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The CANNON® Automatic Viscometer (CAV 2000 Series)

The CANNON® Automatic Viscometer (CAV) is a completely automatic viscometer designed for unattended operation. The operator places samples in small vials in the sample holders, enters sample identification information and initiates the testing with software or front panel keypad commands. Without any further operator involvement, the CAV determines kinematic viscosity, cleans the capillary tube(s) and prepares the instrument for the next test. All pertinent test data can be saved to a computer database for future retrieval and reporting.

Manual

This manual is designed to provide the operator with information about:

- VISCPRO® software installation and operation
- CAV 2000 Series equipment and operation
- Calibration, service and maintenance procedures

For additional information on initial installation and instrument setup, refer to the Installation & Setup Guide.

Applications

Previous CAV models have been used in laboratories worldwide for over two decades. CAV instruments can be found in R&D laboratories, refinery quality control laboratories, blending plants, and independent testing laboratories. The CAV is ideally suited for the analysis of both transparent and opaque samples. A variety of materials, such as used oils, marine fuels, residual fuels, and crude oils can be tested with ease.

Precision

Precision for the kinematic viscosity determination of the CAV equals or exceeds that specified in ASTM Method D 445. This method is required by the Society of Automotive Engineers (SAE) Engine Oil Viscosity Classification SAE J300.
Measuring kinematic viscosity

Kinematic viscosity is a measure of the internal resistance to flow of a fluid under gravity with the pressure head being proportional to the density of the fluid. For any particular viscometer, the time of flow of a fixed volume of fluid is directly proportional to its kinematic viscosity.

Units of measure

An accepted unit of kinematic viscosity is one centimeter squared per second, which is called one stoke. The centistoke (which is equivalent to 1 mm²/s) is the unit of measure most frequently used.

Methodology

ASTM Methods D 445 and D 446, included with this manual, describe appropriate test methodologies and instruments for glass capillary viscometry.

Manual viscometers

Sections 9-11 of ASTM D 445 provide detailed instructions for using manual viscometers. ASTM D 446 suggests a minimum flow time of 200 seconds for nearly all the glass capillary viscometers (see tables in ASTM D 446).

Automatic viscometers

For automatic viscometers, ASTM D 445 Section 6.1.2 states, “Automated apparatus may be used as long as they mimic the physical conditions, operations or processes of the manual apparatus they replace ... The automated apparatus shall be capable of determining kinematic viscosity of a certified viscosity reference standard within the limits stated ...”

Thus, automated viscometers can be used with flow times less than 200 seconds, as long as the kinetic energy correction and precision requirements are met.

CAV tube characteristics

Each standard viscometer tube has three bulbs, each of which has its own calibration. The normal flow times for each bulb are 60-400 seconds. Each tube has a hundredfold measurement range (for example, range from 2-200 cSt or 20-2000 cSt for each tube).

NOTE

CANNON® Instrument Company has not recommended the use of longer flow times with the CAV, as shorter flow times allow greater productivity. With longer flow times, the data throughput would be significantly reduced. However, the viscometer and software design does permit longer efflux times (up to 600 seconds) as desired by the user.

Safety cautions

Please observe the following safety procedures and notices for proper operation of the CAV:

■ Make sure that your unit is operated only by qualified personnel.
Make sure that you read and understand all operating instructions and safety precautions listed in this manual before installing or operating your unit. If you have questions regarding instrument operation or documentation, contact CANNON® Instrument Company.

Do not deviate from the installation, operation or maintenance procedures described in this manual. Improper use of the CAV instrument may result in a hazardous situation and may void the manufacturer’s warranty.

Handle and transport the unit with care. Sudden jolts or impacts may cause damage to components.

Observe all warning labels.

Never remove warning labels.

Never operate damaged or leaking equipment.

Never operate the unit without appropriate levels of approved bath fluid in the bath.

(CAV-2200 only) Do not fill the expansion vessel higher than the cold fill level.

Unless procedures specify otherwise, always turn off the unit and disconnect the mains cable from the power source before performing service or maintenance procedures, or before moving the unit.

Always empty the bath and disconnect cable and tubing connections to the Service Unit and Solvent Dispensing System before moving the unit.

Never operate the equipment with damaged mains power cables.

Refer all service and repairs to qualified personnel.

In addition to the cautionary statements listed previously, additional cautions may be posted throughout this manual. These cautions, identified by the caution symbol (see left) indicate important operational procedures. Read and follow these important instructions. Failure to observe these instructions may void warranties, compromise operator safety, and/or result in damage to the CAV unit.

Hot surface cautions may be attached on or near hot surfaces of the CAV. Avoid touching hot surfaces, particularly when operating the CAV at bath temperatures exceeding 50°C.

The Protective Conductor Terminal symbol is used to indicate required ground connections for your instrument electrical supply.

**WARNING** When supplying power to this instrument, ensure that the protective ground (earth) terminals of the instrument are connected to the protective conductor of the (supplied) line (MAINS) power cord. Use only the manufacturer-supplied power cord, which should be inserted in a socket outlet (receptacle) which is also provided with a protective ground (earth) contact. Do not use an extension cord (power cable) without a protective conductor (grounding).
The ~MAINS symbol indicates instructions or connections for the AC power supply. The AC Power input must match the electrical specifications listed on the label on the rear panel of the instrument. The supplied AC Mains power cord must be attached to the connector labelled ~MAINS. This connection serves as a means of disconnect and should be readily accessible.

The (O) symbol indicates the OFF position for the electrical switches for your unit (AC Mains or accessories).

Routine CAV operation may require the use and handling of hazardous chemicals and solutions. CANNON® Instrument Company strongly urges the operators and technicians working with the CAV to take proper safety precautions when working with these materials. These safety procedures can be found in the Material Safety Data Sheets which accompany the solutions.

## Specifications

### CAV 2000 Series Bath Unit Specifications/Compliance

<table>
<thead>
<tr>
<th>Part # &amp; Electrical</th>
<th>CAV-2100 Model # 9725-A05: 115 volts AC, 50/60 Hz, 1650 W; CAV-2100F Model # 9725-A10: 230 volts AC, 50/60 Hz, 1750 W; CAV-2100 Model # 9725-A15: 100 volts AC, 50/60 Hz, 1750 W; CAV-2200 Model # 9725-A07: 115 volts AC, 50/60 Hz, 1650 W; CAV-2200F Model # 9725-A12: 230 volts AC, 50/60 Hz, 1750 W</th>
<th>CAV-2200 Model # 9725-A17: 100 volts AC, 50/60 Hz, 1750 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>305 mm wide x 727 mm deep x 1245 mm high (12x35x49&quot;)</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>CAV-2000: 91 kg (200 lbs) without bath fluid and sample holders  CAV-2000: 96 kg (212 lbs) without bath fluid and sample holders</td>
<td></td>
</tr>
<tr>
<td>Operating Conditions</td>
<td>15-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2</td>
<td></td>
</tr>
<tr>
<td>Compliance</td>
<td>CE Mark: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.)</td>
<td></td>
</tr>
</tbody>
</table>

### CAV 2000 Series Service Unit Specifications/Compliance

| Part # & Electrical          | CSU-200 Part # P61.5067: 115 volts AC, 60 Hz, 300 W CSU-200 Part # P61.5108: 230 volts AC, 50 Hz, 600 W |
|-----------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Dimensions                  | 178 mm wide x 508 mm deep x 356 mm high (7 x 20 x 14")                                        |                                                                  |
| Weight                      | 12.3 kg (27 lbs)                                                                               |                                                                  |
| Operating Conditions        | 15-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2               |                                                                  |
| Fuse Rating                 | All Models: M 250V 4A, 1-1/4 x 1/4"                                                            |                                                                  |
| Compliance                  | CE Mark: EMC directive (89/336/EEC); Low voltage directive (73/23/EEC); HI-POT (1900 VDC, 60 sec.) |                                                                  |

*Use only the approved power cord supplied with your unit.*

### CAV 2000 Series Solvent Dispensing Unit Specifications

<table>
<thead>
<tr>
<th>Part #</th>
<th>Single-Solvent SDU-100 Part # P61.5068 Dual-Solvent SDU-100 Part # P61.5076</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>178 mm wide x 508 mm deep x 356 mm high (7 x 20 x 14&quot;)</td>
</tr>
<tr>
<td>Weight</td>
<td>11.4 kg (25 lbs)</td>
</tr>
<tr>
<td>Operation</td>
<td>Pneumatic</td>
</tr>
</tbody>
</table>
VISCPRO® for Windows®

VISCPRO® is a powerful software product designed to provide a generic instrument interface for controlling and operating your CANNON® instrument(s) via computer. When the Remote mode setting is selected with the instrument keypad, all instrument functions necessary for testing may be computer-controlled. VISCPRO® also includes reporting/analysis modules for processing and displaying sample data.

Installing VISCPRO® software

To install the VISCPRO® software, follow the instructions below in the sequence presented. Make certain that you complete the sections on checking instrument settings and initial calibration data. If you encounter difficulties at any stage in the installation process, call CANNON® service at 814-353-8000.

Computer requirements

Consult CANNON® Instrument Company at 814-353-8000 for current computer specifications. The computer should be a PC with a working version of the Windows® operating system (XP® or above) installed.

Windows® XP® installation

1. Turn on your computer. Wait for the Windows® software to load.
2. Insert the first VISCPRO® installation disk or CD-ROM into the disk drive. If the installation program does not begin automatically, click Settings/Control Panel from the Windows® Start Bar. Then double-click the Add/Remove Programs icon and follow the Windows prompts to complete the installation procedure. The executable file for VISCPRO® software installation is SETUP.EXE.

Installation actions

The installation program will:

- create a directory for your program files. The default directory is C:\Program Files\Cannon Instrument\VISCPRO).
- write SETUP information to the Windows® registry.
- copy the software executable file and other necessary files to the directory you specify.
- update other files in your Windows® directories to versions fully compatible with the current VISCPRO® software.
- place a shortcut icon for the VISCPRO® executable file on your Windows® desktop.

Configuration diskette (First-time installation only!)

If you received a Configuration floppy diskette with your VISCPRO II software, follow the instructions that came with the diskette to copy the SAMPLES.MDB file to your VISCPRO II installation directory.
Running the software

Provide power to the CAV instrument, and verify serial connections to the computer. To load your newly-installed VISCPRO® software, double-click on the VISCPRO® icon on your Windows® desktop (Windows® NT® users can click Start/All Programs/VISCPRO/VISCPRO 2.0).

If this is an initial installation, and you received a configuration disk with your installation software package, make certain that the samples.mdb file has been copied to the sample installation directory (see separate instruction sheet for sample database location on your computer hard drive). Your software may have already been preconfigured with instrument settings unique to your instrument, including instrument type(s), tube ranges and serial #s, and calibration constants. In a moment, we will verify these settings. Right now, your computer monitor should look something like this.

The VISCPRO® primary display

The VISCPRO® primary display window is framed on the top by the VISCPRO® title bar and menu bar, and on the bottom by the VISCPRO® status bar. The application window may have been preconfigured to include two child windows which can be opened and closed independently. The first
is a Sample Input window that describes your CANNON® instrument and provides controls for running tests. The second is an Analysis window that presents data from CAV tests.

The Sample Input window (note networked instrument tubes on tube tabs)

**NOTE**

If the Sample Input window does not appear when the software loads, click View Instrument from the Main menu, then click the desired instrument group (type of instrument, e.g. CAV, CCS, PolyVISC) from the list of available instruments and click OK. If the Available Instruments list box is blank, your CAV instrument may not be on-line. Check cable connections and make certain the control panel red power switch is ON. (Turn the switch clockwise for ON. Push the switch in when turning the unit OFF.)

The Sample Analysis Table window displays report data based on user-configurable parameters.
Checking configuration

Configuration disk

For first-time installations, check your software packet for a CONFIGURATION floppy disk after installing VISCPRO®. If you have one, insert the disk in your floppy disk drive and follow the instructions printed on the disk label to add factory calibration information for your instrument to your VISCPRO® database.

CAUTION

Copying floppy disk information to your VISCPRO® directory will overwrite existing sample data. If you wish to restore the original configuration, make certain to archive your sample data before doing so (see Chapter 13 for information on using the Database Manager software).

Follow the procedures in the next several sections of this chapter to verify/edit the instrument and calibration settings to ensure that they conform to the actual characteristics of your CANNON® instrument.

Configuration protection

To check the configuration settings for your instrument(s), you must log in to the security system as a manager. The software is installed with a default Manager account. This account has no password, allowing any operator access to manager-level software functions as long as the password is not activated/changed. If you would like to engage the full-release security options, see Security Options in Chapter 4 for instructions.

Logging in

1. Use your mouse to click Main from the VISCPRO® menu bar.
2. Click Log In from the Main menu options.
3. Click on the (arrow) on the right side of the User Name: list box to display the list of registered users.
4. Click Manager. Do NOT enter a password!
5. Click OK. The Log In window will close automatically and you will be logged in as management personnel.
Checking Instrument Settings

1. Use your mouse to click (select) Configure from the VISCPRO® menu bar.

2. Select your instrument from the list of available instruments (there may be only one instrument in the list).

3. Select Instrument Settings from the list of configuration options. The Instrument Settings window will appear.

You will use the Instrument Settings window (see below) to describe and control CAV instrument operational features. These settings affect the instrument as a whole. Check the instrument settings for your instrument per the instructions below, and make any necessary changes:

The Instrument Settings window

Click the radio button corresponding to the number of sample positions for your sample trays.

Use the ID field to input instrument identification information using up to 16 alphanumeric characters.

The S/N: field (non-editable) indicates the four-digit serial number from the label on the CAV rear service panel.
Prompt options

The *Prompt for Check Standards* options permit you to set a computerized “alarm clock” which will pop up a message reminder to run a calibration standard (using the Verify Known KV viscosity action) based on the schedule you set with the control. Notice that you can specify a reminder after “x” number of days and/or “x” number of samples. Click the check box(es) to enable/disable each reminder.

When you have verified all settings, click OK.

Viewing/editing setup information

If your instrument has already been set up by a technician, you can use the instructions in this section of the manual to check or, if necessary, change the instrument settings.

1. Click *Configure* from the VISCPRO® menu bar.
2. Select your instrument group and instrument from the list of available instruments.
3. Select *Tray Settings: Tube and Bath* from the list of configuration options. The *Tray Settings: Tube and Bath* window will appear.

The *Tray Settings: Tube and Bath* window

The *Tray Settings: Tube and Bath* window contains setup information for each tube associated with your instrument. You can click on the tube tabs to see the setup information for each tube:

4. Click on the tube tab for Tube 1 (the tube on the left).
5. Verify that the tube serial number (Tube S/N) is correct. If it is not, input the correct serial number in the text box. Each tube should have a unique serial number!

6. Verify that the calibration values (C and E) for each bulb are available. If calibration data is not available, the default values are C=1 and E=0.

**NOTE**

For first-time installation, make certain that the factory-prepared Configuration file has been copied to the VISCPro II directory per instructions.

7. Compare calibration values to any existing archives of the calibration constants for each bulb of Tube 1. The values, which cannot be edited from the Tray Settings: Tube and Bath window, should be identical.

8. Write down the tube and bulb number for any incorrect values. We will change these values later, using the Tube Settings: Calibration window.

9. Click on the tube tab for Tube 2 and repeat steps 7-8 above. When you are done, click OK to close the Tray Settings: Tube and Bath window.

**Manually changing tube calibration constants**

If you discovered any errors in the values of the calibration constants (see previous section), follow the directions in this section to manually correct them using calibration information previously obtained for your unit. If the calibration values are correct, instrument setup is complete.

**NOTE**

This procedure for manually entering/changing calibration constants bypasses the normal calibration procedure. To ensure the most accurate viscosity readings, CANNON® Instrument Company recommends that the instrument be calibrated per the calibration procedure outlined in Chapter 3.

1. Click Configure from the VISCPro® menu bar.

2. Select your instrument from the list of available instruments.

3. Select Calibration from the list of configuration options. The Calibration window will appear (see next page).

The Calibration window provides controls for calibrating each tube associated with your instrument. You can click on the tube spin controls to display current tube constants and valid check standard data available for calibration of each tube.

Sample calibration data

<table>
<thead>
<tr>
<th>Tube</th>
<th>C</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.40547</td>
<td>-251.00531</td>
</tr>
<tr>
<td>2</td>
<td>1.57324</td>
<td>254.99480</td>
</tr>
<tr>
<td>3</td>
<td>0.08280</td>
<td>348.69639</td>
</tr>
</tbody>
</table>
Procedure

1. Make sure that the spin controls for Tube and Bulb are both set to “1”:

   ![Calculate Calibration Constants](image)

This corresponds to the left-hand tube in the left-hand bath and the bottom bulb in the tube.

2. Check the values for the calibration constant(s) as they appear at the bottom of the window:

   ![C: 7.40647 E: -251.00531](image)

   Compare these values to your archive of the calibration constants (if available) for tube 1 and bulb 1. The values should be identical.

3. If they are not, place your cursor in the appropriate field, delete the entry, then type the correct values for the constants in the text boxes.

4. Click Update bulb.

5. Use the tube and bulb spin controls to select the tubes/bulbs for which you noted calibration constant errors. Input the correct values for each. Make certain to click Update bulb after you have corrected C and E calibration values for each bulb BEFORE selecting the next tube and/or bulb.

The Calibration window

![Calibration window](image)
6. When you have entered corrected constant values for each bulb on both tubes, click to exit the Calibration window.

You have verified the software configuration of VISCPRO®. To test samples with your instrument, follow the instructions in Chapter 2. For additional details regarding operating procedures for your instrument or software, consult the appropriate section of this manual.
This chapter of the manual will provide information on testing samples using the CAV-2100 or CAV-2200 instruments. Observe the safety cautions noted in the introductory chapter when operating equipment. The CAV should only be operated by qualified personnel.

## Preparing the CAV

### Turning on the CAV

1. If CAV power is off, turn on the CAV Bath Unit by rotating the red power switch on the control panel clockwise. Provide power to the CSU Service Unit (rear panel On/Off switch) and the Solvent Dispensing Unit (front panel On/Off switch).

   **NOTE**

   *If it is necessary to cut power to the CAV Bath Unit, press the power switch IN.*

### Preparing sample trays

Sample trays will slide into place along the grooved track in the sample table. Plated steel vial adaptors should be placed in the circular recesses in the tray.

Glass sample vials slide into the adaptors. To position the first sample vial under the viscometer tube in preparation for testing, slide the tray forward until the detente mechanism engages. A heated sample tray should snap into position against the detent mechanism when the front of the tray extends approximately 2 centimeters (3/4") over the edge of the sample table. The forward edge of an unheated tray will be indented approximately 2.2 centimeters (7/8"). During sample testing, trays are automatically advanced by the pneumatic system.

### Electrical connections

For heated sample trays, verify that the attached three-pin tray cable is connected to the interior wall connector above the sample table.

### Using a temperature probe

A recessed thermometer well at the front of the sample tray permits insertion of a temperature probe to monitor tray temperature.
Tray/drain heat operations

To provide power to the heated sample trays and/or heated drain lines which may be installed on your CAV unit, use the heater ON/OFF switches on the left side of the front panel. These two switches provide power to left- and right-hand heating elements. To adjust temperature, use the Adjust knobs on the upper front panel of the Bath Unit. Turn the knobs clockwise to increase temperature and counterclockwise to lower it. The knobs regulate the duty cycle of the heaters for the sample trays and the drain lines. The low-temperature sample heaters will maintain temperature stability as high as 80°C. The high-temperature sample heaters will maintain temperature stability as high as 100°C.

⚠️ CAUTION
Avoid skin contact with heated sample trays, as burns may result. Use appropriate protection when handling heated samples, vial adaptors, and sample trays.

Inserting/removing the CAV reference thermometer

Inserting the thermometer

ASTM thermometers with specially-fitting adaptors for the CAV instrument (see photos) are available from CANNON® Instrument Company. Digital thermometers meeting the ASTM D 445 specification are also available.

1. To install the reference thermometer, check the current temperature of the CAV bath and select the calibrated thermometer appropriate for that temperature.

2. Using the two opposing 0.05” Allen screws, secure the thermometer adaptor plate to the connector on the thermometer cable.

3. Using a ladder to access the top of the CAV Bath Unit, remove the knurled cap, ferrule and O-ring from the thermometer holder.

4. Insert the thermometer assembly into the holder until the plug with O-ring is seated inside the top of the holder. Rotate the plug until the thermometer scale is easily visible from the Bath Unit front window.

5. Slide the ferrule over the end of the plug until it seats against the O-ring.

6. Place the knurled cap over the plug and rotate the cap clockwise to secure the cap to the top of the thermometer holder. Tighten finger tight to seal the connection.

For additional information and details for CAV thermometer installation/removal, see Appendix A.

Removing the thermometer

To remove the reference thermometer, permit the bath to cool below 80°C and reverse the above procedure. Use appropriate safety procedures when handling the thermometer assembly, as it contains mercury.
Local mode operation

The Local mode option permits manual control of CAV functions via the control keypad on upper front panel of the Bath Unit. Local mode offers the advantage of convenient and quick testing for an individual sample. The single-sample drop time or kinematic viscosity is displayed on the vacuum fluorescent display (VFD).

NOTE

The VFD is equipped with a screen saver feature which will reduce the intensity of the display if the keyboard is not touched for five minutes. To restore the original intensity of the display, press any key on the keypad.

Selecting Local mode

To select Local mode operation, toggle the Remote/Local (RMT/LOC) button on the keypad on the Bath Unit to select Local mode operation. When the unit is in Remote mode, the front panel display will indicate REMOTE operation. If the display does not indicate REMOTE operation, then the instrument is in Local mode.

