DHR Series and AR Series

Asphalt Submersion Cell

Getting Started Guide

Revision H Issued November 2013

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
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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 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.

Instrument Symbols

The following label is displayed on the accessory 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. 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.

Table of Contents

Chapter 1:

Introducing the Asphalt Submersion Cell

Overview

The TA Instruments Asphalt Submersion Cell is a Smart Swap™ accessory designed to be used with the DHR Series and AR Series Rheometers. For the general operation of those instruments, including use of the Smart Swap system, see the appropriate operator's manual.

The Submersion Cell is specifically designed to satisfy the latest Federal Highway Administration (FHWA) requirements for asphalt binder testing. When used with the cell, the DHR Series and AR Series Rheometers meet the requirements of Dynamic Shear Rheometer (DSR) as defined by the FHWA.

The cell is designed to be used with a Julabo Computer Controlled Fluid Circulator (CCFC), normally model FP35-HE. The operation of the cell and CCFC is directly controlled through TRIOS Software. For full details of the operation of the Julabo and Safety information, see the manufacturers operating manual. A summary is provided in Appendix A of this manual.

Historically, asphalt characterization was based on measurements of penetration, capillary viscosity and ductility. While these measurements were repeatable, they could not be easily correlated to end-use performance characteristics such as rutting or cracking. Recently an exhaustive multiyear study (SHRP) by FHWA resulted in the adoption of alternative measurements that solve this correlation problem. These new measurements provide a set of alternative criteria for selecting asphalt binders and aggregate mixes to meet specific end-use conditions.

Techniques Used

For asphalt binders, the new measurements are based on the Bending Beam Rheometer, the Direct Tension Tester, and the Dynamic Shear Rheometer (DSR). The first two techniques evaluate low temperature performance, whereas the DSR evaluates performance over a broader temperature range (5 to 85°C). Specifically, the DSR test measurements include:

- AASHTO T315 & ASTM D7175: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR).
- AASHTO R29 & M320: Grading or Verifying the Performance Grade of an Asphalt Binder.
- AASHTO TP70 & ASTM D7405: Multiple Stress Creep and Recovery (MSCR) of Asphalt Binder Using a Dynamic Shear Rheometer
- AASHTO XXXX: High stress repeated creep
- AASHTO XXXX: Determining the mixing and compaction temperature of asphalt binder

This manual should be read in conjunction with these Standard Methods. The cell can be used with TRIOS Software, but for full automated testing using the standards listed above, Rheology Navigator and Rheology Advantage are required. More information about the operation of this software can be found in CSA II Asphalt Rheometer with Rheology Navigator Software PDF.

Chapter 2:

Installing the System

Components

The Asphalt Submersion Cell consists of the following items:

- Smart Swap Asphalt Submersion Cell
- 8-mm parallel plate set
- 25-mm parallel plate set
- Lower plate removal tool
- In-line water filter housing unit
- Filter material
- Mold (1 pair)
- Solenoid box
- Interconnecting cables
- Interconnecting water tubing and adaptors
- Manual tap

Important Instructions

The following items are important to the installation and use of the Asphalt Submersion Cell:

- For general instructions on the use of the Julabo CCFC, see the manufacturer's operating manual. For settings particular to the operation of Asphalt Submersion Cell, see Appendix A of this manual.
- Position the CCFC close to the rheometer to keep the tubing run as sort as possible. However, locate the circulator slightly lower than the rheometer, otherwise water can siphon into the Submersion Cell after the system has been turned off.
- Position the CCFC so that its top reservoir fill line opening is lower than the Asphalt Submersion Cell Overflow.
- For the standard testing temperatures, use deionized water as the circulating fluid. Below 5°C, it may be necessary to use a glycol/water mixture.

System Connections

A schematic of the Asphalt Submersion Cell is shown below.

