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# INTRODUCTION

## Overview

### *Scope of the manual*

This manual is intended to provide information on the installation, characteristics and operation of the **CANNON**<sup>®</sup> Digital Paddle Viscometer.

### *DPV capabilities*

The **CANNON**<sup>®</sup> Digital Paddle Viscometer (DPV) is designed to measure viscosity of asphalt emulsions, residual oils, slurries, paints, marine fuels, and other similar materials between 30 and 30,000 cP (mPa·s) at temperatures of 40°C, 50°C, 80°C and 100°C (25, 40, 50 and 100°C with cooling coil option). The Digital Paddle Viscometer can also be used for other applications consistent with its temperature control and viscosity measurement capabilities, including the ASTM D 244 consistency test. The Digital Paddle Viscometer can determine the viscosity of lubricating oils, marine fuels and other liquids, yielding results with an accuracy of 5 percent or better for most materials—better than that required by ASTM D 445 for residual oils at 50°C.

### *Instrument operation*

The DPV offers convenient keypad controls for instrument setup and testing.

### *DPV description*

The DPV consists of a base, adjustable heater block/tray, sample cups, head unit and removable paddles.

### *DPV function*

Microprocessor circuitry, functioning in tandem with twin temperature probes and sophisticated internal electronic sensors detect and analyze temperature and viscosity data as a rotor immersed in the test oil is turned at a fixed rate.

### *Reading test results*

Viscosity test results are continuously updated on a digital display screen on the front panel of the head unit. Results are displayed in centipoise (cP; mPa·s) or centistokes (cSt; mm<sup>2</sup>/s) where density is known and input. When the test is complete, test data is output to the 9-pin serial output port for (optional) printing.



*The Digital Paddle Viscometer (DPV)*

## Safety features

### *Overheat thermostat*

A thermostat in the heater block senses any over-temperature fault condition. If such a condition occurs, all power is removed from the DPV heater until the temperature drops to a safe level.

### *RTD cutoff detection*

If the control RTD is disconnected, power to the heater block is cut off.

### **NOTE**

*Deviation from the installation or operation procedures described in this manual may result in a hazardous situation.*

## Operator Safety

All technicians who use the DPV should follow these basic safety procedures:

- Use appropriate safety precautions for working with high-temperature liquids/equipment.
- Follow instructions in this manual regarding use and maintenance of the DPV.
- Do not place the DPV on an unstable cart or stand. The DPV should be placed on a sturdy table or bench.
- Avoid spilling liquids on the viscometer head or electric cables and connectors. If spillage occurs, remove power from the unit immediately.
- Do not position power cords so that they are likely to be walked on or pinched by items placed on or against them.
- If the DPV will not be used for an extended period of time, unplug the power cord from the wall outlet. To disconnect the power cord, pull it out by the plug. Never pull the cord itself.



### **CAUTION**

*Do not attempt to service the DPV system beyond the basic installation and troubleshooting guides provided with this manual. Contact **CANNON**® Instrument Company regarding service and repair needs. Use the proper safety precautions when handling heated test samples. Use gloves when handling heated sample cups. Avoid touching the interior of the heater block. Improper handling of the heater block or the sample cup during or after testing at higher temperature settings may cause burns.*



### General Caution



### Hot Surface Caution

In addition to the warnings listed above, additional cautions are posted in the manual. These warnings may be designated by an appropriate symbol inside an equilateral triangle. General cautions are indicated with an exclamation point (see diagram, left).

Hot surface cautions (see diagram, left) may be attached on or near hot surfaces of the instrument. Avoid touching these surfaces when operating the instrument at temperatures above 50°C.

## DPV specifications

DPV SPECIFICATIONS			
<b>Dimensions</b>	191 mm wide × 235 mm deep × 451 mm high (7.5" × 9.5" × 17.75") 150 mm rear clearance required.		
<b>Weight</b>	8 kg (17.5 lbs.)	<b>Shipping Weight</b>	12.3 kg (27 lbs.)
<b>Viscosity Range</b>	30 to 3,000 cP for large paddle; 300 to 30,000 cP for small paddle.	<b>Viscosity Accuracy</b>	± 5%
<b>Test Temperatures</b>	40, 50, 80, 100°C (DPV w/Cooling Option: 25, 40, 50, 100°C)	<b>Temperature Accuracy</b>	± 0.1°C
<b>Operating Conditions</b>	15°C to 30°C, 15% to 95% RH, non-condensing	<b>Installation Category</b>	II
		<b>Fuse Rating</b>	M 2A 250V **
<b>Compliance</b>	EMC directive (89/336/EEC)		
<b>Power Requirements</b>	230V AC ± 10%, 50/60 Hz <b>OR</b> 115V AC ± 10%, 50/60 Hz (consult rear panel for requirements for your unit)		
<i>** Fuse replacement is 5 mm × 20 mm fuse. Use only identical size/rating or hazard may result.</i>			

## Calibrating the DPV

The DPV is factory-calibrated to ensure accurate temperature and viscosity readings. If results cannot be verified with a viscosity standard, recalibration may be required. Contact **CANNON**® Instrument Company for further information.