NOTES

Local mode may be selected at any time during CAV operation. Remote operations will be suspended. When switching from Remote to Local mode, it is the user’s responsibility to monitor the instrument tube state(s) and to properly prepare the instrument before running tests. Operator intervention is required to test each sample in Local mode. Additionally, test data is not saved to the VISCPRO® database and viscosity calculations must be performed manually.

Setting temperature

WARNING

Prior to setting the bath temperature, ensure that the reference thermometer in the bath is suitable for the desired temperature range. If not, remove thermometer from the bath (see previous page). If the bath temperature rises above the range of the thermometer, it may be damaged. Mercury thermometers pose particular problems, since mercury from a damaged thermometer may circulate with bath fluid.

To set the temperature in Local mode, press the Set Temp key on the front panel keypad, select the desired bath (CAV-2200 only) and input the target (desired) temperature(s) using the keypad characters. Then press the Enter key. Acceptable values are any numbers between 20°C and 100°C (150°C for high-temperature CAV models). If necessary, you may use the decimal point key to input temperature to the nearest 0.01°C.

NOTE

To cancel temperature selection before completing the procedure, press the Set Temp key a second time.

After the target temperature has been set, the CAV bath temperature will be adjusted to the target temperature and the bath will equilibrate at the test temperature. When the instrument has attained a temperature within
0.05°C of the target temperature, the current bath temperature will be displayed in large type (CAV-2100 only) on the display.

Preparing the bath

When operating in Local mode, visually check the condition of the viscometer tubes prior to initiating a sample run. If sample or solvent residue remains in the tube, use the Local mode options to wash and/or dry the tubes (see Chapter 5, Solvent wash by operator (Local mode)).

Testing samples

1. Pour the test sample into a glass vial and slide the vial into the steel vial adaptor in the sample tray.

   **NOTE**  
   Do not fill the vials to the top. Sample overflow may damage the seals of the LOAD cylinder.

2. Position the vial directly underneath the viscometer tube, using the detente mechanism as a guide in orienting the sample. A heated sample tray should snap into position against the detent mechanism when the front of the tray extends approximately 2 centimeters (3/4”) over the edge of the sample table. The forward edge of an unheated tray will be indented approximately 2.2 centimeters (7/8”).

3. Press the Test button.

4. Select the desired tube for testing (Left (1) or Right (2)).

5. Select the desired protocol for the sample drop:
   - Run (Determine Bulb) will calculate the optimal test bulb.
   - Run (Use Previous Bulb) will test the sample using the same bulb as the previous test (this option is desirable when averaging multiple drop times for the same sample). The sample will be tested and the drop time and/or kinematic viscosity (see next page) will be indicated on the VFD.

6. After the test has been completed, you may rerun the sample using the above procedure, or wash the tube using the keypad WASH option (see pages 18-19 for details on keypad options).

Aborting a test

To immediately halt testing for a given tube/tray (left/right), press the Stop Left and/or Stop Right button on the keypad. On rare occasions when it is necessary to quickly abort tests on both tubes and remove power from the unit, press the red power button on the control panel.

**NOTE**  
Aborting a test using either method clears all sample test information for that tray. If test actions are aborted, it is the responsibility of the user to restore the instrument to a safe state before running tests (see Local mode diagnostics/maintenance in chapter 5 for more information).
Concluding a test

At the conclusion of a test, the drop time for the sample will be displayed on the display screen. Record the drop time and press the Enter key to return to the temperature display. Then remove the sample from the tray.

⚠️ CAUTION Use appropriate procedures when handling heated sample trays and heated samples to avoid the possibility of burns.

Empty the oil from the sample vials into the appropriate container(s) for use/disposal and clean glass vials per approved laboratory procedures.

Wipe any excess oil from the table, sample tray and vial holders (glass vials only) using an absorbent paper towel. If necessary, clean these items by wiping with a paper towel wetted with appropriate solvent.

Obtaining kinematic viscosity (KV) readings in Local mode

Local/Remote operation of the CAV is selected via the RMT/LOC button on the CAV keypad. Local mode operation involves CAV control via the keypad. Remote operation involves CAV control via the VISCPRO software interface. Pressing the RMT/LOC button on the CAV keypad will toggle between the Remote and Local operation modes. To obtain kinematic viscosity readings in local mode with the CAV 2000 Series instrument, calibrate each bulb for each bath at the desired bath temperature using VISCPRO II with the instrument set in REMOTE mode.

After calibration, open the Tray Settings: Tube and Bath window for the desired instrument. Make sure the settings are correct and close the window by clicking the OK button. This action will transmit the bath temperature(s), the soak times, and the current bulb calibration constants to the instrument.

Press the RMT/LOC button on the CAV keypad to change the instrument mode to LOCAL. Then press the Menu button on the CAV instrument. On the screen, select option #7: Display KV : YES/NO. Toggle the #7 button to select the desired option. If YES is selected, the KV will be displayed at the end of a test.

**NOTE**

If the instrument is set to display KV, it will only display KV if the tube calibration constants have been loaded as described above; otherwise, it will display the efflux time. If multiple drops are required for a result, the customer will need to average the KVs resulting from each drop.

Other Local mode keypad options

The Local mode keypad options described above are the more common functions available. The Keypad Options table (see next pages) contains a list of all Local mode keypad options, including entry parameters and (where applicable) default instrument settings.

**NOTES**

Any incomplete keypad command sequence may be cancelled by pressing the keypad button that initiated the sequence.
Acceptable keypad input is indicated audibly with a short beep. Unacceptable keypad input is indicated audibly with a longer tone.

**Remote operation [computer-controlled]**

Local/Remote operation of the CAV is selected via the RMT/LOC button on the control panel. Pressing the button will toggle between the **Remote** and **Local** operation modes. The Remote mode option permits automatic control of CAV functions via the VISCPRO® controlling software. Remote mode offers the advantage of multi-drop, multi-sample automatic testing for up to 100 samples depending on tray type. Sample data is automatically stored to the VISCPRO® database for future reporting/data collection. Additionally, several reports (analyses) may be used to calculate and display kinematic viscosity and viscosity index (VI) values. See the chapters on VISCPRO® analyses for further information.

All analyses provide a dynamic operation mode which can immediately display and transmit test results to your computer screen, printer, and/or serial port for in-house data collection. See Chapter 6 for more information on configuring analyses.

To select Remote mode operation, press the Remote/Local (RMT/LOC) button on the keypad on the Bath Unit until the front panel vacuum fluorescent display indicates **REMOTE** operation. If the display does not indicate **REMOTE** operation, then the instrument is in Local mode.

**NOTE**
Remote mode may only be selected when the CAV is idle.

**Setting temperature**

To set the temperature in Remote mode, load the VISCPRO® software and click **Configuration**. Select the CAV from the list of available instruments and click **Tray Settings: Tube and Bath**. Select the desired tube and type the desired temperature in the **Bath Temp:** field. Acceptable values are any numbers between 20°C and 100°C (150°C for CAV high-temperature models). If necessary, you may use the decimal point key to input temperature to the nearest 0.01°C. Press **OK** to save the temperature setting.

**NOTE**
To cancel temperature selection before completing the procedure, click **Cancel**.

After the target temperature has been set, the CAV bath temperature will be adjusted to the target temperature and the bath will equilibrate at the test temperature. When the instrument has attained a temperature within 0.05°C of the target temperature, the current bath temperature will be displayed in large type on the display for CAV-2100 models.

**NOTE**
Placing the instrument in Remote mode while the VISCPRO software is loaded will reset the bath temperature(s) to match the VISCPRO settings.
## Keypad Options (Local Mode)

<table>
<thead>
<tr>
<th>Keypad Command/Description</th>
<th>Parameters</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RMT/LOC</strong></td>
<td>Changes from Remote to Local mode. Display indicates when in Remote mode. All keypad operations except RMT/LOC and STOP LEFT/RIGHT are invalid in Remote mode.</td>
<td></td>
</tr>
<tr>
<td><strong>STOP LEFT</strong></td>
<td>Stops activity for left tube.</td>
<td></td>
</tr>
<tr>
<td><strong>STOP RIGHT</strong></td>
<td>Stops activity for right tube.</td>
<td></td>
</tr>
<tr>
<td><strong>SET TEMP</strong></td>
<td>Select bath (CAV-2200 only) and input desired temperature. Then press Enter.</td>
<td></td>
</tr>
</tbody>
</table>
| **MENUS** | **1) Test Parameters**
1) Use left tube
2) Use right tube | Bulb(s) Soak Time(s): 0-255 120
Advanced Parameters (restricted)
1) Max Bulb 1 Fill Time(s): 20-200 200
2) Min Bulb 1 Select Time(s): 3.5-20 10.5
3) Min Bulb 2 Fill Time: 0-4 1.0
4) Max Bulb Empty Time(s): 90-600 400
5) Max Tube Empty Time(s): 5-125 15 | |

| **2) Wash Parameters**
1) Use left tube
2) Use right tube | (0) A Wash B1: Input solvent A/ Bulb "X" wash time.
1) A Wash B2: 0-18 11
Set at "0" for fast run tubes.
2) A Wash B3: 0-18 5
3) Sh Fill(s): Input solvent fill time.
4) Sh Soak(s): Input solvent soak time.
5) B Wash B1: 0-18 9
6) B Wash B2: 0-18 5
Set at "0" for fast run tubes.
7) B Wash B3: 0-18 2
8) Sh Flush(s): Input solvent flush time.
9) Final Air(s): Input air dry time. 15-255 50 | |

| **3) Temperature Units** | 1) ""F
2) ""C | Use keypad buttons to select desired units.
""F"" / ""C"" | |

| **4) Calibrate Temperature** | 1) Set Current Temperature Offset
Use keypad buttons to input temperature from reference thermometer to the nearest 0.01°. Then press ENTER button. | N/A N/A | |

| **5) Train Sensors** | 1) Train left tube sensors
2) Train right tube sensors
3) Train all sensors
4) Adjust Left Tube Trip Pts.
5) Adjust Right Tube Trip Pts. | Initiates automatic sensor training procedure. Display will indicate IDLE when training is completed.
Initiates sensor adjustment using sample in the vid under the viscometer tube. | N/A N/A | |

| **6) Service** | 1) Instrument Address
Input unique value for each Bath Unit. | 0-9 0 | |

| **7) Display KV YES/NO** | Press Enter to toggle YES/NO options. | | |

| **TEST** | 1) Use left tube
2) Use right tube | 1) Run (Determine Bulb)
2) Run (Use Previous Bulb) | |
| **WASH** | 1) Use left tube
2) Use right tube | Washes viscometer tube using Wash parameters. | |

| **DRY** | 1) Use left tube
2) Use right tube | Dries viscometer tube using Wash parameters. | |
| **ENTER** | Used to input numeric data. Press ENTER upon completion of data entry to accept input values. 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.. | | |

| **Password** | Input password from CANNON Instrument Company to access restricted options. | N/A |
Testing samples

**Loading software**

1. Turn on the computer and load the CAV software by double-clicking the VISCPRO® icon on the Desktop.

**NOTES**

If the software is already loaded, use your computer mouse to click Main from the menu bar and click Poll for Instruments from the Main menu options. This will establish communications between the computer and the on-line instrument.

Permit the bath(s) to stabilize at test temperature before testing samples.

2. Pour sample material into the glass vial(s). Fill to within 1.3 cm (½”) of the top of each vial (somewhat less sample may be required for testing in lower bulbs of the viscometer). Insert the glass vials into the steel carrier cylinders and place the cylinders into the sample tray.

**NOTES**

Do not fill the vials to the top. Sample overflow may damage the seals of the LOAD cylinder. You should run calibration check standards per your established laboratory procedures. Recalibrate the CAV (see Chapter 3, Calibration) if result variance warrants.

3. Place the sample tray into the track underneath the viscometer tube. Push the sample tray forward until the first vial is under the viscometer tube. A heated sample tray should snap into position against the detent mechanism when the front of the tray extends approximately 2 centimeters (3/4”) over the edge of the sample table. The forward edge of an unheated tray will be indented approximately 2.2 centimeters (7/8”).

4. Ensure that the splash guard(s) in front of the viscometer tube has been secured in place with the thumbscrew. If a splash guard has been removed, replace it.

**CAUTION**

The splash guard(s) may be removed to allow the user to handle the sample not yet running (replace with a different sample, etc.). However, make certain to return the splash guard to its proper position to prevent sample/solvent contamination and to protect the viscometer tube tip. Do not allow your hands to contact or obstruct the pneumatic mechanism or heated sample trays and electrical connections.

5. Check the thermometer in the temperature bath to make sure the bath is holding the proper temperature. If necessary, calibrate the CAV temperature control probe using the temperature calibration procedure in Chapter 3.

6. Open the View Instrument Group window (if it is not already open) by clicking View Instrument from the Main menu and selecting the desired instrument group from the list box (see Chapter 4 for more information).
The View Instrument Group window

7. Click OK to display the Sample Input View for the desired group:

The Sample Input window

Then click the Tray tab corresponding with the desired viscometer tube.

8. Double-click on Sample ID (1) with the left mouse button to access the sample ID data entry field (or press F2).

9. Enter sample ID information in the sample list box using your computer keyboard. After you have typed the sample ID, press the Tab key to save the entry and move the cursor to the next Sample ID field. Or press Enter to save the entry.
NOTE

Once sample information is entered, the software automatically assigns a sample action, Measure Sample Viscosity, for the sample. If you do not enter a sample ID, the sample is automatically labeled Unknown.

To select or change a sample action, highlight the appropriate Sample ID(s) using the mouse or arrow keys, then click the RIGHT mouse button to access sample action options:

0 No action
1 Measure Kinematic Viscosity
2 Verify Known KV
Configure

Then you may select the desired action by highlighting it and clicking the left mouse button.

NOTE

For additional information on software data entry features, including multiple sample selection and cut & paste options, see Testing samples—software options in Chapter 4.

Running check standards

If Verify Known KV is selected as the test option for a sample, the Viscosity Action window will open automatically. Enter the necessary check standard data, including the Check Standard viscosity from the standard bottle, and click OK to complete data entry. To revise or confirm standard data, right-click on the desired sample ID from the list box and select Configure from the popup menu choices.

NOTE

See Chapter 4 for additional information on the Viscosity Action window.

10. Continue entering sample information for all desired trays. When sample ID data entry is complete, check the Tray Status window to verify that all trays are ready for testing.

11. Click on the RUN button at the bottom of the Sample Input window. The Select Trays window will open.

12. Click on the check box(es) to select the desired prepared tray(s) for automatic testing. Then click OK to begin the CAV test(s).

Pausing a test

To temporarily halt testing for a given tube/sample, click the Pause button from the Sample Input window. Then select the desired tray(s) and pause action(s) from the Select Trays window (Pause Now will immediately pause test actions; Pause after current sample will pause testing after the current test is complete). Click OK to pause testing for the selected tray(s).

NOTE

If the test was paused prior to the initiation of the Wash cycle, drop time data for that sample will be discarded.
Resuming a test
To resume test actions for paused trays, click the Resume button from the Sample Input window. Then select the desired trays from the Select Trays window. Click OK to resume sample testing (see note above).

Aborting a test
To permanently halt testing for a given tube/tray, click the Abort button from the Sample Input window. Then select the desired trays from the Select Trays window. Click OK to abort testing for the selected tray.

**NOTE**
Aborting a test clears all sample test information for that tray. If test actions are aborted, it is the responsibility of the user to restore the instrument to a safe state before running tests (see Service menu options in chapter 4 for more information on tube washing and drying).

Concluding a test
After automatic testing has been completed for a sample tray, make certain that the final sample has drained and the calculated viscosity for each sample tested is displayed in the Sample Input window. The tray status for the tube, as indicated in the VISCPRO® Instrument View Tray Status window, will be PAUSED. Click the Resume button to clear sample data from the Sample Input window and return the instrument to IDLE status. Then remove the sample tray from the tray rack.

**CAUTION**
Use appropriate procedures when handling heated sample trays and heated samples to avoid the possibility of burns.

Empty the oil from the sample vials into the appropriate container(s) for use/disposal and clean glass vials per approved laboratory procedures.

Wipe any excess oil from the table, sample tray and vial holders (glass vials only) using an absorbent paper towel. If necessary, clean these items by wiping with a paper towel wetted with appropriate solvent.

Working with Instrument Groups
VISCPRO II provides a new, convenient interface for working with multiple CANNON instruments simultaneously. Rather than requiring the user to open individual Instrument Views for each online instrument, the Sample Input window (formerly the Instrument View window in VISCPRO) provides individual tabs for each viscometer tube, making it easy to enter sample information for up to four different instruments (eight viscometers). The Machine Status window makes it possible to monitor the performance of all instruments in an Instrument Group simultaneously.
Here’s how it works: Just click Main/View Instrument from the VISCPRO II interface to open the View Instrument Group window, which displays all CANNON instrument types communicating with your computer. Then select the desired instrument group (all instruments in a single group communicate with the computer via the same COM port).

Once you have opened the desired instrument group, the Sample Input window will appear. Individual viscometer tube tabs now make it possible to enter sample information for each viscometer in the instrument group.

You can toggle back and forth between the Sample Input window and the new instrument Machine Status window by pressing Ctrl-Page Down.

![Machine Status Window](image)

The Machine Status window (note that two instruments are online in this example)

Monitoring instrument status You can monitor the status of all instruments in an instrument group by pressing Ctrl-Page Down from the Sample Input window to display the Machine Status window. To return to the Sample Input window, press Ctrl-Page Down again. In the image above, instruments three and four do not exist but could be accommodated in this instrument group. The “placeholders” for these instruments are greyed out to indicate that additional machines are not yet online for the group.
If additional instruments are online but are not appearing in the correct instrument group, check network connections and make certain that each instrument is turned on and functioning normally. Then click Main/Poll for Instruments to refresh communication with online instruments.

**Group configuration**

If your laboratory had 3 CAV-2100 instruments with RS-485 connections, all could communicate with the computer via a single COM port, provided that they were all assigned different instrument addresses. Each instrument group provides its own Instrument View customized for that instrument type. The number of instruments that can be assigned per group varies per instrument type. The default is four instruments per group, although the Cold-Cranking Simulator (CCS) design allows only one instrument per group.

When a new type of instrument is found on a port, the VISCPRO software automatically creates a group for that instrument. The maximum number of instruments that can exist on that port is determined by the nature of the instrument. A single COM port may be used for communication with multiple instrument groups as long as the total number of instruments does not exceed the number set by the group that can contain the least number of instruments.

**Configuring the Machine Status window to correspond with physical instrument placement**

It is desirable to configure your CAV instruments so that the VISCPRO software computer interface display for the instrument group (Machine Status window) corresponds with the actual physical placement of the multiple instruments in the laboratory.

Use the instrument keypad controls to assign each instrument in the group a unique address using numbers 1-4 from left to right (MENU/#6 Service/#1 Instrument Address; see page 21 for details regarding keypad operation).

**NOTE**

Do not use “0” as an instrument address for this configuration option.

When configured per the above instructions, the instruments will always be displayed in the same “sequence” even if a single instrument in the series is not online.

**Viewing test results**

Data obtained from all instruments during sample testing is stored in the central VISCPRO® database. To view data, you must create an analysis requesting the desired sample information.

The following analyses are shipped with the software:

- Sample Data Table—displays test information of your choosing.
Creating an analysis

The following procedure creates a standard CAV Data Table which will be updated as samples are tested. For additional information on analyses, consult the manual chapter corresponding to the desired analysis.

1. Select Analyses from the VISCPRO® primary menu options.
2. Select View Analysis ... from the Analyses menu. The Choose Analysis window will appear.

3. Double-click on Basic Package.
4. Click on CAV Data Table to reveal the available analyses.
5. Click on the Define and Open New Configuration radio button (or verify that the option is selected).
6. Click OK. The Sample Analysis Configuration window will appear. The Sample Analysis Configuration window consists of tabbed pages with filter options appropriate for the analysis.
7. Click on Date Filter and then click the Use Dynamic Update check box. This option will update the displayed analysis with new data as samples are tested.

NOTE
For additional information on analysis filter options, consult the manual chapter corresponding to the desired analysis.

8. Click on the spin controls to select a value for the sample time window (the time parameter you desire for the report of recent test data).
9. Configure any other report options (see Chapter 7 for details). Then click OK. The program will prompt you to save the analysis configuration.
10. Click Yes. (OR click NO to display the analysis without saving it.)
11. If Yes was selected, use your keyboard to type the name you wish to use for the analysis in the text box.
12. Click OK. The analysis will be saved and data obtained during the selected time window will be displayed.
Calibrating the CAV

Calibration is essential for the proper operation of the CAV. The CAV is calibrated before it is shipped to the customer. The CANNON® representative who sets up the CAV will calibrate it again after installation. Frequency of recalibration is at the discretion of the user. There are two types of calibrations—the temperature calibration ensures that the temperature probe readings conform to the reference thermometer, and the standard calibration ensures that the mathematical constants used in calculation of kinematic viscosity from sample flow times accurately reflect the unique properties of the viscometer tube.

**Calibrating temperature**

Periodically, the temperature display of the CAV Bath Unit should be verified using a reference thermometer for that temperature. The CAV temperature control system permits the calibration of the bath temperature to agree with any temperature reference standard, including an ASTM thermometer mounted within the bath (see page 16). The bath can be calibrated by the user whenever the bath temperature is stable for any given target temperature in degrees Celsius or Fahrenheit.

**BIN settings**

For every whole degree Celsius, a calibration “BIN” exists in nonvolatile memory within the temperature control system. The “reference actual temperature” is entered by the user as the actual temperature of the bath according to the user’s temperature reference standard and is stored by the bath in this memory and used whenever that particular target temperature is entered. Fractional degrees will use the closest whole number bin.

**Calibration procedure**

1. Using the REM/LOC key on the Bath Unit, place the Bath Unit in Local mode. Make certain the reference thermometer temperature has stabilized.