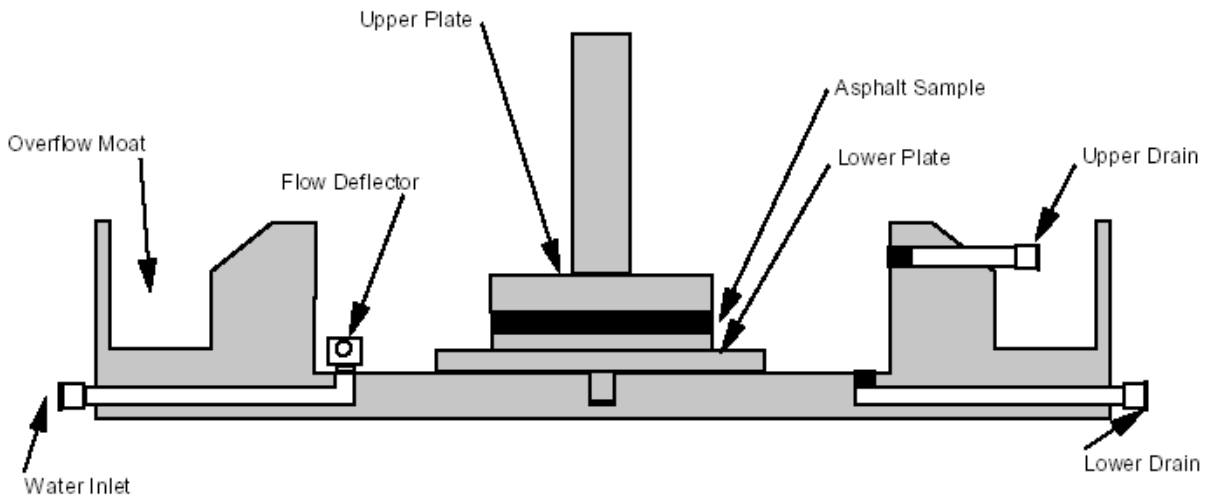


Figure 1 Schematic of the Asphalt Submersion Cell.

For the AR Series Rheometers, mount the solenoid box on the rear of the rheometer using the four 3-mm panhead Pozidrive screws supplied with the instrument, as shown below.