### *Calibration theory*

The DPV stores user calibration information in a “bin” corresponding to each temperature setting. This calibration adjustment value is automatically applied in viscosity calculations.

## DPV options

### Printer



The Digital Paddle Viscometer transmits data to the RS-232 serial port in the following format:

With Density input provided	Without Density data
Temp: 25°C	Temp: 25°C
Dens: 0.9842 g/mL	Dens: N/A
KV: 546.2 mm <sup>2</sup> /s	VISC: 537.6 mPa·s
SFS: 252.1	SFS: 252.1

The information is transmitted in ASCII format at the conclusion of a test.

The Extech Mini Serial Printer II (available from CANNON) is capable of printing the transmitted data. Other printers may be compatible, but have not been tested.

The serial printer should be connected directly to the serial port on the DPV.

### Cooling coil

The Digital Paddle Viscometer is available with a cooling coil option for testing at 25°C. Only the 25°C temperature setting requires use of the cooling coil in most laboratory environments. Tests at other temperatures should be performed without using the cooling coil.

In many laboratories, tap water may provide sufficient cooling. If a chiller is required, the Julabo FE500 chiller (available from CANNON) is recommended. Other chillers may be used.

#### *Chiller specifications*

- Cooling capacity: 400W
- Flow rate/pump capacity: 10 liters/minute
- Temperature setting: +15 to +20°C.

#### **NOTE**

*The cooling coil is supplied with two 1/8" Swage-Lok connections.*



*DPV with cooling coil option installed*

# UNPACKING AND ASSEMBLY

This chapter of the manual provides assistance in unpacking and assembling the Digital Paddle Viscometer.

## Unpacking the DPV

1. Remove all components from the shipping container(s).
2. Remove any and all packing materials (Styrofoam, etc.) from the components.
3. Verify reception of shipped materials by comparing equipment items with packing/parts list(s). Report missing items to **CANNON**<sup>®</sup> Instrument Company immediately.
4. Inspect each component for signs of damage. Report damages to the shipper and to the **CANNON**<sup>®</sup> Instrument Company immediately.

### *Damaged items*

Retain all packing materials until the instrument is connected and functioning properly. If any component(s) must be returned to **CANNON**<sup>®</sup> Instrument Company, the damaged item(s) should be packaged in the original shipping container. Refer to the final chapter of this manual for instructions on returning defective equipment. Customers outside the United States should contact the local **CANNON**<sup>®</sup> agent for procedures on returning products to **CANNON**<sup>®</sup>.

The **CANNON**<sup>®</sup> Digital Paddle Viscometer is shipped assembled in a single box. The sample cups (2) for holding oil samples during testing are shipped in the same box.

## Assembly procedure

### *Heater connection*

1. Unpack the DPV unit and move it to an appropriate test location on a stable bench or table with convenient access to required AC power.
2. Connect the IEC320 heater block power cord to the matching connector on the rear panel of the DPV (see *Figure 2*, next page).
3. Connect the Lemo<sup>®</sup> plug from the heater block temperature probe to the matching connector on the rear panel of the DPV (see *Figure 2*, next page). To insert the plug, line up the red dots on the plug and the connector and push the plug into place. If it is necessary to remove the Lemo<sup>®</sup> plug, pull it out by the knurled portion of the plug.