2. Press MENU and select 4) Calibrate Temperature. CAV-2200 users should then select the left or right bath.

3. To calibrate temperature, select 1) Set Current Temperature Offset and use the keypad controls to input the current temperature reading to the nearest 0.01°, subject to the following:

   - A decimal point MAY be included as an entry. It should be preceded by at least two numbers or a "0".
- The entered temperature must be within the operational temperature range of the bath (20°C/68°F to 100°C/212°F or 20°C/68°F to 150°C/302°F inclusive for the CAV high-temperature model).

- The entered actual temperature must not cause a correction in temperature greater than +/- 2.5 degrees.

To clear the BIN offset for the current temperature, select 2) Zero Current Temperature Offset.

**Multiple corrections**

Multiple or successive entries of correction for any temperature are permissible. A newly entered corrected temperature is mathematically compensated with the previously entered correction and is stored in memory by the onboard microprocessor as the latest correction.

**Data entry errors**

The CAV will not accept temperature reference data outside the parameters noted previously.

Additionally, if the amount of the correction (delta to displayed temperature) is too large, the correction will not be accepted.

**Training sensors**

It is necessary to train instrument sensors in preparation for sample testing at a specific temperature. The training procedure establishes the proper power level for sensor detection of the sample meniscus. That data is then stored by the CAV instrument, and recalled when testing at that temperature. The sensor training procedure requires approximately 30 minutes (longer at lower temperatures).

**NOTE**

You will be prompted to train sensors by the instrument hardware or software whenever a new temperature is selected for CAV operation. You will be unable to test samples until the training has been completed. Sensor training data remains valid until the sensors are retrained at the same temperature. Retraining is necessary only when the viscometer tube is changed, or if sensor performance changes over time.

**Procedure**

Sensor training is accomplished in Local mode. To train sensors, press the Menu button on the control panel. Then select option 5 (Train Sensors) and follow the display prompts to complete the training procedure.

**Standard tube calibration**

During standard calibration, the software uses check standard data from CAV tests to perform the mathematical calculations necessary to derive new constants for each timing bulb of the viscometer tube. Then the program displays the new constants and computes a viscosity (in cSt) for
each sample using the actual flow time of the calibration standards. The resulting viscosity calculation is compared with the known viscosity of the standard and displayed on the computer screen.

**NOTES**

The software allows the operator to manually change the constants if necessary to more closely match actual viscosities.

A separate calibration must be performed for each temperature at which samples will be run.

**Calibration procedure**

1. Assemble a group of CANNON® standard oils with known kinematic viscosities for calibration. Refer to the following table when choosing the appropriate standards.

**NOTE**

For the calibration procedure, select oils such that at least two oils are tested in each timing bulb, since a minimum of two oils per timing bulb is necessary for proper calibration.

<table>
<thead>
<tr>
<th>VISCOMETER TUBE TYPE</th>
<th>TIMING BULB 3 (thermistors 4-1)</th>
<th>TIMING BULB 2 (thermistors 3-1)</th>
<th>TIMING BULB 1 (thermistors 2-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Tube</td>
<td>1-4 x lower cSt limit</td>
<td>4-16 x lower cSt limit</td>
<td>&gt; 16 x lower cSt limit</td>
</tr>
<tr>
<td>Fast-Run Tube</td>
<td>N/A</td>
<td>1-3 x lower cSt limit</td>
<td>&gt; 3 x lower cSt limit</td>
</tr>
</tbody>
</table>

If you Verify Known KVs regularly, it may not be necessary to process additional calibration standards. Existing sample data for the standards may be retrieved from the software database by specifying the appropriate time parameter from the software selection options (see steps 6-12).

2. Complete sample ID data entry for each standard.

3. After entering each sample ID, click on the highlighted ID entry using the RIGHT mouse button (or press [F5]). Then select Verify Known KV from the popup window. The Viscosity Action window will appear.

4. Enter the viscosity (in centistokes) for each sample from the standard bottle, along with other desired configuration settings; then click OK.

**NOTE**

If you will not be using previous check sample data for calibration, make sure that tests are performed with at least two different standard oils for each timing bulb on the viscometer tubes being calibrated.

If a calibration standard viscosity has NOT been entered (or if the default viscosity value of 1.000 has not been accepted by the user), a yellow arrow (current sample) or red circle caution symbol will appear to the left of the sample ID.
CAUTION  Make certain to enter the correct calibration standard viscosity (in centistokes) BEFORE running the standards. Incorrect data entry may skew future calibration results.

5. Click Run, then select the appropriate sample trays to test the standards.

6. When testing is completed, use the VISCPRO® software to log on as a Manager (Main/Log In) in order to access the calibration menu.

7. Click View Instrument from Main to select the desired CAV instrument from the Configure menu; then select Calibration.

8. Use the spin controls to select the desired Tube and Bulb for calibration.

NOTE  Standard viscometer tubes have three timing bulbs (fast-run tubes have two timing bulbs).
9. Select the date range for acceptable calibration data by using the **No older than** [x] days spin controls to set the date search parameters (if “1” is selected, only data from the standards run on yesterday and today’s date will be listed). Any check standards from the time frame you specified which are appropriate for calibration calculations will appear in the window list box.

**Selecting samples**

10. Select (or deselect) the specific sample entries you desire to use for calibration from the displayed list by clicking on them. To select a range of samples, highlight the first sample and click on the last sample while simultaneously pressing the Ctrl key. To select several individual samples for calculation, hold down the Ctrl key and click on each of the desired samples.

**NOTE**

You must select at least two entries or the software will not recalculate the constants.

11. When the desired samples have been selected, click on **Calculate New Constants**. The new constant(s) for that bulb, C and E, will be displayed in their respective fields at the bottom of the window.

You may evaluate the accuracy of the new calibration constants by comparing the known viscosity for the standard with the calculated viscosity for each standard selected for the new calibration. This difference is displayed as a percentage in the last column (% Diff) of the updated sample list box.

12. If the new calibration constants are acceptable, click on **Update bulb** to save the constants for the current instrument. If the difference is not within acceptable limits, refer to Chapter 5 for CAV maintenance/service information.

**NOTES**

Once the Update bulb button is pressed, the updated calibration constants are associated with the selected instrument, and will remain the same regardless of the instrument configuration defined for that instrument.

You must click **Update bulb** before changing bulbs if you wish to save the new calibration constants for that bulb.

13. Repeat steps 8-12 for all the viscometer tubes and timing bulbs. When the proper constants for all the timing bulbs of all the viscometer tubes have been determined, close the Calibration window.

14. Test several standards to verify a successful calibration.

**Saving a calibration**

When calibration is complete, the calibration information is saved to the current instrument configuration and will be displayed in the Tray Settings: Tube and Bath window (see page 45). This calibration
information will remain in effect until the instrument is recalibrated at that same temperature, or until instrument and tray settings from a previously-saved instrument configuration are restored (see page 53).

To avoid losing valid calibration data, CANNON® recommends saving the instrument configuration settings after completing a new calibration (see Saving a configuration, page 53). The name for the instrument configuration should identify the specific instrument, the calibration time, and the temperature:

**EXAMPLE:**

CAV2 1–10–04 40C

After the instrument configuration has been saved, calibration data may be restored at any time using the Restore Instrument Settings option from the Configure menu (see page 53). Note that the Restore Instrument Settings and Restore Tray Settings check boxes must both be selected to restore instrument calibration data:

![Restore Instrument Settings](image)

**NOTE**

The Restore Instrument Settings and Restore Tray Settings options are security-protected at the Manager level (see pages 37-39).

**CAV calibration equations**

**Viscosity calculation equation**

In the CAV, viscosity is calculated by using the viscosity calculation equations as described in ASTM Methods D 445 and D 446. Because samples running in the CAV can have short flow times, the kinetic energy correction term \( \frac{E}{t^2} \) is used as prescribed in the aforementioned ASTM methods. The VISCPRO® software for Windows® performs all necessary calculations to derive constants \( C \) and \( E \). These constants are used by the software when determining values for kinematic viscosity using sample drop times measured by the CAV.

Kinematic Viscosity equation:

\[
v = C \cdot t - \frac{E}{t^2}
\]

*Where:*  
- \( v \) = kinematic viscosity (cSt)  
- \( C \) = calibration constant (cSt/s)  
- \( E \) = kinetic energy correction (cSt·s²)  
- \( t \) = flow time (seconds)

**NOTE**

When calibrating the CAV, the operator must analyze the viscosity standard using double determinations to obtain two flow times for each standard. The average of the two flow times is used as input data for the calibration program.
CHAPTER 4

USING THE CAV SOFTWARE

VISCPRO® generic instrument interface

Your software for Windows® is comprised of a generic instrument interface (VISCPRO®) and a collection of instrument/analysis-specific modules. This chapter of the manual will explain the software options for the VISCPRO® program and other modules commonly bundled with the instrument software. Additional software modules, customized software, and any documentation for add-on software options, are provided separately.

HELP system

Your software supports a complete HELP system. To access HELP for the software, click the HELP option from the VISCPRO® primary display. For context-sensitive HELP support for your interface, press \[F1\] or click on the HELP buttons provided.

NOTE

Because the VISCPRO® software is security-protected, some documented menu options may not be visible to technician-operators.
Main options

The View Instrument option opens the View Instrument Group window which permits you to view existing instruments and configurations. You may also select and restore elements from saved configurations for on-line instruments.

The View Instrument Group window is comprised of:

- The Instrument Group list box
- Three button options (OK, Cancel, and Help).

**View Instrument Group window button options:**

- **OK**: Opens the Sample Input window for the selected instrument group and restores any configuration settings for that group.
- **Cancel**: Closes the View Instrument Group window without opening a Sample Input window.
- **Help**: Accesses context-sensitive help.

**Available Instruments**: The Instrument Group list box in the View Instrument window displays a list of all on-line instruments.

To use the View Instrument Group window to open the desired instrument group from the list, click the group name to select it; then click OK.
The **Poll for Instruments** option queries the hardware interface to establish communications with **CANNON®** instruments attached to the host computer.

Use the **Poll for Instruments** option to establish a computer connection with instruments which may have come “on line” after the software has been in operation. When the connection has been verified by the controlling software via the hardware interface, the instrument name will be added to the status bar at the bottom of the VISCPRO® window.

### Security options

The VISCPRO® application offers a level-based security system with a log in procedure. This system ensures that available software functions are appropriate for the security level of the user.

Initial security settings will be completed during CAV installation. Following installation, security options may be accessed and changed from the VISCPRO® **Main** menu by individuals who have the manager password.

Each user can be assigned a security level, which is used to determine permitted operations. Three security levels are defined by the software: **Technician** (least privileged), **Manager** (intermediate privilege), and **Service** (maximum privilege—reserved for **CANNON®** Instrument Company service personnel).

Users log in when using the software by typing their name and (optional) password in the **Log In** window. Different security levels offer different CAV use options. Technicians are permitted to access operational features required for testing samples and performing other routine operations. Managers may access advanced configuration and reporting options. The Service level permits access to all instrument and security parameters.

### Initial security setup

The VISCPRO® software installation creates a security account for one manager with a blank password. After VISCPRO® installation, a password should be assigned for the manager using the **Change Password** menu option from **Main**. Managers may add or change accounts for technician status personnel.

Use the **Log In** feature to identify the CAV operator and/or access security functions.

**NOTE**

*Once an operator is logged in, that operator’s name is associated with any sample data obtained during that VISCPRO session. The operator name may be included in analyses.*

**Procedure**

1. Click **Log In** from **Main**.
2. Select the desired name from the drop-down list box.
3. Type the desired password in the Password field for the individual selected.
4. Click OK.

Use the **Change Password** feature to change the current user password.

**Procedure**

1. Log in to the VISCPRO® software using the Log In command from Main.
2. Select Change Password from the Main menu options.
3. Type in the new password in the Password field.
4. Retype the password in the Confirm Your New Password field.
5. Click OK to save the new password and close the Change Password window.

Use the **Update User Information** feature to update the security list of authorized CAV technicians and managers. User information can only be updated by an individual logged in with a higher security clearance than the user for which information is to be altered. Manager status is necessary to change Technician information. Service status is necessary to change Manager information. To obtain Service status, it is necessary to select user CANNON Instrument Company from the Log In window and to type in the current **CANNON®** password. For the current password (updated daily), call **CANNON®** at (814) 353-8000.

**Procedure**

1. Click Log In from Main.
2. Select your Manager or Service level user name from the User Name list box. Input the correct password in the appropriate field.
3. Click OK.
4. Click Update User Information from Main.
5. Select the desired user from the User Name list box.

**NOTE**

To delete a user, just click Remove User after selecting the user name. The account will be immediately and permanently removed.

6. Enter and verify the desired password, and select user security status using the appropriate list boxes.
7. Retype the password in the Confirm Password field.
8. Click Add or Update User to save your changes.
9. Click Done to exit the Change User List window.
To use the Log Out feature, click Log Out from Main. The current user will be logged out of the security list of authorized CAV technicians and managers. The software will automatically reset to the lowest security level. Any ongoing test operations will continue.

**Adjusting Security Settings**

VISCPRO® provides an interface to customize security settings for your facility. To adjust the security settings for your VISCPRO® software, complete the procedure below:

1. Log in as a Manager.
2. Click Service and select the desired instrument. Then click Set Security Levels.

The Set Security Levels window will open.

3. To make changes to security settings displayed in the window, click the current security level for the software option you want to change; then click the desired setting (Technician or Manager) from the drop-down box displaying the security levels. When you are done, click OK to save your settings or click Cancel to exit the Set Security Levels window without making changes.

**NOTE**

There are no SERVICE security settings that are modifiable by the user.

---

**Print/Print setup options**

Select this standard Windows® print option to access the Windows® print window. Then select print options for the currently-active analysis/report (see Analysis options).
Select this standard Windows® print option to access the print setup window. Check your printer driver documentation for additional information on print setup options.

Select the Exit option to exit the instrument software. Or you may click on the application title bar.

⚠️ **CAUTION**

*Exiting the application aborts current tests. It is the responsibility of the user to restore the CAV to a safe state using Wash Viscometer Tube functions from the Service menu before resuming CAV testing.*

### Analyses options

Data obtained from all instruments during sample testing is stored in the central VISCPRO® database. To view data, you must create an analysis configuration requesting the desired sample information in the desired format. Analysis configurations can be saved and later restored. The analysis configuration options provide powerful tools for reporting sample information. Refer to Chapter 6 of the manual for general information on using the analysis options. For specific information regarding the individual analysis packages shipped with your software (e.g., *CAV Data Table*, *VI Matching*), consult the manual chapter for that particular analysis.

Each analysis generates a report based on instrument data in the VISCPRO® database. The following analyses are shipped with the software:

#### Analysis types

- Error Data Export, Sample Data Export and VI Data Export analyses—configures data for output to a file, parallel port, or serial port.
- Error Log Table—lists error messages and related data.
- CAV Data Table—displays test information and selected calculated data.
- Standard VI Table—provides a report of matched samples according to configuration information you provide.

#### Analyses menu options

The following VISCPRO® menu options are used to create and manage analyses:

- View Analysis—opens the Choose Analysis window. See View Analysis, below, for more details.
- Report Title—opens the Designate Report Title window. Permits data entry of up to three lines of text for the report title.
- **Configure Analysis**—Accesses Configuration options. For information on configuring analyses, consult Chapter 6 and the manual chapter corresponding to the particular analysis.

- **Save Configuration**—Opens the Save Configuration window. Type the desired file name in the Save As: field and click OK to save the configuration.

**NOTE**

*The Configure Analysis and Save Analysis options are only available from the Analyses menu when an analysis window is open.*

Select **View Analysis** to select an analysis from a list of available analyses or define a new analysis.

To display an analysis, click the **View Analysis** option from the Analyses menu. The Choose Analysis window will appear. The Choose Analysis window provides a list of available analyses in a list box on the left side of the window. The analyses are organized into similar groups using a directory tree structure.

![Choose Analysis window](image)

**NOTE**

*“Unopened” report directories identified with the symbol contain one or more analysis packages. Click on the symbol to reveal or conceal the list.*

Select the desired analysis from the directory tree. After an analysis has been selected, you can configure the analysis to display the information you want from the central VISCPRO® database. The Choose Analysis window provides three options for doing this:

- Click the appropriate radio button.
- Then select the desired saved configuration (if any) and click OK:
Select **Open Selected Analysis Configuration** if you wish to create and display the selected analysis using the saved configuration highlighted in the list box on the right side of the Choose Analysis window.

Select **View and Open Existing Configuration** if you wish to open the configuration window for the analysis configuration highlighted in the list box on the right side of the Choose Analysis window.

Select **Define and Open New Configuration** to open the configuration window using default settings for the selected analysis.

**NOTE**

For more information on defining and using configurations, see Chapter 6.

### Window options

The Window menu provides options for scaling and arranging multiple windows/icons for screen display. In VISCPRO® you can also save and restore a specific window configuration.

- **Arrange Icons** select this standard Windows® display option to arrange any minimized analysis/report or instrument windows at the bottom of the primary application window.

- **Tile** select this Windows® display option to resize and regroup all open windows to view multiple on-screen reports/instruments. You may select horizontal or vertical tiling for more convenient viewing of data.

- **Cascade** select this standard Windows® display option to resize and regroup all open windows in an overlapping format which provides more space for the active window.

- **Save Window Layout** select this security-protected Manager-level function to save the current VISCPRO® screen configuration, including any currently-open analyses and Sample Input windows. To restore the saved configuration to the VISCPRO® display, click **Restore Window Layout** (see below).

- **Restore Window Layout** this function restores the saved VISCPRO® screen configuration. Any currently-open analysis windows will be closed before the saved configuration is loaded. Also note that currently-open Sample Input windows may be obscured by the restored configuration. To view these obscured windows, either click Window from the VISCPRO® primary display and select the desired instrument view OR right-click the appropriate group.
button on the status bar on the bottom of the primary window. Restoring a saved window configuration does not affect current CAV sample testing operations.

**CAV module menu options**

In addition to the VISCPRO® menu functions, unique software application modules for each type of CANNON® instrument generate additional interface options. The modules determine the characteristics, function and appearance of VISCPRO® software menus and windows. The CAV software module generates menu choices from the VISCPRO® primary display. These menu choices (under the Configure and Service headings) access important CAV configuration and operation options.

**Configure options**

The Configure menu provides the user with a powerful tool for description of CAV instrument capabilities, and for customizing CAV test procedures. Once configuration settings have been determined for optimum performance, the settings can be saved and restored using the Main menu Save Instrument and View Instrument functions.

A CANNON® representative will assist in determining initial configuration settings during the CAV installation procedure. Additional configurations may be created to enhance test performance with different types of samples.

Configuration settings will need to be updated when instrument specifications or components change (sample tray types, viscometer tubes, tube types, etc.).

Each of the configuration menus is explained in detail in the following sections. To access the configuration options, click Configure from the VISCPRO® primary display and select the desired instrument group and instrument.

**Print Instrument and Tray Settings**

The Print Instrument and Tray Settings option prints instrument and tray settings. When you select this option, a standard Print window is opened. Select the desired print settings and click OK to print out a hard copy of the instrument and tray settings. You may wish to retain the printout for diagnostics, verification and record-keeping purposes.

Select Print Calibration Certificate to print calibration parameters for your current instrument configuration. CANNON Instrument Company recommends archiving calibration data each time a new calibration is performed. Note that after you select the Print Calibration Certificate option, the standard Windows Print dialog will be displayed. After you have selected your print options, the VISCPRO software will display the Save Calibration Data window. Input the filename and location to save an electronic archive of your printed calibration information to disk. Then click Save to save the data, or Cancel to exit the Save Calibra-
tion Data window without saving the information. The calibration certificate will be printed after you exit the Save Calibration Data window.

### Restore Instrument and Tray Settings...

The Restore Instrument and Tray Settings option from the Configure menu allows you to restore Instrument Settings, Tray Settings and/or Sample Information from saved configurations for the current instrument.

To access all Restore options, log into VISCPRO as a Manager. Then click the Restore Instrument Settings check box if you want to restore all Instrument Settings for the highlighted saved configuration (see Instrument Settings section in this chapter). Instrument settings apply to the instrument as a whole.

Click the Restore Tray Settings check box if you want to restore all tray settings for the highlighted saved configuration (see Tray Settings: ... sections in this chapter). Tray configuration settings apply to the individual sample trays for an instrument.

Click the Restore Sample Information check box if you want to restore all sample ID information for the highlighted saved configuration. Sample information includes individual sample IDs and actions.

### Save Instrument...

The Configure: Save Instrument Settings option from the Configure menu opens the Save Configuration window. The Save Configuration window permits you to save all current instrument information for any selected instrument, including Instrument Settings, Tray Settings and Sample settings, to the database. Once saved, the instrument information may be restored at any time using the Restore options from the Configure menu (see above).

To use the Save Configuration window, select the desired instrument by clicking on the instrument name in the Available Instruments list box. Then enter a name for the configuration in the Save As: field.

**NOTE**

If you wish, you may choose to overwrite an existing configuration with current settings by clicking on the name of the existing configuration in the Configuration list box. The Configuration name will be transferred to the Save As: field.

Click OK to store the new configuration. To exit the Save Instrument window without saving the configuration, click Cancel.

**Saved Configurations:** The Saved Configurations list box allows you to make changes to the current configuration for any networked CANNON instrument by restoring any or all elements (Instrument, Tray or Sample) of a saved configuration. To restore saved configuration settings, select the instrument from the Available Instruments window and then click on the desired configuration from the list of saved configurations. Then click on the desired Restore ... options (see below) and click OK.
NOTE

If you wish to permanently delete a saved Configuration, highlight it and click the DELETE button or press the Delete key. Click Yes at the Confirm Delete prompt to immediately and permanently delete the configuration.

Instrument Settings

Select Instrument Settings to open the Instrument Settings window, which provides features for describing the CAV and controlling the instrument. These settings apply to the instrument as a whole.