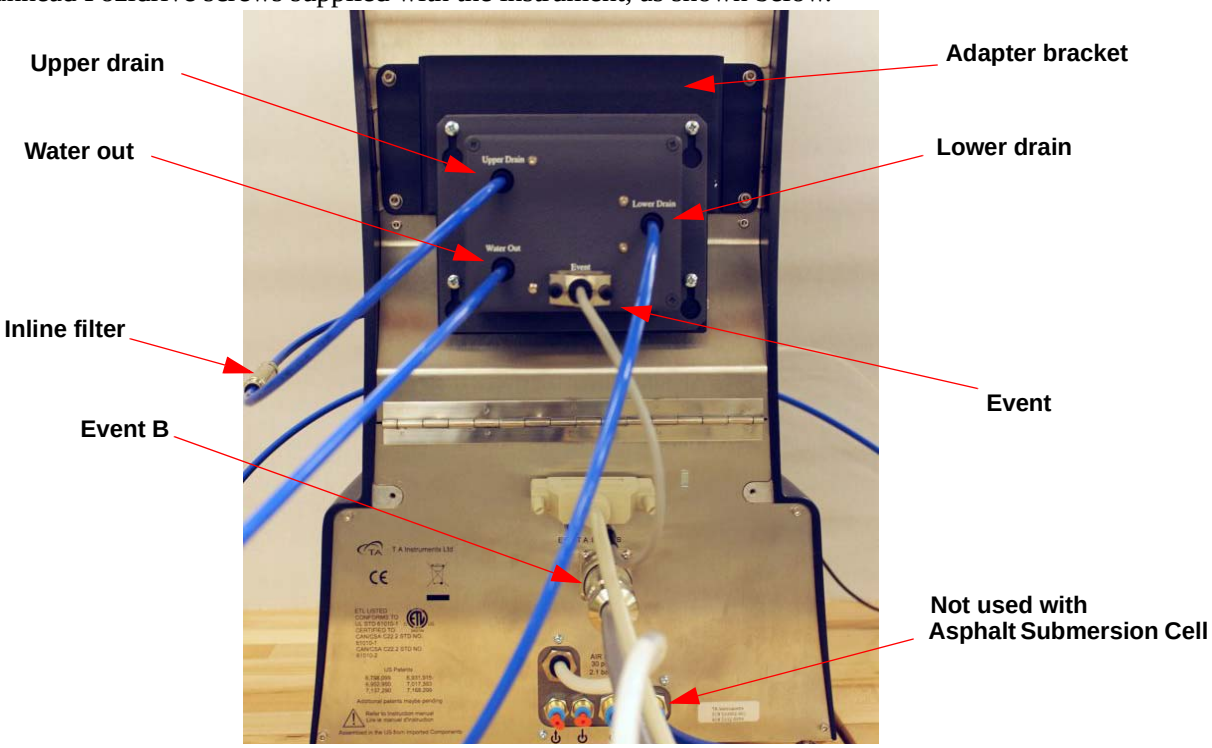


Figure 2 Solenoid box mounted on rear of rheometer (DHR shown).

For the DHR Series Rheometers, fit the adapter bracket to the back of the instrument before mounting the solenoid box.

Mount the Asphalt Submersion Cell on the rheometer using the Smart Swap connector, as shown below.

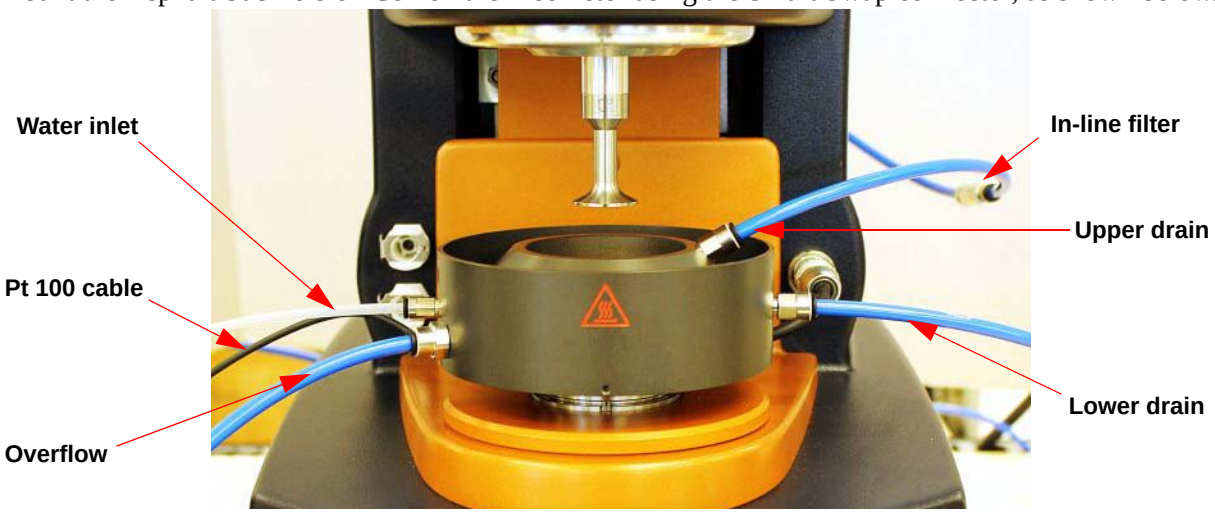


Figure 3 Asphalt Submersion Cell mounted on rheometer (DHR shown).

Make the following connections, referring to the diagrams for guidance. All tubing should be cut to length.