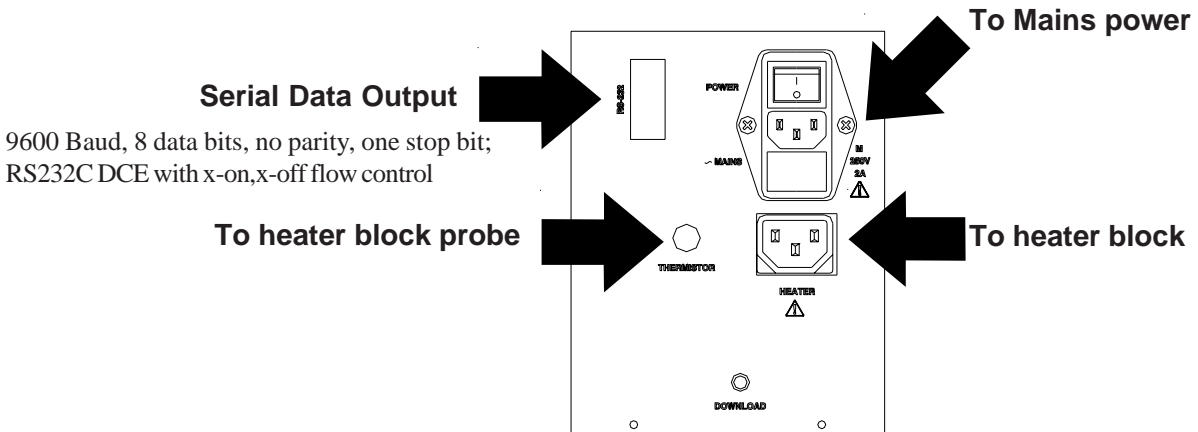


Figure 2: DPV rear panel with electrical/probe connections highlighted

Power cord



### CAUTION

4. Connect the DPV power cord to its matching socket on the DPV rear panel.

*Do not turn on the power to the DPV without completing the installation requirements. Make sure that the mains voltage specified on the rear panel identification label matches your mains voltage.*

5. Attach the optional printer to the serial data output (see diagram above) using the supplied null modem cable. Printer output will include Temperature, Viscosity and (if applicable) input Density.

### NOTE

*Data from the DPV may be acquired with a computer by attaching a straight (1:1) cable from the DPV (DCE) to the computer (DTE).*

6. Make sure that the power switch on the rear panel of the viscometer head unit is in the **OFF** position. Then plug the other end of the power cord into an appropriate outlet meeting the electrical requirements specified on the rear panel identification label.

## Adjusting the stop collar

The stop collar on the right-hand rail of the DPV has been adjusted during factory calibration to ensure that the spindle and paddle will be positioned correctly in the sample cup when the heater block tray is raised into position for a test.

On occasion, it may be necessary to adjust the height of the stop collar:

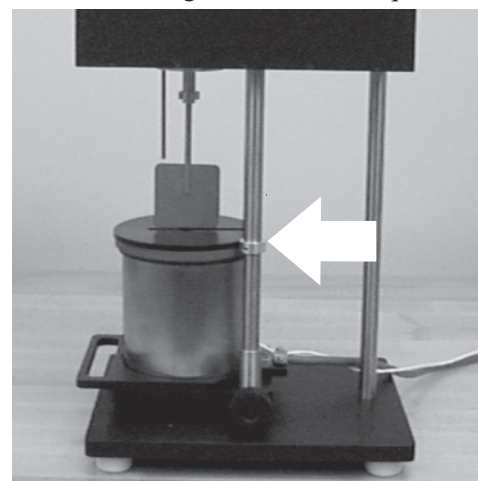
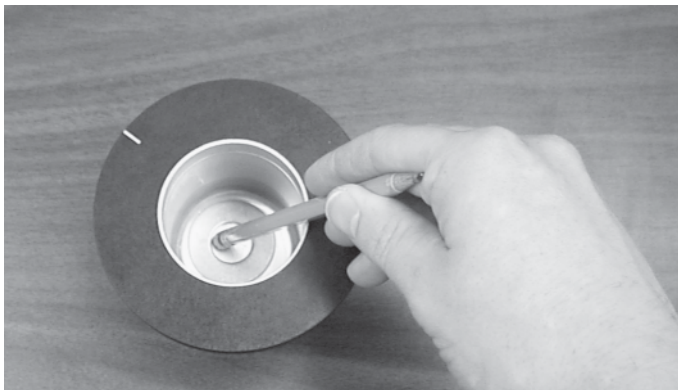