Use the ID field to input instrument identification information using up to 16 alphanumeric characters.

The S/N: field displays the instrument serial number stored by the operational firmware of the CAV.

Click on this check box to synchronize the timing of wash cycles for viscometers in the same bath. (While slowing the throughput rate, this option may enhance bath temperature stability during CAV testing for some applications). The Synchronous Wash Only option is not available/applicable with the CAV-2200 instrument.
Click on this check box to activate a software counter which will generate a warning for a tube whenever the specified number of days have elapsed without performance of the Verify Known KV sample action. Enter the number of days in the appropriate field.

Click on this check box to activate a software counter which will generate a warning whenever the specified number of samples have been tested without performance of the Verify Known KV sample action. Enter the number of samples in the appropriate field.

Instrument Settings window button options:

- **OK**: saves the current instrument settings and exits the Instrument Settings window.
- **Defaults**: restores the default configuration settings for several instrument options.
- **Cancel**: closes the Instrument Settings window without saving any configuration changes.

**Tray Settings: Tube and Bath**

Use the Tray Settings: Tube and Bath window to describe and control test parameters for each individual viscometer tube. Alter the settings using the instructions below. When you have achieved the desired configuration, save the current instrument settings by clicking **OK**. To exit the configuration screen without saving your changes, click **Cancel**. To restore software defaults, click **Defaults**.

To complete the tray configuration, first select the desired tube number by clicking on the desired tube tab # at the top of the window. Tubes are numbered from left to right per their placement in the CAV temperature bath.

Use the **S/N:** field to input the identifying tube serial number (you may wish to use the serial number handwritten on the viscometer tube).

**NOTE**

For reporting and calibration purposes, tube serial numbers should be unique for all instruments controlled by the VISCPRO® software.

Click on the Fast Run Tube check box if the viscometer tube is the fast run (dual bulb) type. The Wet Tube option is required for some manual viscosity determination protocols. If this option is checked, the CAV automatic determination will be preceded by an untimed sample drop, coating the inside of the capillary with the sample material.
The CAV-2200 Tray Settings: Tube and Bath window

**NOTE**
Settings for soak times may need to be reconfigured when the bath temperature setting is changed.

**Bath Temperature**
Input the desired temperature for the CAV Bath corresponding to the selected tube in the Bath Temp: field and select the desired unit of temperature measurement by clicking on the corresponding radio button.

**CAUTION**
Changing bath temperature may necessitate removing the reference thermometer from the Bath Unit. See Inserting/removing the reference thermometer in Chapter 2 for information on the procedure. Damaged thermometers may contaminate the bath fluid.

**Soak time**
Input the desired sample soak times for each bulb of the viscometer tube. The soak time is the length of time in which the sample will remain in the viscometer tube before being dropped. The soak time is important to ensure temperature equilibration of the sample. Values between 5 and 255 seconds are acceptable (the default value is 120 seconds).
Constants

The Tray Settings: Tube and Bath screen displays the calibration constants (C and E) for each bulb of the viscometer tube. These values cannot be edited from the Tray Settings ... screen. For information on determining bulb constants for viscometer tubes, see Calibration later in this chapter.

NOTE

When you have completed the configuration and saved the current tray settings, you may wish to permanently store the current instrument settings using the Save Instrument option from Main.

Tray Settings: Test

The Tray Settings: Test window is used to select parameters for CAV sample testing. Each sample test is called a determination. Multiple determinations are possible for a single sample. Comparisons of sample results permit user regulation of test precision.

The Maximum Absolute Difference option permits you to input the maximum acceptable deviation for multi-drop samples, expressed as the difference in the sample drop times in seconds.

The Maximum % Difference option allows you to input the maximum acceptable deviation for multi-drop samples expressed as a percentage (.35 is the default percentage difference allowable). Values from 0.01 to 99.99 are acceptable. If the difference between test drop times is greater than the acceptable deviation, the sample will be tested again until the deviation in drop times is less than the Maximum % Difference, or until the maximum number of determinations has been reached.

The Maximum Determinations option permits you to select from 1-20 iterations of the test using the same sample.

Tolerance parameters

Determine if the tolerance for differences between sample run times (determinability) is going to be decided by the absolute difference in drop time values (in seconds) or by the percentage difference between the drop times. Click on the appropriate check box to select your choice(s).

Enter the maximum acceptable difference in measured results when using multiple determinations (the default percent difference value is 0.35 percent and the default absolute difference value is 0.2 seconds).

Use greater

If both tolerance options are selected, the VISCPRO software will apply both criteria unless the Use greater option is checked. If Use greater is checked, then the software will apply the less exacting tolerance value when calculating/evaluating test results.
The Tray Settings: Test window

The **Use spread** and **Use mean** radio button options determine the manner in which the VISCPRO mathematically determines which sample tests have met tolerance parameters. Testing is continued until a group of samples meets the tolerance parameters and the rules for sample drop time determination (see Determinations, next page).

**Use spread**

The **Use spread** option compares the individual drop time values for each test sample with the individual drop time values of the other samples. If a sample deviates from tolerance parameters when compared with any other sample in a grouping, the sample is eliminated from consideration.

**Use mean**

The **Use mean** option compares the individual drop time values for each test sample with the mean (average) drop time represented by all samples in the group. If any sample in the group deviates from the mean by a value greater than the value specified in the tolerance parameters, the group is eliminated from consideration.

**Determinations**

Select the determination option by clicking on the radio button corresponding to the appropriate determination method (Always perform maximum determinations, Use successive determinations only, or Use any determinations).
Selecting sample run required and maximum determination settings

Select the number of Required determinations by clicking on the spin controls (values from 1 to 4 are acceptable). In the same manner, select the Maximum number of determinations which can be run for the tube samples (values from 1 to 20 are acceptable).

NOTES

VISCPRO determines the sample flow time by averaging the values of the sample runs which correspond to the chosen criteria.

If the Always perform maximum determinations radio button is selected, the last flow times will be used for the viscosity determination.

When you have completed the configuration and saved the current settings, you may wish to permanently store the settings using the Save Instrument option from Main (see Main options).

Tray Settings: Wash

Use the Tray Settings: Wash window to determine wash settings. Different wash settings may be selected for each tube individually.

Automatic calculation...

The Automatic calculation of wash rinses check box is used to restore the software default value for rinse cycles. These settings are recommended by CANNON®.

Solvent rinse settings

The solvent rinse settings for Solvent A and (if applicable) Solvent B are determined using the Tray Settings: Wash window. These settings determine the number of rinse cycles performed by the CAV instrument after each test.
The Tray Settings: Wash window (Dual Solvent options shown)

**Solvent fill time(s)**

The Solvent fill time(s) setting determines the amount of time that solvent will be introduced into the viscometer tube during each rinse cycle. Acceptable values are 1 to 30 seconds.

**Solvent soak time(s)**

The Solvent soak time(s) setting determines the amount of time that solvent will remain in the viscometer tube prior to the solvent flush during each rinse cycle. Acceptable values are 1 to 30 seconds.

**Solvent flush time(s)**

The Solvent flush time(s) setting determines the amount of time pressurized air will flush the remaining solvent from the viscometer tube following the solvent soak. Select a value from 1 to 60 seconds for this option.

**Final dry time(s)**

The Final dry time(s) setting determines the additional amount of time forced air is channeled through the viscometer tube to dry it at the conclusion of the rinse/dry cycle. Select a value from 15 to 300 seconds for this option.
Dual solvent wash options

The dual solvent wash options determine which solvents (Solvent A and/or B) will be used for the solvent washes. If the dual solvent capability exists for your CAV unit, click on the radio button corresponding to the desired dual wash option for that tube/tray.

⚠️ CAUTION  Be careful to consider bath temperature(s) and potential solvent hazards when selecting solvents for use with the CAV instrument.

NOTE  When you have completed the configuration and saved the current wash settings, you may wish to permanently store the current instrument settings using the Save Instrument option from Main.

Tray Settings: Advanced

Select the Tray Settings: Advanced option to open the Tray Settings: Advanced window used to define additional operational parameters for sample testing with the CAV instrument. Access to this window is reserved for Managers and CANNON Instrument Company service level personnel by the VISCPRO security system. Log in to access Advanced settings, which are determined individually for each tube.

The Tray Settings: Advanced window
CAUTION  Advanced settings will ordinarily be configured by a technician from CANNON® Instrument Company when the instrument is initially installed. Advanced settings should only be adjusted by or in consultation with a representative from CANNON®.

Maximum bulb 1 fill time(s): Adjust this setting to select the desired maximum fill time for bulb one. Acceptable values are between 20 and 400 seconds.

Minimum bulb 1 selection time(s): Adjust this setting to select the desired minimum time permitted for selection of bulb one for sample testing. Acceptable values are between 3.5 and 20 seconds.

Minimum bulb 2 fill time(s): Adjust this setting to select the minimum fill time permitted for bulb two. Acceptable values are between 0 and 4.0 seconds.

Maximum bulb empty time(s): Adjust this setting to select the maximum drop time permitted for the test before the software will abort the sample run. Acceptable values are between 90 and 600 seconds.

Maximum tube empty time(s): Adjust this setting to select the sample recovery time (the amount of time between the conclusion of the sample run and the initiation of the wash cycle). Acceptable values are between 5 and 125 seconds.

When you have selected the desired tray settings, save the current instrument settings by clicking OK. To exit the configuration screen without saving your changes, click Cancel. To restore software defaults, click Defaults.

Bulb overdraw

Use the Bulb Overdraw button/window to set the amount of time in seconds that the instrument will draw sample AFTER the sample meniscus has cleared the top sensor.
Saving a configuration
Whenever you have altered instrument, tray or sample configuration, you may wish to save the resulting settings as a new or existing configuration. To save current settings, use the **Save Instrument** option:

**Procedure**

1. From the VISCPRO® primary menu options, click **Configure**.
2. Select the desired instrument and click **Save Instrument & Tray Settings**. The **Save Configuration** window will appear.
3. Type a name for the new configuration in the **Save As:** box. Or double-click an existing configuration from the configuration list box.
4. Click **OK** to save the configuration. Or click **Cancel** to exit the **Save Instrument & Tray Settings** window without saving your changes.

Restoring instrument settings from a saved configuration
There are three options for restoring instrument settings from a saved configuration. These restore options are individually selectable from the **Restore Instrument Settings** window.

**NOTE**
*The Restore Instrument Settings and Restore Tray Settings options are only available if you are logged in as a manager.*

**Restore procedure**
To restore instrument settings from a saved configuration:

1. Click on **Restore Instrument Settings** from the **Configure** menu options for the desired instrument.
2. Select the desired saved configuration from the list box.
3. Use the check boxes to select the desired configuration elements to be restored.
   - **Restore Instrument Settings** restores instrument properties from the saved configuration.
   - **Restore Tray Settings** restores tube/tray/wash properties from the saved configuration.
   - **Restore Sample Information** restores all sample ID setup information for the Sample Input window from the saved configuration.
4. Click **OK**. If you clicked the check box to restore instrument, tray or sample settings, the current instrument will be updated with the selected settings.
NOTE
If you have updated the settings, you may wish to save the current instrument/tray/sample configuration by selecting Save Instrument & Tray Settings from the Configure menu, inputting the configuration name in the Save As: text box, and clicking OK.

Calibration

The Calibration window provides controls for calibrating each tube associated with your instrument. You must be logged onto the system as a manager to access these security-protected calibration functions.

The Calibration window options are described briefly below:

**Tube selection:** Tubes in the bath are numbered from left to right. Use the spin controls to select the correct tube for calibration.

**Bulb selection:** Viscometer bulbs are numbered from the bottom to the top of the viscometer tube. Use the spin controls to select the correct bulb for calibration.
Date selection: The calibration program uses data from previously-run standards to determine the calibration constants. To select the desired standard data, use the No older than [x] days spin controls to set the date parameters for the database search (if “1” is selected, only the standards run on yesterday and today’s date will be used).

NOTE
Sample run data from at least two different standards for each bulb at each calibration temperature must be available for calibration calculations to be performed.

Data selection: Test data from standards run with the CAV within the specified Date parameter will be automatically displayed in the list box.

To select and deselect the data from the sample runs to be used for the calibration, press and hold the keys and click on the samples to highlight those you wish to include in calibration calculations (the default is all selected). After you have selected the desired data, release the key and click Calculate new constants to update values for C and E:

Click on Calculate new constants to update values for C and E.

You may evaluate the accuracy of the new calibration constants by comparing the known viscosity for the standard with the calculated viscosity for each standard selected for the new calibration. This difference is displayed as a percentage in the last column (% Diff) of the updated sample list box.

Show Calibration Data
The Show Calibration Data button is a toggle that will permit you to compare current and new calibration data and constant information. Press the Show Calibration Data button once to view the current calibration information. Note that the button name will change to Display Sample Data. Press the button again to display the new calibration data.

Update bulb
When you are satisfied with calculation results, click on Update bulb to save calibration values for the current configuration.

If the difference is still too great, repeat the calibration process until the difference falls within acceptable limits (refer to the precision statement in ASTM D 445).

NOTES
You must click Update bulb before changing to the next bulb if you wish to save the new calibration constants for that bulb.

Once the Update bulb button is pressed, the updated calibration constants are associated with the selected instrument, and will remain the same regardless of the instrument configuration defined for that instrument.
**Service menu options**

To access the service options, click Service from the VISCPRO® primary display and select the desired instrument.

**Monitor**

The Monitor window permits the user to view current operational values for the CAV instrument. These settings may be helpful to CANNON® technical personnel when troubleshooting difficulties with the CAV.

Select Wash viscometer tube to open the Wash viscometer tube window and select the desired tube.

Click the desired tube tab; then click Begin Wash to initiate the wash cycle. The Status: indicator will display and update current actions. Click Done to exit the Wash viscometer tube window.

**NOTES**

The Wash operation cannot be executed if the tube is currently running a sample. To terminate the Wash cycle at any time, click Abort Wash.

**CAUTION**

The Wash viscometer tube function overrides automatic CAV software operations. Verify that the tubes are clean and dry before initiating computer-controlled sample testing.
To set security levels, first log into the VISCPRO software as a Manager. This will permit you to determine Manager or Technician accessibility for the following protected menu-accessible functions:

**Configuration:**

Instrument Settings
Tray Settings: Tube & Bath
Tray Settings: Test
Tray Settings: Wash
Tray Settings: Advanced
Calibration

To make security changes, click Service/Set Security Levels for the desired instrument. The Service/Set Security Levels window will open. Current security settings will be displayed. To change the security level for a protected function, click on the Security Level cell opposite the function name until the Manager/Technician drop-down box is displayed. Then click the desired security level to select it.

When you have finished updating settings, click the Save button to save settings and close the Set Security Levels window. Or click Cancel to close the window without saving changes.

**Testing samples—software options**

This section of the manual provides information on using the software to perform common CAV operations in Remote mode. For a step-by-step procedure detailing both hardware and software operations involved in sample testing, refer to Chapter 2.

**Entering sample ID information**

*Procedure*

1. From the VISCPRO® primary menu options, click on Main.
2. Select View Instrument from the menu options.
3. Select the desired instrument group from the list box in the View Instrument window.

**NOTE**

*If you do not see the desired instrument listed in the list box, make certain that the instrument is turned on and is on-line (verify cable connections to the computer). Then click the Refresh button to scan for additional on-line instruments.*

4. When you are done, click OK. The Sample Input window for the selected instrument will appear.
5. To input sample identification information for the samples to be run, first select the correct tray for the test by clicking on the tab corresponding to the tray.
6. After the tray has been selected, click on the sample number in parentheses (or press [F2]) to access the sample ID field.
7. Enter the desired sample ID, using up to 21 alphanumeric characters; then press the Tab or Enter key.

Selecting sample actions

8. Whenever a new sample ID is entered, the sample action defaults to Measure Sample Viscosity. To access all sample action options, highlight the desired sample and right-click the mouse or press [F5]. The Sample Action popup window will appear.

9. Select the desired sample action from the window by clicking on it.

Sample actions

- **No action**—clears action column for highlighted samples. No testing will take place for this tray position.
- **Measure kinematic viscosity**—measures sample viscosity.
- **Verify Known KV**—measures sample viscosity at the conclusion of the automated test and tags data for possible use in calibrations/reports.
- **Configure**—permits adjustment of sample run specifications for selected individual samples/standards from the Viscosity Action window (see next page). The Configure options will vary depending on the selected sample action (Measure Sample Viscosity or Verify Known KV). Note that changes to Configure options will override general settings.
- **Delete**—Deletes currently-selected sample data. Samples in succeeding tray positions will be moved up to fill the empty “slot”.
- **Insert At**—Inserts a sample field at the currently-selected location.
- **Copy All Selected Samples**—copies selected sample IDs
- **Paste Into Selected Samples**—pastes selected sample IDs
- **Sequential Sample IDs**—Numbers selected samples automatically.
- **Clear All Trays**—Clears sample data for all trays.
Viscosity Action window

The Viscosity Action window permits you to set test parameters for individual samples, overriding the general settings. For information on general settings, refer to Tray Settings: Test; beginning on page 43 of this manual.

The Wash Options are only available for instruments configured for dual-solvent operation. Click on the radio button to select desired solvent option for individual samples.

NOTES

Parameters for the solvent wash are determined by Wash settings from the Tray Settings: Wash window (see Tray Settings: Wash section, this chapter, for more information). The Wash Options default setting is for a solvent wash using both solvents.

To select more than one sample at a time from the list box, highlight the first sample and the press the Shift key and click on the last sample, or just press and hold the Ctrl key and click on individual samples to be selected. When you have completed sample selection, right-click the mouse on any of the selected samples to select the desired sample action for all highlighted samples.

Sequential Sample IDs—creates a numeric sequence for the highlighted sample ID(s) in the list box. You have the option of selecting a standard alphanumeric prefix and/or suffix to accompany the sequence numbers, and you also can select the starting numeral in the sequence.

Procedure

1. To use the Sequential Sample IDs feature, highlight the desired sample tray location(s) in the list box.
2. Right-click any of the highlighted locations and select Sequential Sample IDs from the Sample Action popup.
3. Enter necessary information in the Assign Sequential Sample IDs window:
   - **Prefix**—Input a character string to be used as an identifier
   - **Suffix**—Input a character string to be used as an identifier
   - **Starting ID**—Input a number to start the numeric sequence
   - **Number of Samples**—Select the number of samples in the highlighted block which are to be sequentially numbered
   - **Use as Format**—If checked, this feature activates a “wrap-around” function for sequential numbering like an odometer (if 001 was input, the sequence would restart at 001 every 100 samples).

![Assign Sequential Sample IDs](image)

Assign Sequential Sample IDs window

4. When done, click OK.

**NOTE**
The VISCPRO® software “remembers” the last number in the last sequence and will place the next number in the sequence in the Starting ID field the next time the Sequential Sample IDs option is selected.

**Viscosity Action for viscosity standards**

The Viscosity Action window for KV verification is identical to the Viscosity Action window for measurement of kinematic viscosity (see previous section), except that there is an additional field provided for input of the known viscosity of the standard. This value must be entered in the appropriate field in order that the resultant viscosity determination may be used for verification and calibration.

**Copy & Paste Sample ID data entry options**

The VISCPRO® Sample ID data entry screen supports Windows® Copy and Paste options.

**Copying Sample IDs**

To copy a Sample ID entry, including the configuration information, highlight the desired line(s) from the Sample List Box and right-click your mouse to access the Sample Action window. Then select **Copy All Selected Samples** from the menu options. OR you can use the **Ctrl-C** key combination.
Pasting Sample IDs

To paste Sample ID entry information into another tray/sample location, highlight the desired line(s) in the Sample List Box and right-click your mouse to access the Sample Action window. Then select Paste Into Selected Samples from the menu options. OR you can use the Ctrl-V key combination.

Copying/pasting multiple IDs

You may copy or paste a block of (multiple) sample ID entries using the same procedure described above. When pasting multiple entries, make certain to select the same number of sample locations as were initially copied. If you select a larger number, only the original copied number of entries will be pasted. If you select a smaller number, information for the last sample(s) in the block will not be copied.

Inserting/deleting a sample ID in the test sequence

To insert a sample ID into an existing sample run test sequence, highlight the desired sample location in the sample run sequence and press Insert. OR highlight the desired ID number, click the right mouse button, and select Insert At from the Sample Action options.

The existing sample entries will be moved down one position in the sequence and you can enter the new sample ID information at the cursor.

⚠️ CAUTION

If the list box already contains a sample ID for every position on the tray, the sample data for the final position will be discarded when a position is cleared for new data.

To delete one or more sample IDs and move all remaining samples in the sequence up in position, highlight the sample ID(s) you wish to delete and press the Delete key. OR you may right-click in the highlighted block and select Delete from the sample action options window. The highlighted sample (or samples) will be deleted and any existing sample entries following the removed items will be moved up to take their place in the sample run sequence.

CAV analysis modules

The VISCPRO® software is shipped with several analysis modules which can be used to create reports based on sample test data. For general instructions on using analyses, see Chapter 6, Analysis Configuration Options. For information on a specific analysis module included with your CAV package, see the chapter on the particular analysis.

Configuring the VI Matcher

VI Matching with VISCPRO®

The VI Matcher is a VISCPRO® software feature that functions in tandem with the VI analyses to enable Viscosity Index (VI) calculation from sample data residing in the VISCPRO® database.
Viscosity Index calculations require kinematic viscosity data derived from samples tested at a high and a low temperature. The VI Matcher permits the user to define which viscometer tubes are high temperature tubes and which are low temperature tubes.

The VI Matcher General Configuration window

After the VI Matcher has been initially configured by the user or CANNON® representative (this is ordinarily done during instrument setup), the VI Analysis can be used to automatically scan the VISCPRO® sample database for samples with matching Sample IDs. If samples with an identical Sample ID have been tested on a low temperature tube and a high temperature tube within an 8-hour time span, the VI for those samples can be calculated and displayed on the VI analysis. The VI Matching function is always indicated on the VISCPRO® status bar, whether or not a VI domain has been defined (see below).