- The lower drain port on the Submersion Cell to the lower drain port on the solenoid box using the 6-mm tubing (blue) provided.
- The upper drain connector on the Submersion Cell to the upper drain port on the solenoid box using the 6-mm tubing (blue) provided. Insert the in-line filter into the line, as shown in Figure 4.
- The water inlet port on the Submersion Cell to the fluid outlet port on the CCFC using the 4-mm tubing (white) provided. It may be necessary to replace the connector on the CCFC with that provided. The manual tap should be inserted into the line. This can be used to cut off the supply of water to the cell in the event of overflow, but should otherwise be in the fully open position.
- The water outlet port on solenoid box to the fluid Inlet connector on the CCFC using the 6-mm tubing (blue). It may be necessary to replace the connector on the CCFC with that provided.
- The overflow port on the Submersion Cell to a suitable container/drain using the 6-mm tubing (blue).
- The **Event** connection on the Solenoid box to the **Event B** connection on the rheometer rear using the 9-pin to Lemo cable provided.
- The **RS232** auxiliary port on the Rheometer Electronics box to the **SERIAL** port on the CCFC using the 9 to 9-pin RS232 cable provided.
- The Lemo connector on the Submersion Cell Pt100 cable to the **Pt100** connection on the CCFC.

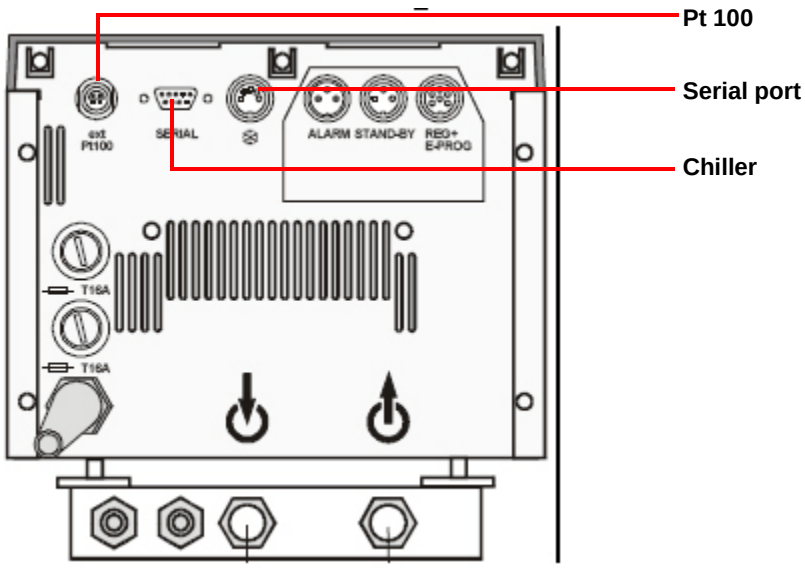


Figure 4 Connections for Julabo CCFC with HE style head.

Chapter 3:

Preparing and Maintaining the Rheometer

Filling and Draining the Cell

The **Environmental** section of the Instrument Control panel in TRIOS software contains icons for filling and draining the cell. These icons are only present when the cell is connected.

Selecting Geometries

You may need to change the geometry set installed, depending upon the desired use:

- To test Original Binder and RTFO residue, install the 25-mm geometry set.
- To test for PAV residue, install the 8-mm set.

The components are shown below.