Figure 3: MFV-1000 with stop collar highlighted

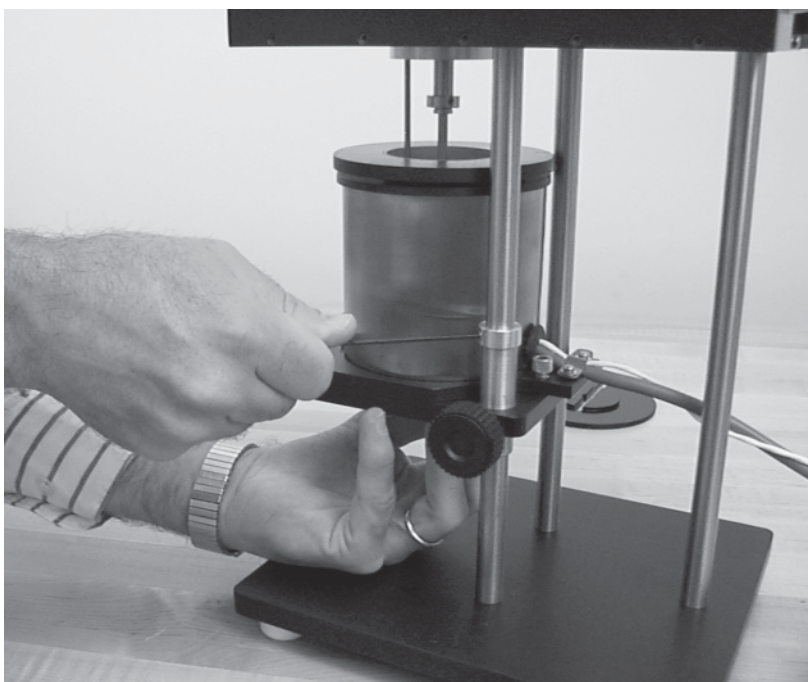


1. Use a 5/64" (#8) or 2 mm Allen wrench to loosen the stop collar set screws until it slides freely on the rail (see *Figure 3*).
2. Place a 0.048" (1.22 mm) high spacer in the bottom center of the sample cup (see *Figure 4*, next page). Then place the sample cup in the heater block.



*Figure 4: Orienting spacer in sample cup*

3. Relocate the collar by raising the tray assembly until the paddle makes contact with the spacer.
4. Retighten the set screws when the tray mechanism is at the correct height (see *Figure 5*).



*Figure 5: Securing the stop collar at the correct height*

5. Lower the tray mechanism and remove the spacer from the sample cup.

Installation of the DPV is complete.

## Applying power



### CAUTION

Do not turn on the power to the DPV without completing the installation requirements. Make sure that the mains voltage specified on the rear panel identification label matches your mains voltage.

### NOTE

The DPV stores the “last-used” temperature setting in memory, so that on power-up the instrument default test settings will be those last used.

## Cold Start

The Cold Start is the normal start-up mode for the DPV.

To Cold Start the DPV, turn the rear panel power switch ON. The digital display should light when power has been supplied to the unit. The five LEDs in the lower row of keys will blink on and then off as the instrument emits a long and a short “beep” tone.

During the Cold Start process, the DPV will perform several diagnostics (see Self-Test Sequence, next page). At the conclusion of a successful self-test, the current machine temperature, target temperature and status will be visible on the digital display:

Status:	Idle		
Temp:	25.01°C	---	°C
Time:	00:00	00:00	

## Warm Start

The Warm Start is the abnormal start-up mode for the DPV and it occurs only if the power was previously off for a period less than about two seconds, or if a fault was detected in the microprocessor during the self-test sequence. If the DPV Process Function Monitor senses a momentary or ongoing failure in the system hardware or software, the heating element will be shut down and the system will be reactivated in Warm Start mode. The keypad lights will flash in a repeating pattern and power to the heating element will be disabled.

The display will show the following:

POWER UP
Warm Start
Consult User's Guide

If this condition occurs, turn off the power switch and wait at least five seconds. Then return the power switch to the ON position and wait for the display to indicate either a warm or cold start again. If the DPV digital display indicates a cold start condition and starts its normal self-test sequence, it is possible that a momentary power interruption caused the warm start condition and no further action is required. If the DPV continues to enter the warm start condition, contact **CANNON**<sup>®</sup> Instrument Company for further assistance.

## Self-test sequence

The DPV start-up includes a self-test procedure encompassing key components of the system.

Following the self-test, the DPV will enter its normal display condition provided that the Lemo connection for the temperature sensor is secure. If the sensor is unplugged from the rear panel of the DPV during a test, the screen will display the following warning:

```
***** Error *****
The Control Probe
is unplugged.
```

It will be necessary to reconnect the sensor and press the ENTER key on the keypad to resume normal DPV operations.

## Front panel operations

Following a successful Cold Start, the DPV is ready for instructions from the user.

The front panel of the DPV provides a digital display screen and a simple keypad interface (see *Figure 6*).

