder

The Peltier Concentric Cylinder installs on the AR Rheometer using a Smart Swap™ connection. Refer to the sections below for installation instructions.

**CAUTION: The Peltier elements may be damaged by operating the instrument without a flow of water through the Peltier jacket. There is a Peltier overheat protection device that will activate if the device becomes too hot.**

**MISE EN GARDE: La plaque Peltier peut être endommagée si l'instrument est utilisé sans écoulement d'eau dans la plaque Peltier. Il existe un dispositif de protection contre la surchauffe qui s'active si le dispositif devient trop chaud.**

## *Setting Up the Peltier Concentric Cylinder*

The Concentric Cylinder system consists of a temperature-controlled jacket, an inner cylinder (the cup) and a rotor (or bob).

To set up the concentric cylinder system, follow these steps:

**1** Raise the rheometer head to the top most position.

**2** Press the **Release** button on the control panel, as shown below. A continuous green light indicates that the attachment can be fitted.

**NOTE**: The release state will only stay active for 10 seconds.

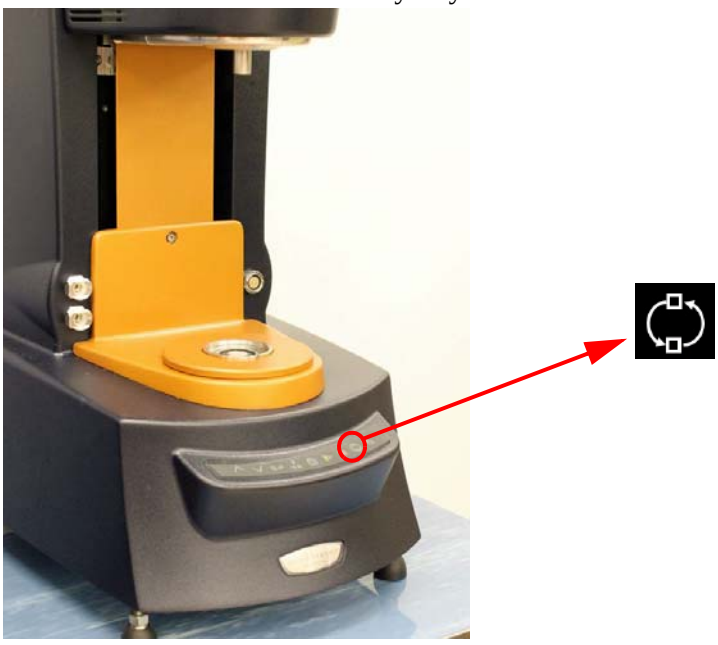

**Figure 3** Release button (DHR Series shown).

**3** Fit the cylinder jacket, ensuring it is aligned correctly. See the figure below.

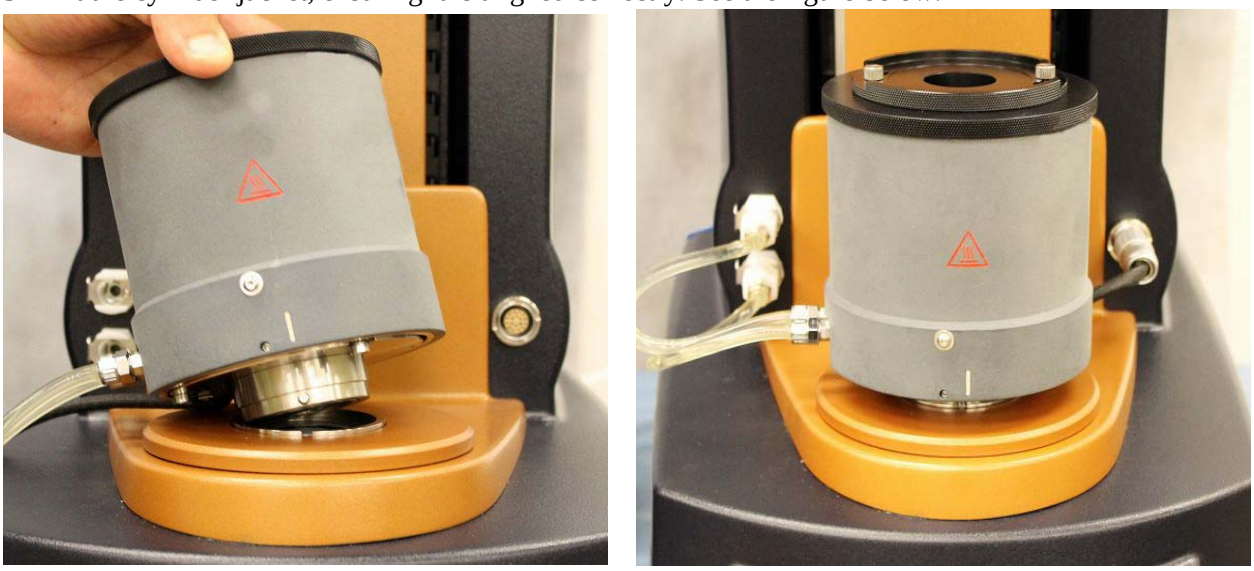