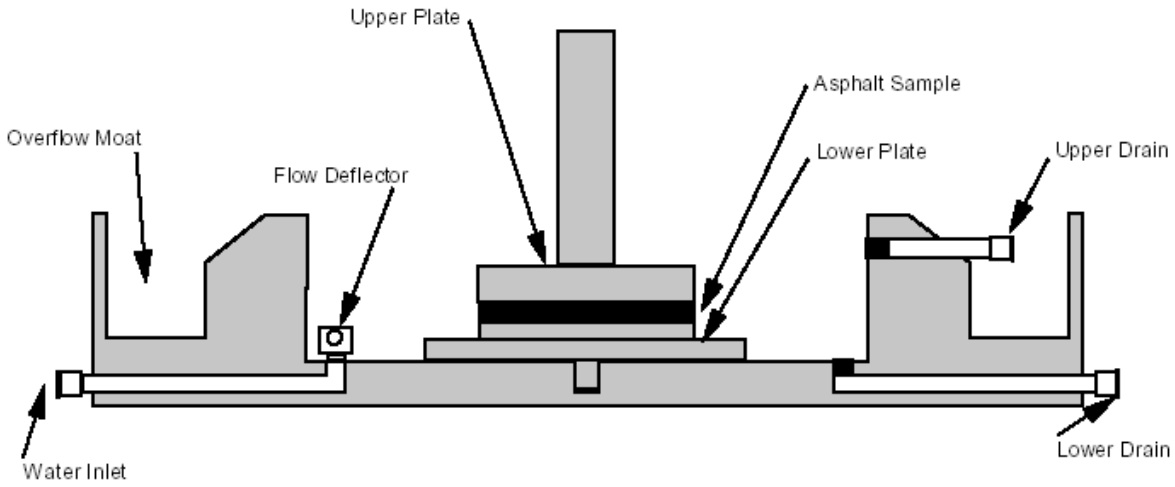


Figure 5

Routine Maintenance

It is recommended that the following procedures be carried out on a regular basis:

- **Circulation fluid**: This should be changed once per week, or if the water becomes contaminated.
- **Inline water filter**: The filter should be removed, and cleaned or replaced, when visibly contaminated. See the next section for details.
- **Asphalt Temperature Control Cell filters**: These should be changed when visibly contaminated. See the next section for details
- The **Flow Deflector Turret,** shown below, should be unscrewed and cleaned.

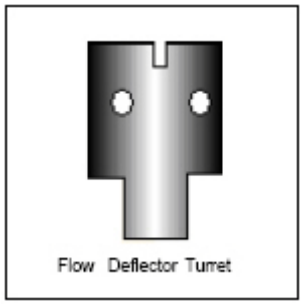


Figure 6 Flow Deflector Turret.

Filters and Plates

Before the Asphalt Submersion Cell is used, you will need to perform several functions:

- Check the drain and inline filters on the cell. The filters should be clean and free of debris.

  a To replace the *lower drain filter*, which is a 6-mm single hole punched from the filter sheet, use tweezers to place the filter in the drain. Then secure the filter with a quarter turn.

  b To replace the inline filter, disassemble the filter-housing unit and remove the tubing. Cut a filter from the sheet provided—it should be approximately 25 mm long and 10 mm wide. Then use a pair of tweezers to replace the filter.

CAUTION: Do not pack the filter material too tightly as this may result in an overflow situation.

MISE EN GARDE: Ne serrez pas trop l'emballage du matériel du filtre car cela risque de provoquer un débordement.

- Clean the plates used in the cell regularly. To remove or install the plates, see the next section. The plates are manufactured from stainless steel so they can be cleaned in a solvent bath.

Installing and Removing Plates

To install or remove the cell plates, follow these instructions:

Upper Plate

The upper plate is simply pushed onto the end of the shaft, and fixed in position by screwing up the draw-rod until finger tight. To remove it, reverse the procedure.

Lower Plate

The lower plate is screwed into the bottom of the asphalt bath. Use the removal tool provided to tighten and loosen this plate (see the figure below).

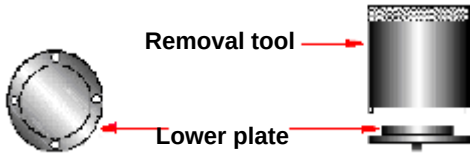


Figure 7 Lower plate removal/installation.

Chapter 4:

Troubleshooting

Solving Common Asphalt Submersion Cell Problems

This chapter provides answers to some common problems that can occur while using the Asphalt Submersion Cell. If you cannot solve the problem using one of the suggestions on the following pages, contact your TA Instruments Service Representative for assistance.

Flow Problems

The flow in and out of the temperature control cell is balanced by the size of the tubing and the efficiency of the pump and suction. The temperature control parameters are optimized for this flow rate. Temperature stability is generally related to flow rates. The on/off valve should not be used to reduce the flow rate, other than during sample loading, if splashing of the lower plate is a problem.