Configuration procedure

To configure the VI Matcher:
1. Load the VISCPRO® software.
2. Log on to the system as a Manager (a password may be required) to access the VI Matcher function, which is security-protected.

NOTE

For more information on the security log-in procedure, see Security Options, this chapter.

3. Select VI Matching—General Configuration from the Configuration menu options. The General Configuration window will appear.
4. Click on the Allow Matching of Invalid Samples box if you wish to permit VI matching of samples with flow times exceeding the specified tolerance for repeatability.

NOTE

The VI Matcher does not match invalid samples UNLESS the Allow Matching ... box is checked. The VI Matcher never matches unsuccessful samples (samples with no flow time and a displayed kinematic
5. Click on the ADD button to add a new VI configuration.

6. Click on the serial numbers in the Select Low Temperature Tubes list box which correspond to tubes that should be configured as low temperature tubes by the VI Matcher. As you do so, the serial numbers will be added to the Selected Tubes list box.

**NOTE**

To “de-select” a selected tube, click again on the highlighted tube serial number

7. Click on the tubes in the Select High Temperature Tubes list box which correspond to tubes that should be configured as high temperature tubes by the VI Matcher. As you do so, the serial numbers will be added to the Selected Tubes list box.

8. When you have finished adding low and high temperature tubes, click OK to save the configuration and exit the General Configuration window.

**NOTES**

To exit the General Configuration window without saving the configuration, click Cancel.

For information on creating VI analyses, see the manual chapter corresponding to the desired analysis.

**Turning off the VI Matcher**

The VI Matcher essentially function as a separate instrument and is indicated as such on the VISCPRO® Status Bar. If you wish to terminate VI matching, you will need to delete any VI domain(s) using the Delete button from the General Configuration window. When no domains are defined, the VI Matcher does not function.

**Handling errors**

**VISCPRO® errors**

The CAV instrument software returns three types of errors during operation: bath errors, fatal errors and tray errors. Bath and tray errors are sample/tray specific, and may affect test results for a given sample. Such results will be indicated as invalid. Fatal errors may be hardware-related, and can produce a FAULT condition (see Chapter 5, Handling fault conditions).
Configuring the Energy Saver

The Energy Saver Configuration window

The Energy Saver allows the user to set a schedule for automatic and unattended power down and power up. Primary instrument systems, including bath lights and heaters can be turned off and on automatically to save energy in the laboratory.

Configuration overview
A seven-day programmable interface allows for setting up to seven Instrument Shut Down and Instrument Ready times for the instrument (one per day—see next page). To use the Energy Saver, select the desired Instrument Shut Down time(s) and Instrument Ready time(s). Use your mouse or keyboard with the drop-down boxes to select the week day and the spin controls to set the time.

Instrument Shut Down
Instrument Shut Down is the time that power is to be removed from the CAV instrument. If the CAV 2000 Series instrument is testing samples at the time of the scheduled Shutdown, the instrument will complete all testing before engaging the Energy Saver feature.

Instrument Ready
Instrument Ready is the time that the instrument is needed for testing. Once the Instrument Ready time is set, smart technology ensures that the instrument engages required systems in time for the instrument to return to the last set temperature at the desired Instrument Ready time.

Configuration details
To configure the Energy Saver, click Configuration and select the desired instrument. Then select the Energy Saver Configuration option. The Energy Saver Configuration window will open. Use a 24-hour
cycle when selecting afternoon/evening hours (2:00 p.m. would be 14:00 hours). Then click the Update button to store the daily data. The new configuration will be displayed in the list box. When you have completed the weekly configuration, click OK to save all changes and exit the Energy Saver Configuration window. To exit the Energy Saver Configuration window without saving changes, click Cancel.

Using the keyboard

Use the TAB key to advance the focus through the different fields in the window. With the window “focus” on Weekday or Time fields, you can use the keyboard instead of your mouse to select days/times: M = Monday, T is a toggle for Tuesday/Thursday, W = Wednesday, F = Friday, and S is a toggle for Saturday/Sunday. You can also use the UP and DOWN arrows for days and times. The DOWN arrow will advance the day or set the time back. The UP arrow will do the reverse. Minutes and hours are set separately.

Overriding existing settings

To manually override current Energy Saver settings, press any number key on the CAV instrument; the CAV will energize, resume normal operation and begin controlling temperature.

NOTES

The Energy Saver will not work if the instrument is manually turned off or if mains power is removed.

If the computer is turned off for an extended period of time, the CAV onboard microprocessor will execute only the next scheduled Power Down and Power Up sequence. If the computer is left on, the CAV will continue to execute the weekly configured Power Down/Power Up sequences.

To navigate the Energy Saver interface, it is helpful to rely primarily on the Tab and arrow keys of your computer keyboard. Pressing the Enter key is the equivalent of clicking the Update [day] button.

To delete an existing daily configuration, select the Instrument Shutdown day for the Configuration; then click (check) the Disable Energy Saver checkbox. Then click Update. The daily configuration will be deleted. To delete all configurations, click the Disable All button. You must click the OK button to save all changes.

The user may set a configuration for each day of the week. A single daily configuration can span multiple days (Friday to Monday, for example). If the chosen Shut Down and/or Ready times conflict with those of another daily setting, a caution window will appear. You must use the Update button (or press the Enter key) to record each daily configuration change (Shutdown/Ready setting). The full weekly configuration is not saved until you click the OK button.

It is not necessary to set a configuration for each day of the week—only those times you want the Energy Saver to function.

The Disable Energy Saver check box option must be “cleared” before a new Configuration can be set for the selected day of the week.
**Uploading the configuration**

The currently-saved Energy Saver configuration is automatically uploaded to the CAV microprocessor:

- at VISCPRO start-up (unless the CAV instrument is in Energy Saver ("sleep") mode, in which case the information will be uploaded at the conclusion of the sleep cycle)
- at the conclusion of testing
- whenever the instrument temperature is changed
- whenever the Energy Saver configuration is changed (unless instrument is currently testing samples)

**Disable Energy Saver for this day**

To disable the Energy Saver for a single day, click the Disable Energy Saver for this day checkbox. Clearing the checkbox enables the Energy Saver option for that day. Checking the box erases the daily configuration, allowing you to set a new configuration if desired. You must click the Update button or press the Enter key for each daily configuration change to be recorded. **You must click the OK button to save all changes.**

**Disable All**

Click the Disable All button to erase all previously-set Energy Saver daily configurations. **You must click the OK button to save all changes.**

**NOTE**

Disabling the configurations deletes them from the computer memory. Once you save your changes, previous configurations cannot be recovered, but must be recreated.
This chapter of the CAV Instruction & Operation Manual contains information regarding the operation, service and maintenance of the CAV instrument. For additional information on required utilities, instrument installation and setup, refer to the Installation & Setup Guide.

**CAV components**

The standard CAV installation includes these primary components:

- Bath unit
- User-supplied solvent & waste vessels
- Service/Dispensing Units

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**Bath Unit**

The Bath Unit houses the primary control and operating systems for the CAV. The lower section of the Bath Unit includes a pneumatics drawer with electronic components and pneumatic controls. The middle section of the Bath Unit includes the sample table, sample trays, and the temperature bath with viscometer tubes. The upper chassis is located above the bath and includes the control panel and additional control hardware and electronics for Local and Remote mode operation including sample testing, viscometer tube cleaning, and calibration.
Bath Unit connections

For information regarding Bath Unit connections, refer to the CAV Installation & Setup Guide.

SDU-200 Solvent Dispensing System

The CAV is equipped with a solvent system used to wash the viscometer tubes after each sample test. The system consists of the Solvent Dispensing Unit (SDU), the internal and external drain lines, and the user-supplied solvent and waste cans. Appropriate solvent containers may be acquired from many suppliers, including JustRite® and Nalgene® (see weblinks below).

http://www.justritemfg.com/containers.tpl
http://www.nalgeneabware.com/products/productsIndex.asp

The SDU will interface with the CANNON Service Unit (CSU) and the CAV instrument.

Solvent system connections

For information regarding solvent system connections, refer to the CAV Installation & Setup Guide.

CSU-200 Service Unit

The Service Unit (CSU-200) contains control electronics, vacuum pump and pressure regulators for air, solvent and vacuum. Each CSU-200 is capable of providing regulated gas/vacuum for up to four Bath Units.

NOTE

If the user has in-house regulation of gas and vacuum, these connections can be made directly to the Bath Unit. See chapter 5 for required pressure/vacuum settings.

CSU-200 connections

For information regarding CSU-200 connections, refer to the CAV Installation & Setup Guide.

NOTE

A compressed air source is required for connection to the Service Unit.

Emptying the waste can

CAUTION

Check the volume of the waste can at the beginning of every work shift, to avoid solvent spillage or overflow.

The waste can collects solvent and sample residue drained from the viscometer tubes during the cleaning process. CANNON Instrument Company does not supply a waste can. The CAV should be connected to a suitable safe container, approved by local safety personnel. The drain system operates on a gravity flow system.

CAUTION

The drain line must be kept short and neat (no loops or knots) or an air lock could result.
Procedure

1. Disconnect the waste can from the drain tube(s).

⚠️ **CAUTION** Be careful when handling the drain tube, to avoid spilling or splashing waste solvent collected in the tube.

2. Pour the collected solvent out of the waste can into a proper waste storage container.

3. Replace the drain tube(s) in the waste can.

⚠️ **WARNING** Waste solvents can present possible environmental and health hazards. Dispose of all waste solvents according to environmental safety regulations.

Waste can connections

For information regarding waste can connections, refer to the CAV Installation & Setup Guide.

Viscometer tubes

The CAV is equipped with borosilicate glass capillary viscometer tubes having a wide viscosity range. The upper viscosity limit is up to 100 times the lower viscosity limit, depending on the tube type. Each viscometer tube contains four glass-bead thermistors used for sensing the level of the sample within the tube (fast-run viscometer tubes contain three glass-bead thermistors). There are two viscometer tubes installed in each CAV-2100 temperature bath; one viscometer tube is installed in each CAV-2200 temperature bath.

Tube thermistors

The glass-bead thermistor is a precision sensor embedded in the viscometer tube. The sensor heats up slightly when an electrical current is passed through it. When the thermistor is covered by a sample, the sample draws heat away from the thermistor, thereby cooling it. As the sample meniscus passes the thermistor, the thermistor quickly returns to its “hot” state. The sensor board detects this change in thermistor temperature and records the time accurately to within one-hundredth (0.01) of a second.

Timing bulb determination

As the sample is drawn into the viscometer tube, the VISCPRO® software automatically determines which timing bulb will be used to test the sample.

The sample will be drawn into the bulb above the upper timing thermistor. That bulb will serve as the overflow bulb for that particular test run.
NOTE

The numbers listed in this table are approximations, not absolute values.

**Fast-run viscometer tubes**

*CAVON®* Instrument Company has developed a fast-run viscometer tube for the CAV. Results of viscosity measurements are typically available within 3-5 minutes. The fast-run tube has a tenfold range (i.e., 60-600 cSt), and requires less sample volume for testing (12-17 ml) and less solvent for cleaning than the standard CAV tube. Fast-run tubes may be used for most typical CAV applications and are ideally suited for analyzing used oils.

Fast-run viscometer tubes are available upon request, either at the time of your initial CAV purchase, or as a future upgrade.

**Temperature bath**

The temperature bath is capable of maintaining constant temperatures between 20°C and 100°C (150°C for high-temperature bath models). Silicone bath fluid is circulated via a pump or central stirring rod. The bath also stainless steel resistance heating elements. Solid state temperature control circuits provide proportional control with reset. Thermal fuses are installed to protect all heating elements.

**Bath fluid grades**

The temperature bath is ordinarily filled with Dow Corning 200 silicone fluid, supplied by *CAVON®* Instrument Company. The viscosity of the fluid depends upon the temperature of the bath during most operations:

<table>
<thead>
<tr>
<th>Average temperature</th>
<th>Recommended bath fluid viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 100°C</td>
<td>10 cSt</td>
</tr>
<tr>
<td>101-150°C</td>
<td>20 cSt</td>
</tr>
</tbody>
</table>

**Expansion vessel (CAV-2100 only)**

The CAV-2100 expansion vessel has been designed to hold excess liquid when the CAV is operating at high bath temperatures. The expansion
vessel is located at the top of the temperature bath and is accessible from the top of the unit. Since bath fluid expands when it is heated, the expansion vessel contains any overflow of bath fluid during high-temperature CAV operation (see photo).

### Filling the bath

**CAUTION** All fill and drain procedures should be performed when the bath fluid is at ambient lab temperature. The procedure below provides instructions for maintaining bath fluid levels. For instructions on filling an empty bath, consult the CAV Installation & Setup Guide.

**Fill procedure**

1. Obtain the (supplied) funnel.
2. Locate the expansion vessel (CAV-2100) or the top bath flange (CAV-2200) at the top of the temperature bath.
3. For the CAV-2100, open the flip-cap on the expansion vessel (see photo). For the CAV-2200, loosen the knurled thumbscrew (see photo) securing the aluminum hole cover to the top bath flange and slide the cover free of the opening. Then insert the appropriate funnel in the opening.
4. Using the funnel, introduce the appropriate grade of silicone bath fluid into the expansion vessel (CAV-2100) or bath (CAV-2200).
5. Continue adding fluid until the liquid level rises to the cold fill level. For the CAV-2100, that level is even with the bottom of the top bath flange. For the CAV-2200 that level is about 2” or 5 cm below the top flange, and is marked by a decal fill line.
6. When done, remove the funnel and replace the flip-cap or hole cover. Check the bath fittings for leaks to complete the fill procedure. Tighten fittings if necessary.
NOTE
Periodically check the CAV when the bath fluid is at ambient temperature to ensure that liquid is being maintained at the specified fill level.

⚠️ CAUTION
When filling the temperature bath, never fill past the recommended cold fill level.

Draining the bath

1. Using a Phillips screwdriver, loosen and remove the six screws securing the front glass panel to the Bath Unit. Make certain to hold the panel in place when removing the final screws. When the screws have been removed, carefully remove the front panel and set it aside.

2. Ensure that the drain valve handle is in its closed position (handle perpendicular to valve). Then remove the drain plug with a 3/16" Allen wrench (see photo).

3. Attach the barbed hose fitting (provided) to the valve outlet.

4. Secure a drain hose to the hose fitting. The other end of the drain hose should be inserted in an appropriate bath fluid waste or storage container.

5. Open the drain valve by turning the handle counterclockwise. Fluid should begin draining from the bath into the safe container.

NOTE
It may be helpful to open the flip-cap on the top of the expansion vessel to atmosphere when fluid is draining.

6. When fluid has drained from the bath, close the drain valve by rotating the handle clockwise to its furthest position.

7. Remove the drain hose and barbed hose fitting from the drain valve.

8. Apply PTFE tape or other sealer to the threads of the drain plug previously removed. Then reinstall the drain plug to the drain valve and secure with the 3/16” Allen wrench.

NOTE
For instructions on refilling an empty bath, refer to the CAV Installation & Setup Guide.

Bath heaters

The CAV-2100 Bath Unit is equipped with twin 400W heating elements suspended in the bath fluid from the top bath flange. The CAV-2200 heating elements are incorporated into the pump circulating system.

Heat shield (optional)

A stainless steel heat shield at the rear of the bath helps maintain a constant operating temperature for higher temperatures (above 100°C). The shield is only required for the high-temperature CAV option.
Bath fluid safety features

The CAV-2100 Bath Unit is equipped with a fluid level float suspended from the top bath flange at the front of the bath. If the bath fluid level drops to an unacceptable level, a fluid level float warning will abort bath operations until an acceptable bath fluid level is restored and the CAV is restarted.

The CAV-2200 has a flow switch that will prevent CAV-2200 operation if the pump circulation system is not operational.

Temperature probes

The CAV Bath Unit incorporates temperature sensors suspended in the bath fluid from the top bath flange. If the bath fluid temperature rises above normal operating temperatures, the over-temperature thermistor will abort bath operations until the CAV instrument is restarted and an acceptable bath temperature is detected.

Sample trays/drains

Both heated and unheated sample trays will slide into place along the grooved track in the sample table. The plated steel vial adaptors should be placed in the receptacles in the tray. Glass sample vials slide into the adaptors. Place the sample tray in the track and slide the tray forward until the detente mechanism engages. At position 1 (first sample directly underneath the viscometer tube), a heated sample tray should snap into position against the detent mechanism when the front of the tray extends approximately 2 centimeters (3/4”) over the edge of the sample table. The forward edge of an unheated tray will be indented approximately 2.2 centimeters (7/8”).

Electrical connections

For (optional) heated sample trays, connect the keyed three-pin cable from the sample tray to the interior wall connector above the sample table (see photo), orienting the cable in a “U” configuration aside the sample tray. Turn the knurled ring clockwise to engage and secure the connector.

Tray/drain heat operations

To provide power to the heated sample trays and/or heated drain lines which may be installed on your CAV unit, you will use the heater ON/OFF switches on the left side of the front panel (see diagram, left). These two switches provide power to left- and right-hand heating elements. To adjust temperature, use the Adjust knobs on the upper front panel of the Bath Unit. Turn the knobs clockwise to increase temperature and counter-clockwise to lower it. The knobs regulate the duty cycle of the heaters for the sample trays and the drain lines.

The low-temperature sample heaters will maintain temperature stability as high as 80°C. The high-temperature sample heaters will maintain temperature stability as high as 100°C.
NOTE

During normal operation, the green lamp on the heated sample tray holder will illuminate and/or blink in tandem with the red LED on the front panel ON/OFF switch. If the green lamp is NOT flashing, check cable connections and sample block temperature (block may be overheated and may need to cool down).

Using a temperature probe

A recessed thermometer well (3.63 mm; 0.143” ID) at the front of the sample tray permits insertion of a temperature probe to monitor tray temperature for heated sample trays.

Splash guards

To reduce the risk of contaminating samples, and to protect the viscometer tube from damage, the exposed viscometer tube tips should be shielded with splash guards (provided). Use the captive thumb screw on the top of the splash guard to secure it to the underside of the Bath Unit frame in front of the viscometer tube tip. The felt pad should face the tube tip (see photo, previous page).

Solvent system

The CAV requires a solvent system, which is used to wash the viscometer tubes after each sample analysis. The solvent system consists of the Solvent Dispensing Unit (SDU), the solvent/drain lines, and the user-supplied solvent and waste cans. The SDU delivers to the CAV the chemicals necessary to clean the viscometer tubes before and after oils are tested. The solvent drain system collects the waste sample and solvent used for cleaning and transfers them to the waste can provided by the user.

A dual-solvent washing system for cleaning more viscous samples from the viscometer tubes is available from CANNON®.
Solvent Dispensing Unit

The Solvent Dispensing Unit (SDU) delivers solvent from the user-supplied solvent vessel to the CAV Bath Unit.

Solvents

The CAV is capable of using different kinds of solvents to clean the viscometer tubes. Certain solvents are better at removing specific kinds of oil sample residues. Depending upon the type of sample being tested in the viscometer tube, a mixture of solvents could be the most effective means of cleaning the viscometer tubes.

⚠️ WARNING ⚠️

Some of the chemicals used to clean the viscometer tubes could be dangerous to the health of the operator or technician. Refer to the Material Safety Data Sheet (MSDS) provided with the chemicals and exercise the necessary safety precautions and take extreme care in the use and handling of these materials.

NOTE

CANNON® Instrument Company does not specify or recommend cleaning solvents. Solvent selection is made by the customer. Consult with CANNON to resolve questions pertaining to solvent compatibility with the CAV 2000 Series Automatic Viscometers.

Grades of solvent

The solvent used in a particular viscometer tube must be able to dry at the test temperature of the tube (during the washing cycle). Choose the appropriate grade of solvent accordingly.

Checking solvent levels

Frequently inspect the user-supplied solvent vessel to ensure a steady supply of cleaning solvent for the viscometer tubes. When the solvent level drops to within 2.5-5.0 cm (1-2") of the bottom of the solvent vessel, it should be refilled.

Solvent/drain lines

A solvent line transfers solvent to the CAV Bath Unit from the solvent vessel via the Solvent Dispensing System (SDU).

A drain line transfers solvent/sample from the waste receiver beneath the viscometer tubes to the user-supplied waste can. The drain line is a ½" nylon tube which runs from the inside of the CAV and extends from the rear panel. The drain line should be connected to the waste can.

Heated drain lines, intended for use with highly viscous or waxy samples, are available from CANNON®. Heated drain lines are designed to keep the waste solvent/sample at an elevated temperature while draining into the waste can. Drain line heaters help prevent clogging of CAV drain lines. The customer ordinarily specifies which viscometer tube (if any) should be equipped with a heated drain line during the order process.

Consult the CAV Installation & Setup Guide for details on solvent/drain line connections.
**NOTE** Only the portion of the drain line that is within the Bath Unit will be heated. CANNON® Instrument Company does not heat the length of tubing which extends from the bath to the waste can.

**Waste can**

The waste can collects the waste solvent and sample residue drained from the CAV. The customer must supply a waste can (typically a 5-gallon safety gasoline can) and must empty the can as necessary. Disposal of solvent/sample waste should be in accordance with appropriate safety and environmental regulations. CANNON® Instrument Company does not supply a waste can with the CAV.

**NOTE** When positioning the waste can, make sure that the drain lines slope down from the CAV to the waste can. This will help prevent any solvent/sample waste from spilling back into the CAV. This will also ensure proper and complete drainage of solvent and waste oil from the CAV.

**Drip pan**

The drip pan is located immediately below the expansion tank in the CAV cabinet. It is designed to minimize the amount of liquid which might spill onto internal electrical components. The drip pan is sloped to drain to the rear of the cabinet. The drip pan drain at the rear of the unit must be connected to the waste can or another safe container.