**Figure 4** Fitting the cylinder jacket (DHR Series shown).

**4** Connect the power cable and fluid hoses as shown in the figure below.

**Figure 5** Connecting fluid hoses (DHR Series shown).

**5** When the green status light turns off, the lower cup is correctly installed.

**6** Lift the rheometer head and attach the correct rotor (bob) to the air bearing. See "Attaching the Bob and Finding the Zero Position" on page 15.

## Removing the Cylinder Jacket

**1** Press the **Release** button on the control panel. A flashing green light indicates that the attachment can be unplugged. Refer to step 2 in the previous section for **Release** button location.

**2** Press the **Release** button again. A continuous green light indicates that you can remove the cylinder jacket.

**3** Remove the cylinder jacket from the rheometer.

# *Attaching the Bob and Finding the Zero Position*

Finding the zero gap position for the rotor is slightly more difficult than for the geometries used with the Peltier Plate, as the gap between the rotor and the bottom of the cup cannot be observed visually. It is a good idea to place the bob in the cup before attaching it to the draw rod, to ascertain the approximate zero position. Look for the position of the rotor shaft relative to the top of the cup. On most geometries, a datum mark is machined on the shaft to help with finding the zero position.

**1** Attach the rotor to the draw rod.

**2** To find the zero position, lower the instrument head until the datum mark on the shaft of the rotor is level with the top of the cup (as shown in Figure 6).