Temperature Control Cell Overflows

This is caused by inefficiency in the suction side of the system. If you use the on/off valve to reduce the flow rate and stop the overflow, poor temperature control is likely to result.

Try to isolate the problem area. Check the following:

- Remove all filter material.
- Disconnect and reconnect all pipes.
- Consider replacing pipes if they are visibly contaminated.
- Remove and clean solenoid valve located behind column back panel. Replace the valve, if it appears worn. Turn off power to the instrument before removing the back panel.

Poor Temperature Control

Try the following solutions to poor temperature control:

- Make sure that the on/off valve is fully open.
- Make sure that the configuration parameters in the CCFC have not been tampered with.
- Remove the flow deflection turret and check for blockages.
- Disconnect the pipe from the inlet to the cell and measure the flow rate at the height of the cell. If the flow rate is less than 450ml/min try replacing the pipe, or flush the CCFC with solvent.

Leaks

If you find leaks occurring, first locate the pipe that is leaking. Turn off the fluid circulator's main power switch before disconnecting any lines. Disconnect and reconnect the problem pipe. If problem persists, use a sharp straight tool to trim approximately 3 mm from the end of the pipe (do not use scissors, as this will pinch a hose flat). Then reconnect the pipe.

Appendix A:

Julabo Circulator (HE Style)

Introduction

This appendix covers those aspects of the operation of the Julabo Computer Controlled Fluid Circulator (CCFC) with HE style head, relevant to the Asphalt Submersion Cell. The head incorporates a VFD (vacuum fluorescent display), and membrane keypad through which parameters settings must be entered.

Setting Up the CCFC

1 Fill the CCFC to the level recommended by manufacturer. For the standard testing temperatures, use deionized water as the circulating fluid. Below 5°C it may be necessary to use a glycol/water mixture. A small amount of algaecide can be added at this point (TA part number 952377.901).

WARNING: Use caution when working with the CCFC at high temperatures. Read and study the safety information contained in the manufacturers operating manual thoroughly prior to use.

AVERTISSEMENT: Soyez prudent lorsque vous travaillez avec du CCFC à des températures élevées. Lisez et étudiez parfaitement les consignes de sécurité contenues dans le manuel d'utilisation du fabricant avant d'utiliser l'instrument.

2 Set up the connections between the rheometer, the Submersion Cell, and CCFC.

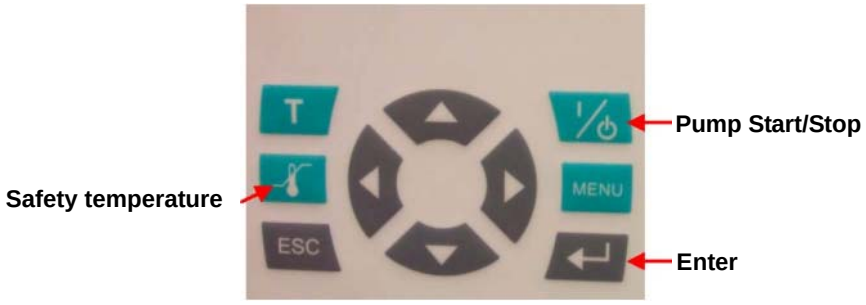
3 Switch on the rheometer and the CCFC head and pump. The CCFC will perform a self-test at this point. When this test has finished, leave the head switched on, but switch off the pump and proceed to the next section.

Using the Membrane Keypad

The following list describes the functioning of the keypad shown below:

- MENU Key: Used to enter the various menus.
- ENTER Key: Used to save entered parameters.
- ESC Key: Used to proceed to the next menu.
- UP/DOWN Arrow Keys: Used to select values.
- LEFT/RIGHT Arrow Keys: Used to change the value of a number. Press the LEFT or RIGHT arrow keys until the desired digit is activated then press the UP or DOWN arrow keys until the desired number is reached.

NOTE: Please note that if you enter the values as prescribed below and then for any reason go back and change any one parameter, all the previous PID settings will be altered. This applies to parameters in the Control Section only.