**Ventilation**

The CAV requires installation of the exhaust shroud on the rear panel of the unit. The shroud must be connected to a customer-supplied exhaust fan/ventilation system. The air flow rate and design of the exhaust fan must be suitable to handle the vapors from the customer supplied solvent and samples. If using multiple CAV Bath Units, exhaust shrouds may be coupled together using shroud adapters (P/N P61.3424, available from CANNON®). Otherwise, a 4" (10 cm) solvent-safe ventilation hose should be connected to the exhaust shroud on each Bath Unit.

To attach shrouds adaptors, remove the blank plate from the top or desired side of the vent shroud. Then attach the adapter in its place.
Checking bath temperature

After the CAV has been turned on, you may monitor bath temperature via the thermometer in the bath or via the front panel display (For the CAV-2100, a large font display is engaged when temperature is ±0.5 degrees of desired temperature). Temperature should rise until the bath has attained the desired test temperature. Make sure the temperature bath is set to control at the desired operating temperature. If the bath temperature needs to be adjusted, refer to the following section for details.

Setting bath temperature

To adjust the temperature of the CAV bath, turn on the power to the instrument and press the SET TEMP button on the control panel (see diagram). Then use the keypad to input the desired temperature to the nearest 0.01°. Press the ENTER key when done.

NOTE

To cancel temperature selection after the SET TEMP button has been pressed, just press the SET TEMP key again.

Service Unit operational settings

After the temperature in the bath is stable, check the CAV operational settings. If you are using the CAV Service Unit (CSU-200), verify the pressure/vacuum readings on the front panel dials. These gauges should ordinarily read as follows:

DIAL SETTING: ....... DESIRED VALUE

MAIN AIR ............... 40-50 psi (275~345 kPa)
NSLV ..................... 15-20 psi (100~140 kPa)
VACUUM .................. -8 inches of mercury (-8 in Hg)

Adjust the settings if necessary, using the control regulator knobs opposite the dials.

NOTE

Readjustment of the Service Unit regulators is seldom necessary unless the dial settings are outside the parameters outlined above.
Regulating pneumatic pressure
To regulate pressure to the pneumatics, including the sample vial elevation apparatus (LOAD) and tray advancement mechanism, use the control opposite the MAIN AIR dial indicator. Turn the control clockwise to increase pressure and/or counterclockwise to reduce it.

Regulating solvent flow
To regulate solvent flow, use the control opposite the MSOLV dial indicator on the CSU-200. Turn the control clockwise to increase pressure and/or counterclockwise to reduce it.

Regulating vacuum
To regulate vacuum to the capillary tubes, use the control opposite the VACUUM dial indicator. Turn the control clockwise to increase vacuum and/or counterclockwise to reduce it.

Adjusting pneumatic controls
Pneumatic controls are adjusted from the CAV drawer at the bottom of the Bath Unit. A key is required for access to service controls through the hinged front panel. These controls are normally set during installation and seldom require adjustment.

CAV service drawer controls
The NVIS regulator (NVIS gauge) regulates the compressed air/nitrogen supply used to dry the viscometer tubes. The pressure should be set between 20-30 psi. Pull the control knob out, then rotate the knob to adjust the pressure setting. When done, push the knob in to lock at the desired setting.

Pneumatics for both viscometer tubes have four corresponding controls (ADVANCE, AIR RETURN, LOAD and SHIFT) located on the inner service drawer panel of the CAV. These controls adjust the air pressure used to regulate the speed at which the mechanisms move. The following table provides an explanation of the function of each panel control:
The speed of these mechanisms should be set to allow them to function smoothly and efficiently without spilling or splashing the sample.

**Adjusting knob settings**

Turn the control knob clockwise to increase the speed of the mechanism. Turn the control knob counterclockwise to decrease the speed of the mechanism.

After adjustments are complete, close the hinged access panel.

**NOTE**

Closing the access panel will also lock it.

**Dual-solvent washing**

For testing heavy oils or hard-to-clean materials, CANNON® Instrument Company recommends a dual-solvent washing system. The dual-solvent washing process uses two different solvents. The first wash might ordinarily use a heavy solvent to clean the sample residue out of the viscometer tubes. The second wash might use a lighter solvent to clean the remaining sample and solvent residue from the viscometer tube. Consult the CAV Installation & Setup Guide for information on dual-solvent connections.

**Solvent wash by computer (Remote mode)**

Use the following procedure for computer-controlled solvent washing:

**Procedure**

1. If the desired tube is testing a sample, wait until the test is complete OR click the Abort button from the Sample Input window and select the tube/tray to abort from the Select Trays window. Then click OK.

2. Proceed with the solvent wash by clicking on Service/Wash Viscometer Tube from the VISCPRO® primary menu options and then selecting the proper tube (Tube 1 is on the left; Tube 2 is on the right) to be washed by clicking the corresponding tube tab in the Wash Viscometer Tube window.

3. After you have selected the desired tube, click on Begin Wash to initiate a solvent wash using current wash settings. During the wash cycle, the Begin Wash button will change to Abort Wash. If it is necessary to interrupt the wash cycle, click Abort Wash.
4. After the tube has been washed, click **Done** to close the **Wash Viscometer Tube** window.

**Solvent wash by operator [Local mode]**

Use the following procedure for Local mode control of solvent washing:

**Procedure**

1. If the desired tube is running, wait until the run is complete OR press the **Stop Left/Right** button on the control panel keypad to stop tube operations for the tube you wish to wash.

2. Make certain that the CAV is in Local mode (press the LOC/REM button on the Bath Unit front panel to toggle between modes). Then press the **Wash** button on the keypad. Then follow the display prompts to select the desired tube for washing. The CAV will complete a wash cycle using pre-set wash parameters.

**NOTE**  
*If the wash cycle does not provide adequate time to dry the tube, press the **Dry** button on the keypad and follow the screen prompts to initiate an additional drying cycle.*

**Setting wash parameters (Local mode)**

Wash parameters for the CAV can be set via computer or locally using the keypad options. For information on using the computer to select wash parameters, see Chapter 4. For Local mode control, follow the instructions below.

**Local mode wash options**

1. Press the **Menu** button on the keypad and select 2) **Wash parameters** button on the keypad.

**NOTE**  
*To cancel wash parameter selection before completing the procedure, press the **Menu** button a second time.*

2. Select the desired tube (right or left) by pressing the appropriate button on the keypad. The control panel display will indicate ten wash options, numbered 0-9:

<table>
<thead>
<tr>
<th>Wash Option #</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>A Wash B1</td>
<td>Determines the number of washes using Solvent A for each individual bulb of the tube (B1 is bulb one; bulbs are numbered from lowest to highest). Values from 0 to 18 are acceptable. (Bulb 3 settings must be &quot;0&quot; for Fast-Ran tubes)</td>
</tr>
<tr>
<td></td>
<td>A Wash B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Wash B3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sh. Fill</td>
<td>Determines the number of seconds during which pressurized solvent is injected into the viscometer tube for each solvent wash. Values from 1 to 30 are acceptable.</td>
</tr>
<tr>
<td>4</td>
<td>Sh. Soak</td>
<td>Determines the number of seconds that the solvent is allowed to remain in the tubes prior to initiation of the solvent flush. Values from 1 to 30 are acceptable.</td>
</tr>
<tr>
<td>5-7</td>
<td>B Wash B1</td>
<td>Determines the number of washes using Solvent B for each individual bulb of the tube (B1 is bulb one; bulbs are numbered from lowest to highest). Values from 0 to 18 are acceptable. (Bulb 3 settings must be &quot;0&quot; for Fast-Ran tubes)</td>
</tr>
<tr>
<td></td>
<td>B Wash B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B Wash B3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sh. Flash(s)</td>
<td>Determines the number of seconds that pressurized air will flush solvent into the waste receiver after each wash. Values from 1 to 60 are acceptable.</td>
</tr>
<tr>
<td>9</td>
<td>Final Air(s)</td>
<td>Determines the number of seconds that pressurized air will dry the tube following the last solvent flush cycle. Values from 15 to 255 are acceptable.</td>
</tr>
</tbody>
</table>
3. Select the desired option and input the appropriate value using the keypad. Press ENTER when you are done. The settings will be saved and used for the duration of the Local mode session.

**Wash configuration options (Remote mode)**

Wash cycle options may be preset using the Tray Settings: Wash... option from the Configure menu in VISCPRO®. The configuration options permit you to select wash settings for each viscometer tube and each bulb of the viscometer. You can then save the configuration settings for future use. The configuration parameters are downloaded to the CAV Bath Unit when the instrument is in Remote mode.

The Wash options include:

- number of solvent rinse cycles (dependent on test bulb)
- solvent fill time (in seconds)
- solvent soak time (in seconds)
- solvent flush time (in seconds)
- solvent dry time (in seconds)
- automatic calculation of wash rinse variables
- dual solvent wash option

The Tray Settings: Wash... settings also determine how instrument capabilities, such as the Dual Solvent wash, will be used. For more information on setting Wash options, see Chapter 4.

**Manually cleaning contaminated viscometer tubes**

A manual cleaning procedure may be performed using front panel keypad options in Local mode. During this service procedure, cleaning solvent is drawn up from a sample vial into the viscometer tube in the manner of a sample test. At the conclusion of the cleaning procedure, solvent is permitted to drain back into the vial.

**Procedure**

1. Place the instrument in Local mode, using the REM/LOC button. Then place an appropriate cleaning solvent solution in a glass vial in the sample tray and orient the tray so that the vial is directly beneath the viscometer tube.

2. Press the MENU key and select 6) Service.


4. Press and release the 1 key (Manual Fill). The vial of solvent will be raised into position.
5. Press and HOLD the 1 key down to initiate a vacuum that will draw cleaning solvent into the viscometer tube. Wait until the solvent has ascended to the desired level; then release the 1 key to permit the solvent to drain. You may continue to press and release the 1 key as necessary to draw cleaning solvent through the tube.

⚠️ **CAUTION**  
*Use appropriate solvents for manual cleaning. Take all safety precautions appropriate for the solvent used. Do not permit solvent to rise above the level of the third bulb (second bulb in Fast-Run tubes). Do not use alkaline solutions to clean CAV viscometer tubes.*

6. Press the 2 key (**Cup Down**) to lower the sample platform. Any remaining cleaning solvent should drain out of the tube.

7. Repeat steps 1-6 using 4 vials of distilled water in place of the cleaning solvent. Do NOT let the water soak in the viscometer tube.

⚠️ **CAUTION**  
*The distilled water may rise in the tube MUCH faster than the cleaning solvent. Do NOT let the water meniscus rise above the top bulb.*

8. If the tube is still dirty, repeat steps 1-7.

9. Repeat steps 1-6 substituting isopropyl alcohol in place of distilled water to dry the tube. After draining the isopropyl alcohol, remove the vial from the sample table.

10. Use the Local or Remote mode wash options (see previous sections) to remove all traces of cleaning solvent.

See the table on page 21 for additional information on using the Manual Tube Fill service keypad option (**MENU/Service/Manual Tube Fill**) and other service functions.

### Handling fault conditions

The CAV Bath Unit will display a fault condition when hardware or communication problems are experienced that are incompatible with continued bath operation.

In this event, power is automatically removed from the bath heaters and CAV testing is aborted. The Bath Unit generates a warning tone and **FAULT** is indicated on the display. Press ENTER to display a diagnostics screen with information about bath function.

To resume normal operation when possible, remove power from the instrument. Then turn the power back on to initiate the automatic start-up self-test sequence. Note any unusual indications during start-up.
Preventive maintenance

The CAV is a precision instrument, durably crafted for years of trouble-free operation. Because of the desirability of consistent viscosity measurements over time, preventive maintenance is limited primarily to cleaning and inspection procedures, rather than regular replacement of equipment items.

Following is a recommended PM schedule. You may copy the checklists and use them to track your PM actions. For detailed descriptions of listed procedures, consult related sections of this manual.

<table>
<thead>
<tr>
<th>Complete?</th>
<th>Daily maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check liquid level in the waste can. Empty if necessary, using appropriate precautions for your solvent/samples.</td>
</tr>
<tr>
<td></td>
<td>Clean the sample table and sample trays.</td>
</tr>
<tr>
<td></td>
<td>Run a calibration check standard or reference oil for each bulb to be used for the day’s testing. Calibrate if result variance warrants.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complete?</th>
<th>Frequent maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check the silicone bath fluid level in the temperature baths. Add fluid as needed per instructions.</td>
</tr>
<tr>
<td></td>
<td>Check and clean the vacuum trap bottles above the baths.</td>
</tr>
<tr>
<td></td>
<td>Check the CSU gauges during normal CAV operation. Adjust if necessary. The suggested settings are: <strong>AIR</strong> — 40-50 PSI (275-345 kPa); <strong>VACUUM</strong> — 8” Hg; <strong>NSLV</strong> — 15-20 PSI (100-140 kPa) Alternate settings may be recommended by the technician installing your unit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complete?</th>
<th>Quarterly maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check pneumatic functions (<strong>LOAD</strong>, <strong>ADVANCE</strong>, <strong>SHIFT</strong>) for correct operation. If necessary, adjust using service drawer controls.</td>
</tr>
<tr>
<td></td>
<td>Check operation of all indicator lamps. Replace as needed.</td>
</tr>
<tr>
<td></td>
<td>Check function of heated sample trays. Check condition of all cables.</td>
</tr>
<tr>
<td></td>
<td>Check function of drain heaters. Make sure that both the waste receiver and drain block heaters are working correctly.</td>
</tr>
</tbody>
</table>
### Biannual maintenance

<table>
<thead>
<tr>
<th>Complete?</th>
<th>Biannual maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inspect ceramic seal around thermistors in the viscometer tubes.</td>
</tr>
<tr>
<td></td>
<td>Ensure that the interface cables are clean and routed appropriately.</td>
</tr>
<tr>
<td></td>
<td>Check for silicone leaks in the top flanges of the constant temperature baths.</td>
</tr>
</tbody>
</table>

### Annual maintenance

<table>
<thead>
<tr>
<th>Complete?</th>
<th>Annual maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remove housing from the Solvent Dispensing System and check torque on the six 1/4-20 bolts around the pump circumference securing primary pump components. Torque if necessary to 70 in. lbs (7.9 Nm) max. Tighten together alternately and evenly, then retorque.</td>
</tr>
<tr>
<td></td>
<td>Replace vacuum pump diaphragm per manual instructions (see photo and procedure following).</td>
</tr>
</tbody>
</table>

**Vacuum pump with diaphragm (left) removed**

### Changing the vacuum pump diaphragm

**CAUTION** Do not run samples while performing this procedure.

**NOTE** It is not necessary to remove the vacuum pump from the CSU-200 Service Unit for the diaphragm replacement. The pump has been isolated from the CSU-200 to enhance clarity of photography.

The vacuum pump is located at the rear of the CSU-200.

1. Turn off the power switch for the CSU-200.
2. Remove the screws securing the top instrument housing to the frame, and lift the housing from the Service Unit. Set the housing aside.
3. On the vacuum pump, locate four symmetrical Allen-head screws on the top housing. Use a 5/32" Allen wrench to remove the four screws (see photo sequence following).

4. Remove the top housing of the vacuum pump (see photo).

5. Remove the screw from the center of the diaphragm (see photo).

6. Pull the old diaphragm off of the vacuum pump (see photo).

7. Place the new diaphragm into position. Line up the hole in the center of the diaphragm with the hole in the vacuum pump.

8. Replace the metal washer and screw in the middle of the diaphragm.

9. Replace the top housing, lining up the holes for the four symmetrical Allen-head screws.

10. Replace the top instrument housing of the CSU-200 and secure in place with the screws previously removed.

11. Restore power to the CSU-200 and verify operation of the vacuum pump.

**CAV repair/replacement kits**

*CANNON*® Instrument Company provides several repair/replacement kits, which are shipped with the CAV unit. These may be used for minor service/replacement of components in consultation with *CANNON*® Instrument Company. The following kits are available:

*Spare parts kit*

The Spare parts kit is a general purpose kit that may be used for replacement of tubing, fuses, temperature, lighting and valve components. It includes:

- (2) Fluid/Gas Solenoid Valve
- (1) Pneumatic Solenoid Valve
- (1) RTD Control Probe
- (1) Over-Temp Thermistor
- (1) Fluorescent Lamp
- (1) Assorted Fuses, 9 types
- (1) Assorted Tubing Kit

(CAV-2100: part #P61.3413; CAV-2200: part #P61.5172—one per bath)
**Assorted tubing kit**

The assorted tubing kit may be used for repairs to the air, vacuum, solvent or drain lines. When making repairs using these items, make certain to replace obsolete or worn components with matching components. Refer to your packing list for a description of kit components. Kit replacements may be purchased from CANNON® (part #P61.234).

**Swagelok® fittings kit**

The Swagelok® fittings kit may be used for replacing nuts/ferrules for heater probe, solvent and air line connections for the CAV unit. When replacing Swagelok® fittings, be certain to replace damaged components with matching replacements. Kit replacements may be purchased from CANNON® (part #P61.550).

**Clippard® fittings kit**

The Clippard® fittings kit contains replacement fittings for pneumatic connections. Kit replacements may be purchased from CANNON® (part #P61.551).

**Poly-Flo® fittings kit**

The Poly-Flo® fittings kit contains Poly-Flo® fittings for connection of air, vacuum and solvent connections to the solvent tank and the CAV unit. When replacing Poly-Flo® fittings, make certain to replace damaged components with matching replacements. Kit replacements may be purchased from CANNON® (part #P62.1510).

**O-ring kit**

The O-ring kit contains an assortment of O-rings used for viscometer seals. When replacing O-rings, make certain to replace damaged components with matching replacements. Kit replacements may be purchased from CANNON® (part #P62.1234).

**Tool kit**

The tool kit contains a variety of tools used to accomplish minor service and replacement procedures. Refer to your packing list for a description of kit components. Kit replacements may be purchased from CANNON® (part #P61.3392).
Data obtained from all instruments during sample testing is stored in the central VISCPro® database. To view data, you must create an analysis configuration requesting the desired sample information in the desired format. Analysis configurations can be saved and later restored. The analysis configuration options provide powerful tools for reporting sample information. Analyses may be displayed on the computer screen, printed, or output via the computer RS-232 port.

Creating an analysis

1. Click Analyses from the VISCPro® primary menu options.

2. Click View Analysis ... from the Analyses menu options. The Choose Analysis window will appear.

3. Highlight the desired analysis from the list of available analyses.

   ![Choose Analysis Window](image)

   **NOTE**
   Use the directory tree structure to browse the report options. Click on the or icons to reveal/hide analyses.

4. Click on the Define New Analysis radio button (or verify that the option is selected).

   **NOTE**
   If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.
5. Click **OK**. The analysis **Configuration** window will appear. The **Configuration** window consists of tabbed pages with filter options appropriate for the analysis.

6. Click on the tab corresponding to the filter you wish to set and complete the configuration options. For further information on selecting **Date**, **Sample** and other **Report** options, see the following sections of this chapter.

7. When you have completed the configuration, click **OK**. The program will prompt you to save the configuration.

8. Click **Yes** to save the configuration. The **Save Configuration** window will appear. Type the name of the new configuration in the **Save As**: field. Or double-click the name of a preexisting configuration in the **Existing Configurations** list box to replace the existing configuration with the new configuration settings.

9. Click **OK**. The analysis will be performed and displayed using the selected configuration settings.

**NOTES**

You may click **Cancel** from the **Save Configuration** window to exit without saving configuration changes.

You may display several analyses simultaneously by repeating the instructions above. Use the tiling options available from the **Window** menu to display multiple analyses in the desired window format (horizontal, vertical or cascade view options are available).

### Sorting analysis data

After you have displayed an analysis, you may sort alphanumerically by any of the table headings (the default sort for most reports is **Time Stamp**). To sort, simply click on the desired column heading. The table will be displayed with the new sort order.

**NOTE**

The **Sort** function is only available for an analysis when the Dynamic Update mode option is NOT selected. To restore sort functionality for an analysis, reconfigure the analysis by clicking **Configure Analysis** from the **Analyses** menu. Then access the **Date filter** options for the analysis and click the **Use Fixed Date and Time** radio button. Set the **Date/Time** parameters and click **OK** to create the new analysis.

### Using the date filter

Use the date filter to select date/time parameters for the analysis. To use the date filter, click the **Date Filter** tab from the analysis configuration window.
To define a Fixed Date and Time, click the corresponding radio button. Then use the spin controls and/or list box selection options to set the appropriate date/time parameters. All samples tested after the start date/time and before the end date/time, inclusive, will be included.

To automatically update the report with sample data as tests are completed, click the Use Dynamic Update radio button. Click the Do not show previous samples box if you do not wish to display samples run prior to the time the analysis is opened.

Use the spin controls to select the Sample Time Window (the desired range of recent samples to be included in the analysis). Data from samples tested within \([x]\) hours will be displayed in the analysis. Note that the analysis sorting options are disabled if you are using Dynamic Update.

**EXAMPLE**

If the Do not show previous samples box was unchecked and a Sample Time Window value of 5 hours was selected, the analysis (when opened) would display data for all samples tested within the last five hours.

**Using the sample filter**

Use the sample filter to limit the analysis to samples which have been tested on certain instruments and tubes, or which have certain Sample ID characteristics.

To filter samples by instrument, tube serial number (S/N) or Sample ID, click the Sample Filter tab from the analysis configuration window.
Some (not all) analyses offer an option to display data for samples which did not complete successfully. Click the **Display Unsuccessful Samples** box if you wish to use this data. Unsuccessful samples, which have no flow time, will be listed with a kinematic viscosity value of “0”.