### Using the keypad

The keypad on the front panel of the DPV consists of fifteen keys:

- numbers 0 through 9
- a RUN TEST key
- a SET TEMP (set temperature) key
- a SET DENS. (set density) key
- a MENU key
- an ENTER key

The keys on the bottom row (non-numerical keys) may illuminate to assist the operator in selecting key entry options.

Press the appropriate keypad choice(s) firmly to make your selections. The DPV will signal reception of each keypad command with a short, high-pitched “beep”. A longer beep indicates a data entry error (unacceptable input), such as a density value outside the range of the unit.

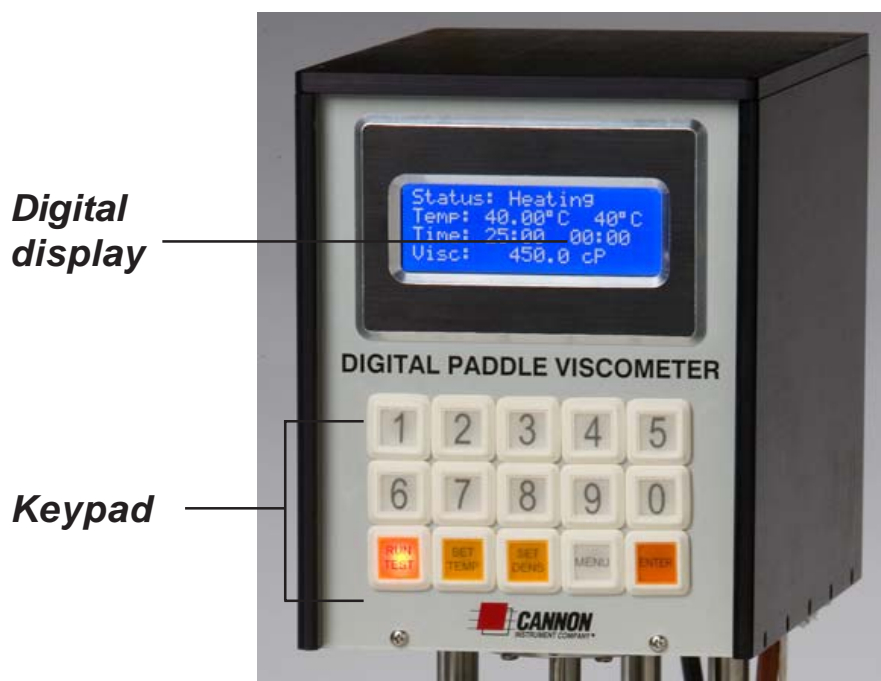


Figure 6: The DPV front panel

#### *The ENTER button*

The ENTER button is the most-used feature on the DPV keypad. You must confirm most menu choices and all numeric input by pressing this button.

#### *Selecting/canceling options*

To access any of the primary keypad options (RUN TEST, SET TEMP, SET DENS.), press the appropriate keypad button once. If you make a data entry error and wish to cancel your input sequence, press the primary keypad option button again.

#### *Initial options*

Only four keypad options are enabled when the Cold Start routine is begun—RUN TEST, SET TEMP, SET DENS. and MENU:

- RUN TEST allows user to begin controlling temperature and testing viscosity.
- SET TEMP allows user to select the desired test temperature setting from the four options provided.
- SET DENS. allows user to enter the density for the current sample, enabling a digital display mode in centistokes (cSt) for the current test. The display will return to the default centipoise reading (cP) when a new test is initiated
- MENU permits access to unit selection (Display Units) and paddle selection (Set Viscosity Range) options.

MENU also accesses advanced calibration, communication and troubleshooting functions. The advanced functions are password-protected and ordinarily reserved for trained service personnel. If further information is necessary, contact **CANNON**® Instrument Company.

## Running a test

### Preparing the sample

Before running a test, prepare the sample using the following procedure:

1. Fill a clean sample cup to the fill line indicated on the inside of the cup (see Figure 7).

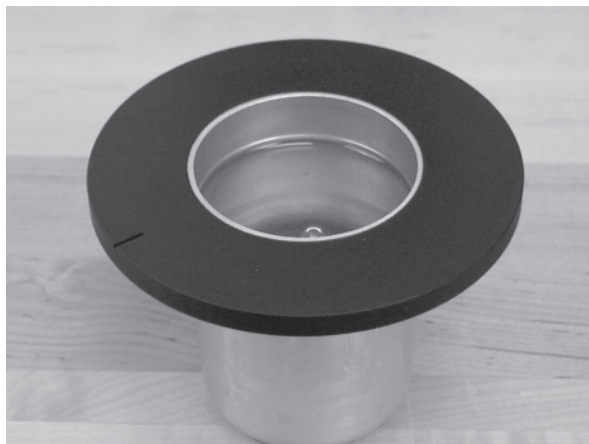


Figure 7: Sample cup with liquid level at fill line

2. Using the handle in front of the heater block tray, pull the tray forward on its rails until it stops. Attach the paddle to the instrument by sliding the paddle shaft into the slotted magnetic shaft coupler.