Menu Settings

Select the following menus settings using the keys as instructed above:

Pump: Adjustable Pump Capacity

Pump Speed: 2

Control: Intelligent Cascade Control Parameters

Control: External (Note: must have pt100 cable connected between bath and circulator. If not display will default to Internal Control.)

	110v/120v	220/240v
Self-Tuning	Off	Off
Cospeed	0	0
Control	PID values	PID values
XP	0.6	0.5
TN	70	90
TV	7	24
XPU	4.5 Default	4.5 Default

Config: Configuration of the Circulator

Set: Serial
A-start: off
Off Mode: Pump off
Reset: no (to restore defaults select yes and then enter)
Actvar: control
Time/Date: Setting time and date

Serial: Communication Protocol

Baudrate: 4800
Parity: Even
Handshake: Hard

Limits: Temperature and Capacity Limits

Set Max: 100°C (these values are for glycol/water mix
Set Min.: 5°C Silicone oils will require a different set)
Heat Max: 100%
Cool Max: 100%
Internal Max: 100
Internal Min.: 0
Band High: 200 (default)
Band Low: 200 (default)

Program: Integrated Programmer (leave as factory defaults)

PS Step: 1
PS Runs: 1
PS Go: Now
P Time: not required
P Date: not required
PS End: SETP/STBY
PE Del: No

Adjust: ATC Automatic Calibration of Prt (leave as factory defaults)

ATC Sen: Int
ATC Stat: Off
C ART: 1 point
T Temp: 1
C Temp: 1

Setting the Excess Temperature Protection

To complete the configuration and installation of the Julabo FP35-HE, you must set the Excess Temperature Protection. This setting is independent of the configuration values that have already been entered. When the bath temperature reaches this excess temperature, both the pump and heater shut down.

To set the excess temperature follow these steps:

1 Go to the keypad and push the **Safety Temperature** key and hold it down until "SAFETMP" is displayed.

2 Adjust the dial control located just below the on/off rocker switch for the correct Over Temp setting as viewed on the VF display. It is recommended to set the Over Temp to a value of 5 to 10°C above the maximum working temperature set point.

NOTE: If the circulator does not accept temperature commands, but is communicating with the Julabo (No beeps present), the Julabo is set for T3, or T2 and **not** T1 as required. To check the control temperature, you must program the circulator so it is in manual mode. To accomplish this:

1 Access the **Configuration** menu and change the **Set** to "**Key**" instead of "Serial."

2 Press Enter to save the change and press Escape to exit back to the normal display. The R above Off on the VFD should disappear, which indicates the circulator is now in manual mode.

3 Select T on the keypad, SETP=1 should be displayed on the VFD. If SETP is set for 2 or 3, select the T key until SETP=1 is displayed.

4 Access the Configuration menu again, and change the **Set** back to "**Serial.**" This will allow you to command a temperature via the instrument.

Appendix B:

REVISED Julabo Circulator (HE Style)