Then select the desired instruments and tubes from their respective list boxes. To select a range of tubes/instruments, click on the first desired item and then hold down the **Shift** key while clicking on the last desired item in the sequence. To individually select tubes/instruments from the list boxes and add them to the analysis, hold down the **Ctrl** key while clicking on each desired tube/instrument.

To filter by Sample ID characteristics, place the pointer/cursor in the Sample ID field and type the desired sample IDs, or leave the field blank to include all sample IDs for the selected instruments/tubes. You may use wildcards (%,_) to select a range of samples. For example, S% would include data from all samples starting with S. %S% would include data from all samples containing S. The underscore (_) is a single-character wildcard.

You may use multiple IDs separated by a comma. For example, AV%,40C% would display all samples beginning with AV or 40C.

**NOTE**  
If no instruments/tubes/Sample IDs are selected, the analysis will display data for ALL instruments/tubes/Sample IDs.
Using the report/port output filter

Use the Report or Port Output filter to determine which data will be calculated and/or included in the analysis, and/or in what sequence that data will be displayed. Report/Port Output filter options will vary depending on the nature of the analysis. For more information on Report/Port Output filter options, please see the chapter on the specific analysis.

Reconfiguring a displayed analysis

An on-screen analysis may be reconfigured using the same filtering tools available when creating a new configuration. To access configuration options for a displayed analysis:

1. Select Analyses from the VISCPRO® primary menu options.
2. Select Configure Analysis from the Analyses options.
3. Select the desired analysis from the available analyses. The Sample Analysis Configuration window will appear.
4. Reconfigure the analysis as desired by clicking the tabs to access the Date, Sample and Report filtering options (see previous sections). When done, click OK.
5. You will be prompted to save the new analysis configuration. After you make your selection(s), the analysis will be performed and displayed using the new configuration settings.

Resizing table columns

To resize columns from a displayed analysis for easier viewing/printing, move your mouse pointer/cursor to the edge of the desired column heading. The mouse pointer will change to a bi-dimensional arrow.

Click and drag the edge of the heading to the new location and then release the mouse button. The entire column will be resized as you drag.

User column size settings will be maintained as long as the analysis window is open.

Saving a current analysis

To save a current analysis configuration:

1. Select Analyses from the VISCPRO® primary menu options.
2. Select Save Analysis from the Analyses menu options.
3. Select the desired analysis. The Save Configuration window will appear. Type the name of the new configuration in the Save As: field. Or double-click the name of a preexisting configuration in the Existing Configurations list box to replace the existing configuration with the new configuration settings.
4. Click OK.
**NOTE**
You may click Cancel from the Save Configuration window to exit without saving configuration changes.

### Deleting an analysis configuration

You can delete an existing analysis configuration from the Choose Analysis window by highlighting the desired configuration in the list box and clicking the **Delete** button or pressing the **Delete** key. The configuration will be immediately and permanently deleted.

### Printing an analysis

To print the complete analysis, select **Print** from the VISCPRO® **Main menu** while the analysis is being displayed. If multiple VISCPRO® windows are open, click the analysis window for the analysis you want to print to make it the active window **before** you select **Print**. Then choose print options from the Windows® **Print window** and click **OK** to print the analysis. (Consult your Windows® manual and printer/print driver documentation for more information on print settings).

It is also possible to select individual or multiple samples from an analysis for printing (see next section).

**NOTES**

The font size for printed analyses will be automatically adjusted to fit data columns to the selected printer paper size. If the font is too small, or if columns of data are missing or truncated, try using print options to set your printer to print in landscape instead of portrait orientation.

The **Print** option from **Main will not be accessible unless the analysis window is the active window.**

### Keystrokes for selecting data for printing

You can print data for a selected sample or samples from an on-screen analysis by highlighting the desired sample data and then using the **Print** option from the VISCPRO® **Main Menu**.

To select data for a single sample, click on the line of data associated with the sample on the screen display. To print a sequential range of samples, highlight the first sample in the range, then hold down the **Shift** key and click on the last sample in the range. To individually select test data from the on-screen list box for printing, hold down the **Ctrl** key while clicking on each desired entry.

When all desired data has been selected, click on **Print** from the **Main menu**. Make certain that the **Selection radio button** has been selected from the **Print range options**. Then click **OK** to print to the selected printer.
**Exporting analysis data**

The data export analyses included with the VISCPRO® software provide a convenient method for outputting sample data to laboratory collection systems or to an ASCII file.

There are three different data export analyses. For step-by-step instructions on exporting data from the VISCPRO® database, consult the manual chapter on the specific analysis:

- **Error Data Export**—Chapter 13 (export of error information)
- **Sample Data Export**—Chapter 11 (export of sample information)
- **VI Data Export**—Chapter 12 (export of sample/VI information)

Once the data has been exported, it can be manipulated using database/spreadsheet software packages such as Excel®, Access® or Quattro Pro®. These packages provide additional tools for configuration of report data for such functions as:

- Statistical Process Control
- Long-term Monitoring of Daily Check Standards
CHAPTER 7

CAV DATA TABLE

The CAV sample analysis is designed to permit convenient viewing of data collected from samples which have been tested using the Measure Sample Viscosity sample action option.

The sample analysis displays sample data in a tabular format. In addition to Sample identification (ID), the following data may be included:

- **INV**—Invalid test indication (flow time out of tolerance)
- **Tolerance**—Acceptable difference in multiple test results for the same sample
- **Date**—Date the sample was measured
- **Time**—Time the sample was measured
- **Tube S/N**—Tube serial number (from Instrument Settings)
- **Tray [Index]**—Position of the sample tray in the numeric sequence (left to right)
- **Sample Index**—Position of the sample in the sample tray
- **Bulb No.**—Bulb number (the bulb in which the sample was run—#1 is the bottom bulb)
- **Technician**—The technician logged on to VISCPRO at the test time
- **Instrument Type**—Instrument type (CAV, CCS, etc.)
- **Instrument ID**—Instrument Identification (from Instrument Settings)
- **KV**—Average kinematic viscosity (calculated from flow times)
- **Known KV**—Known kinematic viscosity of the viscosity standard
- **% Diff KV**—Percent difference between known and calculated KV
- **Temp[erature]**—Average bath temperature
- **T1-T4**—Bath temperature during each sample drop
- **% Diff**—For multi-drop samples: \(((\text{maximum drop time} - \text{minimum drop time}) / \text{average drop time}) \times 100\)
  EXAMPLE: Four drop times: 80.3, 80.4, 80.5, 80.5

  Maximum drop time = 80.5

  Minimum drop time = 80.3

  \(((80.5 - 80.3)/80.425) \times 100 = 0.2487\)

- **Abs. Diff**—For multi-drop samples: maximum drop time - minimum drop time
  EXAMPLE: Four drop times: 80.3, 80.4, 80.5, 80.5

  Maximum drop time = 80.5

  Minimum drop time = 80.3

  80.5 - 80.3 = 0.2
{1,10} Efflux%—For multi-drop samples: displays the first 10 sample efflux times
{1,20} Efflux%—For multi-drop samples: displays the first 20 sample efflux times
Avg Efflux%—The average efflux time for efflux values used for viscosity calculation
C, E—The calibration constants used for this determination
SUS—Saybolt Furol Seconds calculation
% KE—Percent contribution of the kinetic energy correction to the measured viscosity.
% Diff KV—Percent difference between the measured KV and the known KV for viscosity standards

Reporting options

The CAV Data Table analysis can present all or any of the above data for samples residing in the database. Several powerful filters may be used to create useful reports. These filters may be used by making selections from the tabbed property sheets found in the Sample Analysis Configuration window. Once the appropriate filters have been designated, the resulting report configuration can be saved for future use.

Configuring the CAV Data Table

For general information on using analyses, see Chapter 6. To access and configure the CAV Data Table, follow the procedure below:

1. Select Analyses from the VISCPRO® primary menu options.
2. Select View Analysis ... from the Analyses menu. The Choose Analysis window will appear.
3. Double-click Basic Package from the list of Available Analysis Packages.
4. Select CAV Data Table from the Basic Package report options.
5. Click on the Define and Open New Configuration radio button (or verify that the option is selected).

**NOTE**

*If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.*

6. Click OK. The Sample Analysis Configuration window will appear.

The Sample Analysis Configuration window consists of three tabbed pages:

- **Date Filter**—allows you to select date/time parameters for the analysis
- **Sample Filter**—allows you to select which tubes/technicians/tests will be included in the analysis.
- **Report**—allows you to select what sample data will appear in the CAV Data Table and how the data will be displayed

7. Click on the tab corresponding to the filter you wish to set and complete configuration options per the instructions below:

**Date/Sample filters**

Complete selection of Date/Sample filter options per the instructions in Chapter 6.
To select data for inclusion in the Analysis, click the Report tab. Then select which fields to include in the report by clicking the “Click here...” box and selecting the desired data from the drop-down list. After individual options have been selected, review the default settings for Precision, Format and Units [of measure]. You may change the default values by double-clicking the box with the default value. A drop-down menu will appear, providing other optional values. Select the desired replacement value by clicking on it (or type an acceptable value and then press the [Enter] key).

Selecting Report data filter options

Modifying data presentation
To delete an item from the report, right-click the column name for the data and then select the Delete option from the popup menu. To insert an item into the report in a particular position, right-click the column name at the desired position and select the Insert New option. Then click on the desired item to insert it in the report at the selected position.

8. When you have completed the configuration, click OK. The program will prompt you to save the configuration.
9. Click Yes to save the configuration. The Save Configuration window will appear.

![Save Configuration Window]

The Save Configuration window

10. Type the name of the new configuration in the Save As: field. Or double-click the name of a preexisting configuration in the Existing Configurations list box to replace the existing configuration with the new configuration settings.

11. Click OK. The analysis will be performed and displayed using the selected configuration settings.

**NOTES**

You may click Cancel from the Save Configuration window to exit without saving configuration changes.

You may display several analyses simultaneously by repeating the instructions above. Use the tiling options available from the Window menu to display multiple analyses in the desired window format (horizontal, vertical or cascade view options are available).
STANDARD VI TABLE ANALYSIS

The Viscosity Index (VI) matching sample analysis displays VI data from samples which have been tested using the Measure Sample Viscosity sample action option and matched according to user-defined criteria. The VI analysis displays sample data in a tabular format. In addition to Sample identification (ID), the following data may be included:

- **VI**—VI value (always included—precision is determined using the VI Report tab)
- **INV**—Invalid test indication (always included—flow time(s) are out of tolerance and samples will need to be tested again)
- **Avg KV**—Average kinematic viscosity as calculated at the test temperatures
- **KV40C/KV100C** and/or **KV100F/KV210F**—Average kinematic viscosity calculated for bath temperatures of 40°C and 100°C and/or 100°F and 210°F
- **Temp1/Temp2**—Actual average bath temperatures
- **Time**—Time the sample was measured
- **Date**—Date the sample was measured
- **Tube S/N**—Tube serial number (from Instrument Settings)
- **Technician**—Technician name (the individual logged in at the time the sample run was completed)

**Reporting options**

The VI analysis presents data for samples residing in the database. Several powerful filters may be used to create useful reports. These filters may be used by making selections from the tabbed property sheets found in the VI Configuration window. Once the appropriate filters have been designated, the resulting report configuration can be saved for future use.

**Configuring the standard VI table**

For general information on using analyses, see Chapter 6. To access and configure the Standard VI Table, follow the procedure below:

1. Select Analyses from the VISCPRO® primary menu options.
2. Select View Analysis ... from the Analyses menu. The Choose Analysis window (see figure, next page) will appear.
3. Double-click VI Package from the list of Available Analysis Packages.
4. Select **Standard VI Table** from the **VI Package** report options.

5. Click on the **Define and Open New Configuration** radio button (or verify that the option is selected).

**NOTE**

If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click **OK**, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.

6. Click **OK**. The **VI Configuration** window will appear.

The **VI Configuration** window consists of three tabbed pages:

- **Date Filter**—allows you to select date/time parameters for the analysis
- **Sample Filter**—allows you to select which tubes/technicians/tests will be included in the analysis.
- **VI Report**—allows you to select what sample data will appear in the **VI Report** and how the data will be displayed

7. Click on the tab corresponding to the filter you wish to set and complete configuration options per the following instructions:

*Date/Sample filters*

Complete selection of Date/Sample filter options per the instructions in Chapter 6.
**NOTE**

The VI Matcher does not match invalid samples UNLESS the Allow Matching ... box from the Sample Filter tab options is checked. The VI Matcher never matches unsuccessful samples (samples with no flow time and a displayed kinematic viscosity of “0”). If one of the samples ran successfully at one temperature but not at the other, the good sample can still be used for VI matching if the failed sample is rerun within 8 hours.

**VI Analysis filter**

To adjust other VI analysis options, click the VI Report tab.

```
<table>
<thead>
<tr>
<th>VI Report data filter options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Select and configure the data to appear for each VI match.</td>
</tr>
<tr>
<td>Viscosity Index Precision:</td>
</tr>
<tr>
<td>Kinematic Viscosity Precision:</td>
</tr>
<tr>
<td>Kinematic Viscosity Units:</td>
</tr>
<tr>
<td>Display KV at 40°C and 100°C</td>
</tr>
<tr>
<td>Display SUS at 100°F and 210°F</td>
</tr>
<tr>
<td>Actual average KV for each sample</td>
</tr>
<tr>
<td>Tube S/N for each sample</td>
</tr>
<tr>
<td>Temperature for each sample</td>
</tr>
<tr>
<td>Temperature will be displayed in units of:</td>
</tr>
<tr>
<td>OK</td>
</tr>
<tr>
<td>Cancel</td>
</tr>
<tr>
<td>Help</td>
</tr>
</tbody>
</table>
```

Then use the check boxes to select which fields to include in the report. After individual options have been selected, use the related spin controls and radio buttons to determine the appearance of data for kinematic viscosity, temperature and drop times.

8. When you have completed the configuration, click OK. The program will prompt you to save the configuration.
9. Click **Yes** to save the configuration. The **Save Configuration** window will appear. Type the name of the new configuration in the **Save As** field. Or double-click the name of a preexisting configuration in the **Existing Configurations** list box to replace the existing configuration with the new configuration settings.

10. Click **OK**. The analysis will be performed and displayed using the selected configuration settings.

**NOTES**

You may click **Cancel** from the **Save Configuration** window to exit without saving configuration changes.

You may display several analyses simultaneously by repeating the instructions above. Use the tiling options available from the **Window** menu to display multiple analyses in the desired window format (horizontal, vertical or cascade view options are available).
CHAPTER 9
SAMPLE DATA EXPORT ANALYSIS

The VISCPRO® Sample Data Export analysis provides a convenient operator interface for configuring sample information from the sample database for serial output and exporting it in ASCII text format. The port output filters (Date, Sample and Port Output Format) permit the user to select and output desired data to a file, LPT port or serial port in whatever format is desired.

**NOTE**

*Once the analysis has been exported, it cannot be reconfigured like other VISCPRO® analyses. This prevents duplicate data from being resent to network collection systems your lab may have in place. To resend data, close the analysis window (you may save the configured analysis if you desire) and then recreate the analysis.*

**Available data for analysis**

In addition to exporting the selected data, the analysis displays it on the computer screen in a tabular format. The analysis may include:

- Smpl ID—Sample ID
- Instr ID—Instrument ID (from general configuration settings)
- Instr Type—Instrument Type (from general configuration settings)
- Technician—Technician name (the individual logged in at the time the sample run was completed)
- Avg KV—Average measured kinematic viscosity (KV) expressed in mm²/s
- Known KV—Known kinematic viscosity of check standards (from standard bottle)
- Temp °C—Average bath temperature
- Temp °F—Average bath temperature
- Date—Date when the test was completed
- Time—Time when the test was completed
- Tube—Tube serial number (S/N)
- Bulb—Bulb number (the bulb in which the sample was run—#1 is the bottom bulb)
- SUS—Kinematic viscosity expressed in Saybolt Universal Seconds
- Flowtime 1—Flow time of the first sample drop (T1)
- Flowtime 2—Flow time of the second sample drop (T2)
- %Diff Flow—% difference in flow times (between drops)
- Formatting Options (Space, Carriage Return, Line Feed) and ASCII Codes—Permits additional user-controlled data formatting
Configuring the Sample Data Export analysis

1. Select Analyses from the VISCPRO® menu options.
2. Select View Analysis from the Analyses menu options
3. Double-click Data Export Package from the list of available analysis types.
4. Select the Sample Data Export analysis option.
5. Click the Define and Open New Configuration radio button to define a new analysis configuration.

**NOTE**
If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.

6. Click OK. The ASCII Ports Output Configuration window will appear.

The ASCII Ports Output Configuration window consists of three tabbed pages:

- **Date Filter**—allows you to select date/time parameters for the analysis.
- **Sample Filter**—allows you to select which tubes/technicians/tests will be included in the analysis.
- **Port Output Format**—allows you to select the output port(s), what sample data will appear in the output analyses, and how the data will be displayed/sent.

7. Click on the tab corresponding to the filter you wish to set and complete configuration options per the following instructions:

**Date/Sample filters**

a. Complete selection of Date and Sample filter options per the instructions in Chapter 6.

**Port Output Format filter**

b. To select other analysis configuration options, click the Port Output Format tab.

**Adding ports**

c. Click Add Port from the Port Output Format button options to open the Select Port window. Select the desired serial port(s) and/or files for output and verify the configuration settings for each. Then Click OK. Added ports will be displayed in the port list box.
The Port Output Format window

**NOTE**

If you select NEW FILE for output, click the ... button to open the Windows Save As: box. Select the desired directory and type the desired file name in the File Name: text box. If you select an existing file, ASCII port analysis data will be appended to the file.

Make certain that you have selected the desired port for configuration by clicking on the port name in the Add Port list box prior to selecting output data and formatting options for that port. OUTPUT FOR EACH ADDED PORT MUST BE CONFIGURED SEPARATELY (see note below).

**Configuring output**

d. Select the desired port/file for configuration by clicking the name of the port/file in the port list box. Then click the radio button corresponding to the desired locale format (U.S. or local). Your choice will determine the formatting of numeric data, dates and choice of decimals or commas as placeholders.

**Delaying serial output**

e. You may delay data transmission of serial output for a time parameter you specify by clicking the Delay button to insert the delay code into the Configure list box, Header or Footer. The Delay Configuration window will appear. To set the time of the Delay, type a numeric value in the appropriate field, and click on one of the radio buttons to select the correct unit of time. Then click OK.

**Selecting output data**

f. Click the buttons corresponding to the data types you wish to output on the report. As you do so, the appropriate coding for the output analysis will be inserted in the text box.
NOTE
For some data output options, you will need to select the desired output field length using the spin controls provided in the Format Data Output window. Experienced users may type code directly into the text box by placing the cursor at the appropriate point. The text box information may also be manipulated using the mouse click-and-drag technique to highlight data and then using standard Windows® cut (Ctrl-X), copy (Ctrl-C), and paste (Ctrl-V) keyboard combinations. In this way, formatting data can easily be copied from one port configuration to another.

Adding a header

If you would like to include a header at the beginning of the analysis, click the Header button and add the desired text string via the keyboard. Format the entry as desired using the Carriage Return (CR) and Line Feed (LF) options as necessary to indicate line breaks. Then click OK.

Adding a footer

If you would like to include a footer at the end of the analysis, click the Footer button and add the desired text string via the keyboard. Format the entry as desired using the Space, Carriage Return (CR) and Line Feed (LF) options. Then click OK.

NOTE
If you have selected the Dynamic Update option using the Date tab options, the footer will not be sent until the analysis window is closed.

8. When you have completed the configuration, click OK. Serial data will be routed to the appropriate ports/files and you will be prompted to save the configuration.

9. If you do not wish to save the configuration, click No. The analysis will be displayed and the data will be sent to the selected ports. If you wish to save the configuration, click Yes. The Save Configuration window will appear. Type the name of the new configuration in the Save As: field. Or double-click the name of a preexisting configuration in the Existing Configurations list box to replace the existing configuration with the new configuration settings. Then click OK. The saved analysis will be displayed using the selected configuration settings, and the data will be sent to the selected ports.

NOTES
You may click Cancel from the Save Configuration window to exit without saving configuration changes.
The Port Output Analysis cannot be reconfigured. This avoids duplication of output data for collection devices your facility may have in place. You may still view configuration options for a displayed analysis by selecting Configure Analysis from the Analyses menu and choosing the correct analysis.

**Re-sending export data**

To re-send Port Output Analysis data for a displayed analysis, first save the analysis by clicking Analyses/Save Configuration, selecting the desired analysis, typing the analysis name in the Save As: list box and clicking OK. Then close the Port Output Analysis window and re-select Port Output Analysis by clicking Analyses/View Analysis from the primary menu options. Then click on the desired configuration from the list of saved configurations and click OK.

**Exporting specific sample data**

To re-send data from specific samples, use Sample Filter options, including wildcard characters if desired, to reconfigure the analysis to send only the necessary data.

**Port selection**

Make certain that you have selected the desired port for configuration by clicking on the port name in the Add Port list box prior to selecting output data and formatting options for that port. OUTPUT FOR EACH ADDED PORT MUST BE CONFIGURED SEPARATELY.
CHAPTER 10

VI DATA EXPORT ANALYSIS

The VISCPRO® VI Data Export Analysis provides a convenient operator interface for configuring Viscosity Index (VI) sample information from the sample database for serial output and exporting it in ASCII text format. The port output filters (Date, Sample and Port Output Format) permit the user to select and output desired data to a file, LPT port or serial port in whatever format is desired.

NOTE

Once the port output analysis has been generated, it cannot be reconfigured like other VISCPRO® analyses. This prevents duplicate data from being resent to network collection systems your lab may have in place. To re-send data to the serial port, close the analysis window (you may save the configured analysis if you desire) and then recreate the analysis.