### **NOTE**

Make certain that the DPV has been configured for the paddle in use (see chart, page 17)

3. Place the sample cup into the heater block (see Figure 8).



Figure 8: Inserting the sample cup into the heater block

4. Rotate the sample cup slowly until the notch is facing forward and the pin on the sample cup is seated in the hole in the heater block (see Figure 9). When seated properly, the sample cup will not rotate.



Figure 9: Sample cup with notch highlighted

5. Slide the tray toward the back of the DPV until the detent mechanism clicks into position.
6. Loosen the knob on the right side of the sample tray by turning it counterclockwise. Then raise the tray until the bearing contacts the stop collar on the rail.
7. Lock the tray into position by turning the knob clockwise until the tray is secure.
8. Carefully place the sample cover over the sample cup. The DPV is now ready to run the sample.
9. Before beginning the test, verify the test temperature setting by pressing the **SET TEMP** button on the keypad. The current setting is indicated on the last line of the display.

#### Setting the temperature

<i>TEMPERATURE MENU</i>	
1. 40°C	3. 80°C
2. 50°C	4. 100°C
: 1	

To change the test temperature, press the appropriate keypad option (1-4). Then press **ENTER** to return to the initial digital display.

#### Initiating the viscosity test

10. To begin testing for viscosity, make sure that the spindle paddle is totally submerged in the sample and is free to rotate in the sample cup. Then press the **RUN TEST** button on the keypad.

#### Automatic test actions

After the **RUN TEST** button has been pressed, all testing functions of the DPV are automatic. The DPV will begin heating to the test temperature. Spindle/paddle rotation will begin. The current and desired test temperatures will be displayed on the screen, along with a clock indicating the length of the current test.



```
Status: Heating
Temp: 25.01°C 40.00°C
Time: 00:00 01:27
Viscosity: 457.74 cP
```

When the DPV temperature probe senses that the sample temperature is within one tenth of a degree of the test temperature, the instrument will begin timing the test run and sampling readings from the spindle.

```
Acquiring data ....
Processing ....
```

After the instrument has completed the analysis sequence, the total test time and the calculated viscosity will be displayed on the screen. The data will also be sent to the optional label printer via the serial data output.

```
Status: Test Finished
Temp: 25.01°C ---°C
Time: 00:00 00:00
Viscosity: 457.74 cP
```

The display will not change until another keypad action is initiated.

#### *Rerunning the test*

To enhance repeatability for successive measurements of the same sample, permit the sample to cool for at least one hour prior to running the next test.

#### *Aborting a test*

If you wish to abort a test in progress, press the RUN TEST key again.

#### *Spindle/paddle obstruction*

*If motion of the spindle/paddle mechanism is obstructed while the sample temperature is within 0.1 degrees of the target temperature, the DPV will cease testing and the digital display will indicate an error (see below). To restore instrument function, remedy the obstruction and press the ENTER key to return to the initial digital display. Then resume normal DPV operation procedures.*

```
■■■■■ ERROR! ■■■■■■
A locked rotor was
detected. Press
ENTER to Reset
```

#### *Higher temperatures*

When using higher temperature settings (80°C and 100°C) use caution to avoid burns when handling the sample cup, especially after testing.



**CAUTION** Careless handling of the sample cup or touching of the heater block surfaces during or after high-temperature testing may result in injury.

#### *Kinematic viscosity readings*

It is possible to derive kinematic viscosity using the DPV when the density of the sample is known. To view kinematic viscosity readings from the digital display, press the SET DENS. button on the keypad.



```

*Set Density*
Please enter sample
density ...
  _ . ____ g/ml

```

Then enter the correct density value for the sample. Acceptable density values are between .5000 and 1.200. If you make a mistake with data entry, press the **SET DENS.** button again to erase the current entry, then type in the corrected data.