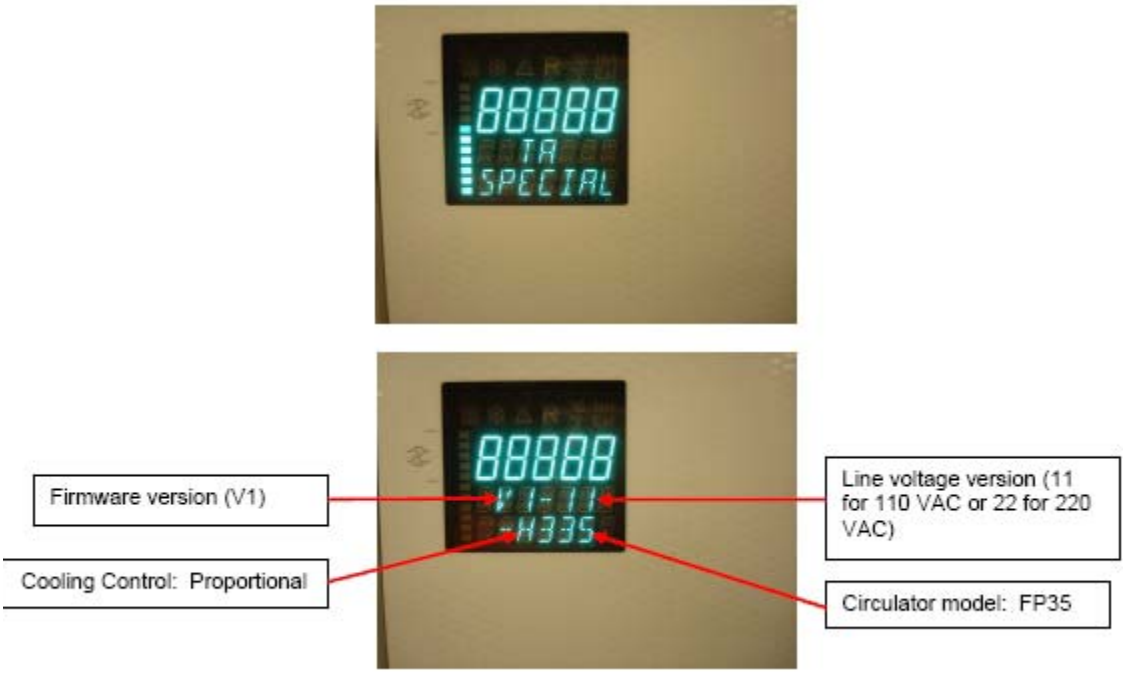
Introduction

The Julabo Computer Controlled Fluid Circulator (CCFC) model FP35-HE (part numbers 500020.901 [110V] or 575004.901 [220V])was updated in October 2009 to include new configuration options and a new front keypad. This appendix covers the new startup procedure for Julabo CCFC's shipped from **October 2009 and later**.

Startup Procedure

Follow the instructions below to configure the Julabo Circulator:

1 Power on the Julabo CCFC. **TA SPECIAL** displays upon power up, then the firmware versions appear.



2 Open the Julabo menu by pressing the **Menu** key MENU on the front panel.

3 Use the ▲ ▼ keys to scroll through the menus and to change parameter values.

4 Press **OK** OK to save changes to the configuration.

5 Press OK key to return to the previous menu selection and to exit the menu.

As with the previous circulator, before entering the configuration values, please take a moment to confirm the correct hose and cables are installed at the back panel of the Julabo. Please note you must have the PT 100 cable installed before you can set the configuration. The RS-232 cable can be attached or disconnected; it does not matter.

Menu Settings

Use the information below to configure the Julabo CCFC. **Use 100% distilled water**.

Menu	P-Start	Leave as default	
Menu	Program	Leave default settings, not used	
Menu	Pump	Set to level **2** (Pump Speed)	
Menu	Configuration		
	REMOTE	Set to OFF temporarily in order to make changes to the configuration. After the configuration is set, set the Remote to ON which will allow remote control via the RS232 port.	
	SP EXT	Set to OFF	
	AUTOST	Set to OFF	
	OFF-MODE	Set to Pump OFF	
	ACTVAR	Set to Control	
	TIME /DATE	Not necessary to enter a valid time or date	
	RESET	Not used	
Menu	Control	110VAC	220VAC
	C-TYPE	Set to External	External
	SELFTUN	Set to OFF	OFF
	COSPEED	Set to 0	0
	XP EXT	Set to 0.6	0.5
	TN EXT	Set to 70	90
	TV EXT	Set to 7	24
	XPU	Set to 4.5	4.5
Menu	Serial		
	BAUDRAT	Set to 4800	
	PARITY	Set to Even	
	HSHAKE	Set to Hard	
Menu	ATC	Leave default settings; not used	
Menu	Limits		
	SETMAX	Set to 90	
	SETMIN	Set to 10	
	HEATMAX	Set to 100	
	COOLMAX	Set to 100	
	INTMAX	Set to 95	
	INTMIN	Set to 5	

Use 100% Distilled Water.

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