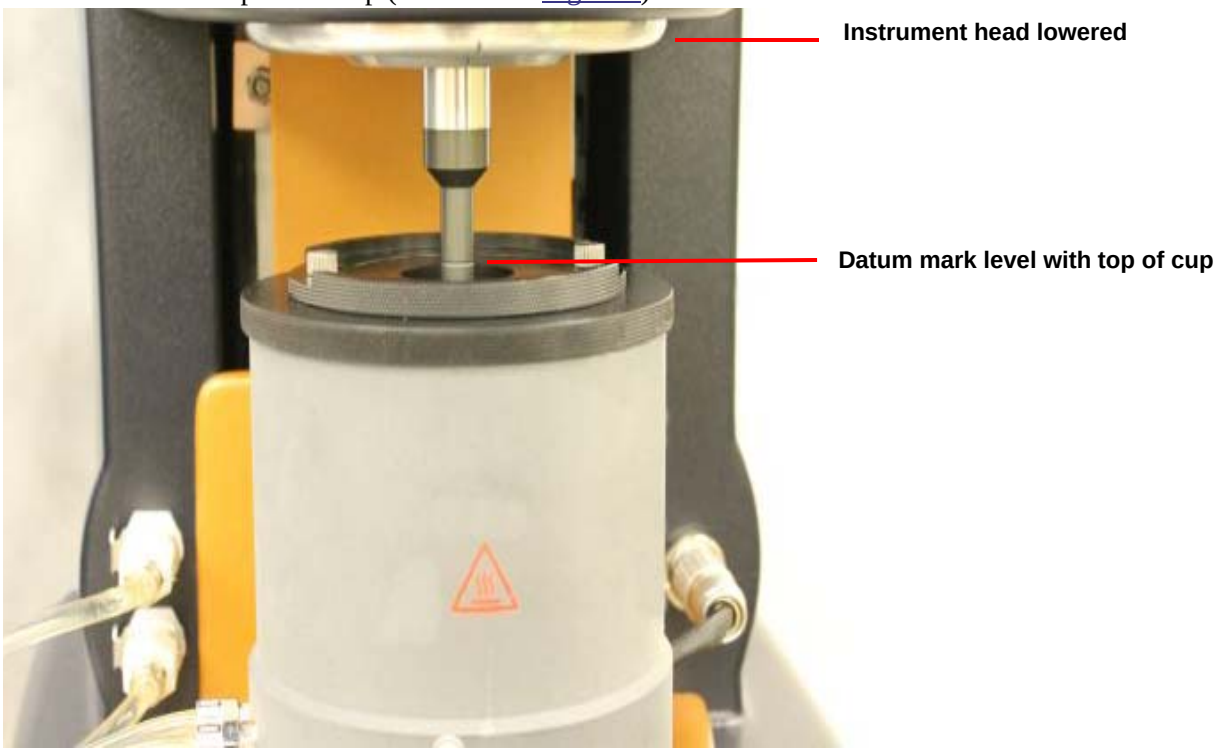


**Figure 6** Finding zero position using datum mark (DHR Series shown).

**3** You can now set up the measuring geometry in the rheometer software and set the gap as explained in TRIOS Online Help.

# *Changing the Cup*

If you want to change the size of the cup you are using, follow these steps:

**1** Undo the two screws on the cup. Turn and lift it out as shown in the figure below.

**Figure 7** Changing the cup (DHR Series shown).

**2** Before inserting the replacement cup, make sure that the surfaces of the cup and jacket are clean. Gently place the cup into the jacket (as shown above) and twist into place. Tighten the two screws by hand.

**NOTE**: The fit between the cup and the jacket is tight by design for best thermal conductivity. Take care not to force the cup into place. The cup will be easier to fit if the jacket is heated to 10-20°C above ambient temperature before inserting.

# *Solid Sample Submersion Clamps*

Some solid samples are required to be run while submerged in water. For this the Peltier Concentric Cylinder system is used. The operation is similar to that of the solids samples used with the ETC.

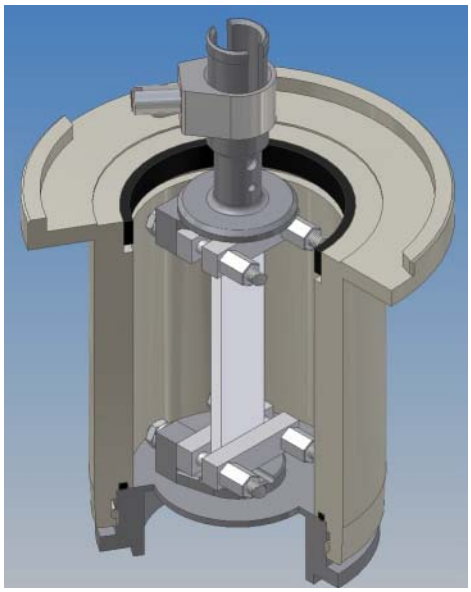

**Figure 8** Torsion submersion clamp cutaway.

# *Concentric Cylinder Solvent Trap Cover*

An optional solvent trap is available for the Peltier Concentric Cylinder. It includes a base reservoir and a two-piece cover that is mounted to the shaft of the rotor. The solvent trap provides a vapor barrier to seal the environment inside the cup and prevents solvent evaporation.

**Figure 9** Concentric Cylinder Solvent Trap.

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