**NOTE** *As you enter each numeral, the numbers will shift placement to the left in relation to the decimal point. It may be necessary to add zeroes to orient the data correctly.*

**EXAMPLE** To enter a density of 1.13, you would need to press the following keypad sequence: **1-1-3-0-0.**

**NOTES** *Once an acceptable density has been entered, the digital display will indicate centistoke values (cSt) for the duration of the test. If you wish to obtain the centipoise reading, press the **SET DENS.** button until all density values are cleared from the screen. Then press the Enter key.*

*If a value for density is entered which is outside of the acceptable range (0.5-1.2 g/mL) for DPV kinematic viscosity conversion, you will receive a **RANGE ERROR** message on the digital display screen. To correct this error, press **ENTER** and follow the screen prompts to enter appropriate data.*

## Cleaning the DPV

The sample cup, spindle/paddle, and sample cover should be cleaned after each test to ensure accurate viscosity readings. To clean, remove the sample cover, wipe if necessary, and set it aside.

Lower the tray mechanism and gently wipe any sample from the temperature probe, taking care not to apply any lateral force. If necessary, you may clean the probe with solvent. Detach the paddle, wipe, and clean thoroughly. Remove the sample cup and empty the used sample into an appropriate waste container. Wipe out the cup and use an appropriate solvent to completely clean it.



**CAUTION** Use appropriate precautions to avoid burns if handling a hot sample cup!

## MENU options

There are three **MENU** options (see chart, page 17 for additional details). Option 1, Configure Density, provides an interface for entering the desired temperature parameter for viscosity calculations based on density (if applicable). The default setting is test temperature. Option 2, Configure Units, accesses several important functions including the selection of desired viscosity units for the front panel display. The Select Visc[osity] Range submenu permits paddle selection (this option must be changed

whenever the paddle is changed!). Another submenu initiates conditioning of the DPV motor (service function). Option 3, Advanced Functions, is a password-protected option ordinarily used only for initial calibration and configuration of test and communication options. These options have been properly configured at the factory. Contact **CANNON**<sup>®</sup> if changes are required. See next section for additional details.

### Downloading firmware

The DPV is capable of receiving new operational instructions via the RS-232 interface. If the DPV firmware is updated, and a new release issued by **CANNON**<sup>®</sup> Instrument Company, a diskette will be sent to the user along with instructions on how to perform this upgrade.

A “download” push button is located on the rear panel of the DPV. Pressing and holding this button for several seconds places the DPV instrument in the “download” mode.

### NOTE

*If the download button is pushed inadvertently, it may be necessary to restart the DPV.*

When the DPV is in the download mode, the digital display will indicate the version number for the resident download hardware code and the operational firmware.

## Keypad Control Options

The following tables provide a synopsis of most DPV keypad options. Some troubleshooting options and advanced settings are not accessible without a password. Contact **CANNON**<sup>®</sup> Instrument Company for more information regarding these security-protected features.

DPV Keypad Controls			
1, 2, 3...0	Used to input numeric data		
Run Test	Displays Status, temperature, target temperature, total temperature equilibration time, total data acquisition time, viscosity and viscosity unit		
Set Temp[erature]	Displays Temperature Menu.	1	Select for 40°C temperature
		2	Select for 50°C temperature
		3	Select for 80°C temperature
		4	Select for 100°C temperature
Set Dens[ity]	Displays Set Density Menu	--	Input known density of sample. Must be between 0.5000 and 1.2000 g/mL

DPV Keypad MENU Options						
Menu	Displays Main Menu	1	Configure Density	Select Density option	1	Test Temperature (default)
		2	Configure Units	Select desired units	2	15°C
		1			1	cgS units (cP or cSt)
		2			2	SI units (mPa·s or mm <sup>2</sup> /s)
		3			3	Set Visc[osity] Range
					1	Low 30-3000 cP
					2	High 300-30000 cP
					3	Condition Motor
						Use large paddle
						Use small paddle
						Press Enter to initiate 20-minute automated conditioning cycle, Menu to cancel.
		1	Configure Tests (includes speed settings, default soak time, clock Hz,	Configure Tests (includes speed settings, default soak time, clock Hz,		
		2	Adv. Functions	Calibrate temperature, calibrate viscosity, calibration reset		
		3	Password-protected functions	Comm[unication] Setup		
					1	Change Port Speed
					2	Select [Port] Address
					3	Config[ure] Reports

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# MODEL DPV PROBLEM ANALYSIS

A successful DPV self-test is an indicator that there are no detectable errors and checked components are functional . There are certain conditions, however, that cannot be verified by these automatic tests. These include:

1. Spindle functionality
2. Temperature probe functionality
3. Heater operation

## *Fault isolation*

For assistance in troubleshooting your DPV consult the troubleshooting guide below. If you are unable to resolve the difficulty, call **CANNON®** Instrument Company for assistance.

TROUBLESHOOTING GUIDE		
Problem	Possible cause	Solution
<b>DPV does not appear to have power.</b>	Power cable not connected to rear panel.	Attach cable.
	Power cord unplugged.	Attach cord to appropriate outlet (see electrical requirements on DPV rear panel).
	Power out on mains.	Restore power.
	Fuses blown on power inlet.	Replace fuses (see Chapter 1 for ratings).
<b>Temperature readings incorrect</b>	Temperature probe damaged or not connected.	Check Lemo connection for sensor on rear panel.
<b>Heater cup not heating sample</b>	Temperature setting may be lower than the current sample temperature.	Verify sample temperature with a thermometer. Temperature must be below the current instrument setting for heat to go on.
	Sample fluid level in the sample cup may be too low.	Add fluid per manual instructions. Make sure that the paddle and the tip of the temperature probe are immersed in the sample.
	Sample heater may not be plugged in.	Check to ensure cable connections are secure.
<b>Viscosity test returns a RANGE ERROR</b>	Sample fluid viscosity may be too high.	Test samples within the DPV range.
	Paddle/spindle may not be operating properly or may be contacting the side or bottom of the sample cup.	Check orientation of the paddle.

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# WARRANTY/RETURN INFORMATION

## Products limited warranty

In addition to other manufacturers' warranties, **CANNON**<sup>®</sup> Instrument Company ("the Company") warrants all products (other than reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in material and workmanship for one year from the date of the Company's invoice to the purchaser. For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole election, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accident or acts of God, or to service or modification of the product without prior authorization of the Company) without charge for parts and labor. The determination of whether any product has been subject to misuse or abuse will be made solely by the Company.

The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment or products, directly or indirectly resulting from the use or misuse of any product sold by the Company except as set forth in and limited by the foregoing warranties. Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent, in conflict with, or in excess of the terms of this warranty shall not be binding upon the Company unless placed in writing and approved by an officer of the Company.

## Reagent and chemical warranty

**CANNON**<sup>®</sup> Instrument Company ("the Company") warrants all reagents and chemicals sold by the Company and delivered to and retained by their original purchasers to conform to the weight, specifications and standards stated on the package. The Company will, at its sole option, either replace or refund the price (net of freight, handling charges and taxes), of any reagent or chemical sold by the Company which does not conform to such weight, specifications and standards upon the prompt return of the unused portion. Except for replacement or refund of the net price, the Company shall not be liable for any damages occurring as a consequence of the failure of any reagent or chemical sold by the Company to conform to the weight, specifications and standards stated on the package.

## Returning a product to **CANNON**<sup>®</sup>

### *Procedure*

Before returning a **CANNON**<sup>®</sup> product for repair or service, make every attempt to identify the problem. If, after careful checking, the problem remains unidentified or unsolved, telephone **CANNON**<sup>®</sup> Instrument Company (or the local service agent) to consult with a product specialist. If the specialist cannot recommend a simple solution or repair, **CANNON**<sup>®</sup> will authorize the return of the product through the issuance of a Return Authorization number (RA).

<b>CANNON</b> <sup>®</sup> Telephone Number	814-353-8000
<b>CANNON</b> <sup>®</sup> Fax Number	814-353-8007

Products returned to **CANNON**<sup>®</sup> must be carefully packed. Ship prepaid to the following address:

CANNON Instrument Company  
 ATTN: Return Authorization # \_\_\_\_\_  
 2139 High Tech Road  
 State College, PA 16803 USA

Please include the following:

### *Required information*

- The Return Authorization number (RA).
- The name and telephone number of the person at your company to contact regarding the product.
- Shipping and billing instructions for the return of the product to your location.
- A detailed explanation of the reason for the return.

If the product is not covered by warranty, the customer will be provided with an estimate of the repair costs and asked for approval before any repairs are made. The customer will be required to issue a purchase order for the cost of the repairs.

### *Hazardous materials*

Stringent government regulations restrict the shipment of mercury. Please contact **CANNON**<sup>®</sup> before returning a product that could possibly contain mercury.

### *Shipping notification*

Products returned without prior notification (by either telephone or fax), or without Cannon's authorization, will not be accepted.

The customer may be billed a testing fee if a product is returned to **CANNON**<sup>®</sup> and found to be working properly.