Available data for analysis

In addition to the serial transmission, the analysis displays requested sample data on the computer screen in a tabular format and may include the following data:

- Smpl ID—Sample ID for sample pair
- VI—Viscosity Index for sample pair
- KV40C—Kinematic viscosity at 40°C for low-temperature sample
- KV100C—Kinematic viscosity at 100°C for high-temperature sample
- KV100F—Kinematic viscosity at 100°F for low-temperature sample
- KV210F—Kinematic viscosity at 210°F for high-temperature sample
- Avg KV 1/Avg KV 2—Average measured kinematic viscosity (KV) for the low/high temperature sample
- Date 1/Date 2—Date when the test was completed for the low/high temperature sample
- Time 1/Time 2—Time when the test was completed for the low/high temperature sample
- Tube 1/Tube 2—Tube serial number (S/N) for the low/high temperature sample
- Bulb 1/Bulb 2—Bulb number (the bulb in which the sample was run—#1 is the bottom bulb) for the low/high temperature sample
- SUS 100F/SUS 210F—Kinematic viscosity expressed in Saybolt Universal Seconds (SUS) for the low/high temperature sample
- TempC 1/TempC 2—Bath temperature
- TempF 1/TempF 2—Bath temperature
- Instr 1/Instr 2—Instrument ID (from general configuration settings) for the low/high temperature sample
- InstrType 1/InstrType 2—Instrument Type (from general configuration settings) for the low/high temperature sample
- Tech 1/Tech 2—Technician name (the individual logged in at the time the sample run was completed) for the low/high temperature sample
- ASCII Codes—Permits addition of user-selected ASCII codes to analysis
- Space—Inserts a blank space (formatting option)
- CR—Inserts a carriage return code (formatting option)
- LF—Inserts a line feed code (formatting option)
- Next/Previous—Displays more button options

Configuring the VI Data Export Analysis

1. Select Analyses from the VISCPRO® menu options.
2. Select View Analysis from the Analyses menu options
3. Double-click Data Export Package from the list of available analysis types.
4. Select the VI Data Export Analysis option.
5. Click the Define and Open New Configuration radio button to define a new analysis configuration.

**NOTE**

If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.

6. Click OK. The Port Output Configuration window will appear.

The Port Output Configuration window consists of three tabbed pages:

```
Date Filter | Sample Filter | Port Output Format
```

- **Date Filter**—allows you to select date/time parameters for the analysis.
- **Sample Filter**—allows you to select which tubes/technicians/tests will be included in the analysis.
- **Port Output Format**—allows you to select the output port(s), what sample data will appear in the output analyses, and how the data will be displayed/sent.

7. Click on the tab corresponding to the filter you wish to set and complete configuration options per the following instructions:

**Date/Sample filters**

a. Complete selection of Date and Sample filter options per the instructions in Chapter 6.

**Port Output Format filter**

b. To adjust other analysis configuration options, click the Port Output Format tab:
Adding ports
c. Click Add Port from the Port Output Format button options to open the Select Port window. Select the desired serial port(s) and/or files for output and verify the configuration settings for each. Then Click OK. Added ports will be displayed in the port list box.

NOTE
If you select NEW FILE for output, click the button to open the Windows Save As: box. Select the desired directory and type the desired file name in the File Name: text box. If you select an existing file, ASCII port analysis data will be appended to the file.

Make certain that you have selected the desired port for configuration by clicking on the port name in the Add Port list box prior to selecting output data and formatting options for that port. OUTPUT FOR EACH ADDED PORT MUST BE CONFIGURED SEPARATELY (see following note).

Configuring output
d. Select the desired port/file for configuration by clicking the name of the port/file in the port list box. Then click the radio button corresponding to the desired locale format (U.S. or local). Your choice will determine the formatting of numeric data and dates.
**Delaying serial output**

- You may delay data transmission of serial output for a time parameter you specify by clicking the **Delay** button to insert the delay code into the **Configuration** list box, Header or Footer. The **Delay Configuration** window will appear. To set the time of the Delay, type a numeric value in the appropriate field, and click on one of the radio buttons to select the correct unit of time. Then click OK.

**Selecting output data**

- Click the buttons corresponding to the data types you wish to output on the report. As you do so, the appropriate coding for the output analysis will be inserted in the text box.

**NOTE**

*For some data output options, you will need to select the desired output field length using the spin controls provided in the Format Data Output window. Experienced users may type code directly into the text box by placing the cursor at the appropriate point. The text box information may also be manipulated using the mouse click-and-drag technique to highlight data and then using standard Windows® cut (Ctrl-X), copy (Ctrl-C), and paste (Ctrl-V) keyboard combinations. In this way, formatting data can easily be copied from one port configuration to another.*

**Adding a header**

- If you would like to include a header at the beginning of the analysis, click the **Header** button and add the desired text string via the keyboard. Format the entry as desired using the Carriage Return (CR) and Line Feed (LF) options as necessary to indicate line breaks. Then click OK.

**Adding a footer**

- If you would like to include a footer at the end of the analysis, click the **Footer** button and add the desired text string via the keyboard. Format the entry as desired using the Carriage Return (CR) and Line Feed (LF) options. Then click OK.

**NOTE**

*If you have selected the Dynamic Update option using the Date tab options, you will not be able to enter Footer information for the analysis.*

8. When you have completed the configuration, click OK. Serial data will be routed to the appropriate ports/files and you will be prompted to save the configuration.
9. If you do not wish to save the configuration, click No. The analysis will be displayed and the data will be sent to the selected ports. If you wish to save the configuration, click Yes. The Save Configuration window will appear. Type the name of the new configuration in the Save As: field. Or double-click the name of a preexisting configuration in the Existing Configurations list box to replace the existing configuration with the new configuration settings. Then click OK. The saved analysis will be displayed using the selected configuration settings, and the data will be sent to the selected ports.

NOTES

You may click Cancel from the Save Configuration window to exit without saving configuration changes.

The Port Output Analysis cannot be reconfigured. This avoids duplication of output data for data collection devices your facility may have in place. You may still view configuration options for a displayed analysis by selecting Configure Analysis from the Analyses menu and choosing the correct analysis.

Re-sending export data

To re-send Port Output Analysis data for a displayed analysis, first save the analysis by clicking Analyses/Save Configuration, selecting the desired analysis, typing the analysis name in the Save As: list box and clicking OK. Then close the Port Output Analysis window and re-select Port Output Analysis by clicking Analyses/View Analysis from the primary menu options. Then click on the desired configuration from the list of saved configurations and click OK.

Exporting specific sample data

To re-send data from specific samples, use Sample Filter options, including wildcard characters if desired, to reconfigure the analysis to send only the necessary data.

Port selection

Make certain that you have selected the desired port for configuration by clicking on the port name in the Add Port list box prior to selecting output data and formatting options for that port. OUTPUT FOR EACH ADDED PORT MUST BE CONFIGURED SEPARATELY.
CHAPTER 11

ERROR DATA EXPORT ANALYSIS

The VISCPRO® Error Data Export analysis compiles error information from the sample database for serial output and exports it in ASCII text format. The port output filters (Date, Error and Error Report) permit the user to select and output desired data to a file, LPT port or serial port in whatever format is desired.

**NOTE**

Once the port output analysis has been generated, it cannot be reconfigured like other VISCPRO® analyses. This prevents duplicate data from being resent to network collection systems your lab may have in place. To re-send data to the serial port, close the analysis window (you may save the configured analysis if you desire) and then recreate the analysis.

Available data for analysis

In addition to the serial transmission, the analysis is displayed on the computer screen in a tabular format and may include the following data:

- Error—Error description
- Date—Date when the test was completed
- Time—Time when the test was completed
- Error Source—Source for the error message (instrument or other)
- Instr ID—Identification of the instrument associated with the error (if applicable)
- Sample ID—Identification of the sample associated with the error (if applicable)
- Bulb No.—Bulb number associated with the error
- Tray Index—Position of the sample tray associated with the error (trays are numbered sequentially from left to right)
- Sample Index—Position of the sample associated with the error (samples are numbered sequentially beginning at the rear of the tray)
- Technician—The name of the technician who was logged on at the time the error occurred (if applicable)
- Formatting Options (Space, Carriage Return, Line Feed) and ASCII Codes—Permits additional user-controlled data formatting

Configuring the Error Data Export analysis

1. Select Analyses from the VISCPRO® menu options.
2. Select View Analysis from the Analyses menu options
3. Double-click Data Export Package from the list of available analysis types.
4. Select the Error Data Export analysis option.
5. Click the Define and Open New Configuration radio button to define a new analysis configuration.

**NOTE**

If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.

6. Click OK. The Port Output Configuration window will appear.

   The Port Output Configuration window consists of three tabbed pages:

   ![Tabbed Pages](image)

   - **Date Filter**—allows you to select date/time parameters for the analysis (see Chapter 6 for more information)
   - **Error Page**—allows you to filter errors by source and by technician.
   - **Port Output Format**—allows you to select the output port(s), what sample data will appear in the output analyses, and how the data will be displayed/sent.

7. Click on the tab corresponding to the filter you wish to set and complete configuration options per the following instructions:

   **Date filter**
   
   a. Use the **Date Filter** to select the appropriate date/time parameters for the analysis. See Chapter 6 for more information on using the Date Filter.

   **Error Page filter**
   
   b. Use the **Error Page** tab to limit the analysis to errors which have been associated with certain instruments or analyses, or which are associated with certain technician names.

   To filter errors by source or technician name, click the **Error Page** tab from the analysis configuration window (see Figure, next page).

   Then select the desired error sources/technicians from their respective list boxes. To select a range of sources/technicians, click on the first desired item and then hold down the **Shift** key while clicking on the last desired item in the sequence. To individually select sources/technicians from the list boxes and add them to the analysis, hold down the **Ctrl** key while clicking on each desired tube/instrument.
The Error Page tab

You may also type filter information directly into the Selected . . . list boxes. Position the cursor in the desired field and use the keyboard to input entries. You may use wildcards (%,_ ) to select a range of samples. For example, S% would include data from all samples starting with S. %S% would include data from all samples containing S. The underscore (_) is a single-character wildcard.

You may use multiple IDs separated by a comma. For example, AV%,40C% would display all samples beginning with AV or 40C.

NOTE

If no error sources/technicians are selected, the analysis will display data for ALL error sources/technicians.

Port Output Format filter

c. To adjust other analysis configuration options, click the Port Output Format tab (see Figure, next page):

Adding ports

Click Add Port from the Port Output Format button options to open the Select Port window. Select the desired serial port(s) and/or files for output and verify the configuration settings for each. Then Click OK. Added ports will be displayed in the port list box.

Configuring output

d. Select the desired port/file for configuration by clicking the name of the port/file in the port list box. Then click the radio button.
corresponding to the desired locale format (U.S. or local). Your choice will determine the formatting of numeric data and dates.

**Error Ports Ouput Configuration options**

**Delaying serial output**

e. You may delay data transmission of serial output for a time parameter you specify by clicking the **Delay** button to insert the delay code into the **Configuration** list box, Header or Footer. The **Delay Configuration** window will appear. To set the time of the Delay, type a numeric value in the appropriate field, and click on one of the radio buttons to select the correct unit of time. Then click **OK**.

**Selecting output data**

f. Click the buttons corresponding to the data types you wish to output on the report. As you do so, the appropriate coding for the output analysis will be inserted in the text box.

**NOTE**

For some data output options, you will need to select the desired output field length using the spin controls provided in the **Format Data Output** window. Experienced users may type code directly into the text box by placing the cursor at the appropriate point. The text box information may also be manipulated using the mouse click-and-drag technique to highlight data and then using standard Windows cut (Ctrl-X), copy (Ctrl-C), and paste (Ctrl-V) keyboard combinations. In this way, formatting data can easily be copied from one port configuration to another.
Adding a header
g. If you would like to include a header at the beginning of the analysis, click the **Header** button and add the desired text string via the keyboard. Format the entry as desired using the Carriage Return (CR) and Line Feed (LF) options as necessary to indicate line breaks. Then click **OK**.

Adding a footer
h. If you would like to include a footer at the end of the analysis, click the **Footer** button and add the desired text string via the keyboard. Format the entry as desired using the Carriage Return (CR) and Line Feed (LF) options. Then click **OK**.

**NOTE**

*If you have selected the Dynamic Update option using the Date tab options, you will not be able to enter Footer information for the analysis.*

8. When you have completed the configuration, click **OK**. Serial data will be routed to the appropriate ports/files and you will be prompted to save the configuration.

9. If you do not wish to save the configuration, click **No**. The analysis will be displayed and the data will be sent to the selected ports. If you wish to save the configuration, click **Yes**. The **Save Configuration** window will appear. Type the name of the new configuration in the **Save As:** field. Or double-click the name of a preexisting configuration in the **Existing Configurations** list box to replace the existing configuration with the new configuration settings. Then click **OK**. The saved analysis will be displayed using the selected configuration settings, and the data will be sent to the selected ports.

**NOTES**

*You may click Cancel from the Save Configuration window to exit without saving configuration changes.*

*The Port Output Analysis cannot be reconfigured. This avoids duplication of output data for collection devices your facility may have in place. You may still view configuration options for a displayed analysis by selecting Configure Analysis from the Analyses menu and choosing the correct analysis.*
Re-sending export data  To re-send Port Output Analysis data for a displayed analysis, first save the analysis by clicking Analyses/Save Configuration, selecting the desired analysis, typing the analysis name in the Save As: list box and clicking OK. Then close the Port Output Analysis window and re-select Port Output Analysis by clicking Analyses/View Analysis from the primary menu options. Then click on the desired configuration from the list of saved configurations and click OK.

Exporting specific sample data  To re-send data from specific samples, use Sample Filter options, including wildcard characters if desired, to reconfigure the analysis to send only the necessary data.

If you select NEW FILE for output, click the button to open the Windows Save As: box. Select the desired directory and type the desired file name in the File Name: text box. If you select an existing file, ASCII port analysis data will be appended to the file.

Make certain that you have selected the desired port for configuration by clicking on the port name in the Add Port list box prior to selecting output data and formatting options for that port. OUTPUT FOR EACH ADDED PORT MUST BE CONFIGURED SEPARATELY.
CHAPTER 12

ERROR LOG TABLE ANALYSIS

The Error Log Table is designed as a troubleshooting tool to display error messages generated by the software during automatic processing of sample data.

The Error Log Table displays data in a tabular format. In addition to an error description, the following data may be included:

- Time at which the error occurred
- Severity of error
- Instrument source (if applicable)
- Source identification (ID) (if applicable)
- Tray associated with the error (if applicable)
- Sample placement in the tray (if applicable)

**Reporting options**

The Error Log analysis can present data for any errors encountered during sample runs for which data resides in the database. Several powerful filters may be used to create useful Error Log reports. These filters may be used by making selections from the tabbed property sheets found in the Error Log Configuration window. Once the appropriate filters have been designated, the resulting report configuration can be saved for future use.

**Configuring the Error Log analysis**

For general information on using analyses, see Chapter 6. To access and configure the Error Log Table, follow the procedure below:

1. Select **Analyses** from the VISCPRO® primary menu options.
2. Select **View Analysis ...** from the Analyses menu. The Choose Analysis window will appear.
3. Select the **Error Log Table** from the list of analyses included in the Basic Package.
Choosing the Error Log analysis

4. Click on the Define and Open New Configuration radio button (or verify that the option is selected).

   **NOTE**

   If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining steps in this procedure.

5. Click OK. The Error Log Configuration window will appear.

   The Error Log Configuration window consists of tabbed pages with filter options.

   - **Date Filter**—allows you to select date/time parameters for the analysis
   - **Sample Filter**—allows you to select which tubes/technicians/tests will be included in the analysis.
   - **Error Filter**—allows you to select what sample data will appear in the Error Log Table and how the data will be displayed

6. Click on the tab corresponding to the filter you wish to set and complete configuration options. Use the check boxes to select which fields to include in the report. After individual options have been selected, use the related spin controls and radio buttons to determine the appearance of data.

7. When you have completed the configuration, click OK. The program will prompt you to save the configuration.
8. Click **Yes** to save the configuration. The **Save Configuration** window will appear.

The **Save Configuration** window

9. Type the name of the new configuration in the **Save As:** field. Or double-click the name of a preexisting configuration in the **Existing Configurations** list box to replace the existing configuration with the new configuration settings.

10. Click **OK**. The analysis will be performed and displayed using the selected configuration settings.

**NOTES**

You may click **Cancel** from the **Save Configuration** window to exit without saving configuration changes.

You may display several analyses simultaneously by repeating the instructions above. Use the tiling options available from the **Window** menu to display multiple analyses in the desired window format (horizontal, vertical or cascade view options are available).
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The Database Manager is a separate software program which is automatically installed in the same directory as your VISCPRO® software. The Database Manager provides options for managing the VISCPRO® database, including functions for:

- archiving old data
- importing archived data to the working database
- changing the database directory
- repairing/compacting the database

The Database Manager interface
Starting the program

To start the Database Manager software:

1. Exit the VISCPRO® application. Then click on the Windows® Start bar.
2. Select Programs/VISCPRO 2.0/VISCPRO Database Manager from the list of options.

Archiving old data

When to archive

Data from the VISCPRO® database should be regularly archived in order to maintain the size and utility of the database file and to provide an additional level of security for your test data. The archive program allows you to back up existing data and/or remove it from the working database.

One recommended archive strategy would be to archive data older than 60 days at the end of each month, removing it from the working database. This will result in a working database of manageable size and a series of archive files, each containing a month of data. If necessary, archive materials could be temporarily imported into the working database for historical reporting.

Archive procedure

1. Select Archive Old Data from the button options. A Windows® Save As … window will appear.
2. Use the Windows® controls to select the drive and directory (folder) you wish to use for the archive file.
3. Enter the name of the archive file into the File name text box.
4. Use the spin controls to select the desired date. Data from sample runs completed prior to that date will be copied to the archive file.

NOTE

If you would like to remove archive data from the working database, click the Remove Archived Data check box.

5. Click Save to copy archive information to the selected archive file. Or click Cancel to exit the Save As archive window without saving data to the archive file.

Changing the database directory

Changing the database location can facilitate its use by multiple networked computers. As the database grows, it may be desirable to relocate it to a different directory or hard drive. The Change Database Directory option does not physically transfer the database files from one location to another. Rather, it allows the user to select the location for the working database. The database must first be archived (see previous page) or copied to the desired location BEFORE using Change Database Directory.
**Change . . . procedure**

1. Select **Change Database Directory** from the button options. A **Browse . . .** window will permit you to select the correct location for the database (SAMPLES.mdb) file.

**NOTE**

*The current database directory is indicated at the top of the window.*

2. Select the correct drive and use the Windows® controls to select the directory (folder) you wish to identify as the database location.

3. Click on **OK** to confirm database directory selection. Or click **Cancel** to close the window without selecting a directory.

**NOTES**

*You may only select a directory which contains a valid working database (SAMPLES.mdb) file.*

*Click Network to access network map options. See your Windows® documentation for additional information.*

**Importing archived data**

1. Select **Import Archived Data** from the button options. An import window will appear.

2. Use the Windows® controls to select the directory (folder) of the archive file to be restored to the working database.

3. Enter the name of the archive file into the **File name** text box.

4. Click **Open** to copy information from the selected file to the working database. Or click **Cancel** to exit the import window without importing archive data.

**Repairing/compacting the database**

Select **Repair and Compact Database** from the button options. The database will be automatically updated.

**NOTE**

*CANNON® recommends that the Repair and Compact Database utility be run at least once a week if possible to provide additional stability for the database.*

**Exit**

When you have completed database management procedures, click **Exit** to exit from the Database Manager program. Or just close the Database Manager window.
Following is a list of CAV-2100 replacement parts and service kits available from CANNON® Instrument Company.

Replacement fuses are initially provided with your CAV-2100 instrument. It may be desirable for some users to maintain additional components in inventory.

<table>
<thead>
<tr>
<th>Description</th>
<th>CANNON Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid/Gas Solenoid Valve</td>
<td>61.3647</td>
</tr>
<tr>
<td>Pneumatic Solenoid Valve RTD</td>
<td>61.3087</td>
</tr>
<tr>
<td>Control Probe</td>
<td>61.3461</td>
</tr>
<tr>
<td>Over-Temp Thermistor</td>
<td>27.9020</td>
</tr>
<tr>
<td>Fluorescent Lamp</td>
<td>27.1300</td>
</tr>
<tr>
<td>Assorted Fuses, 9 ratings</td>
<td>61.3413 (spare fuses supplied)</td>
</tr>
<tr>
<td>Fuse, F250V x 200mA TRS</td>
<td>61.3292</td>
</tr>
<tr>
<td>Fuse, M250V x 7A 1/4x1-1/4</td>
<td>61.3293 -- 230V unit only</td>
</tr>
<tr>
<td>Fuse, M250V x 15A 1/4x1-1/4</td>
<td>61.3294 -- 100/115V units only</td>
</tr>
<tr>
<td>Fuse, M250V x 3A 1/4x1-1/4</td>
<td>65.3248</td>
</tr>
<tr>
<td>Fuse, M250V x 5A 1/4x1-1/4</td>
<td>61.3312</td>
</tr>
<tr>
<td>Fuse, M250V x 1.6A 1/4x1-1/4</td>
<td>61.3338</td>
</tr>
<tr>
<td>Fuse, M250V x 2.25A 1/4x1-1/4</td>
<td>61.3339 (Service unit)</td>
</tr>
<tr>
<td>Fuse, M250V x 300mA 1/4x1-1/4</td>
<td>61.3340</td>
</tr>
<tr>
<td>Fuse, F250V x 100mA 5x20</td>
<td>61.3606</td>
</tr>
<tr>
<td>24vdc Power Supply, 2.5A</td>
<td>61.3031</td>
</tr>
<tr>
<td>24vdc Power Supply, 1.1A</td>
<td>61.3030</td>
</tr>
<tr>
<td>±15/5vdc Power Supply</td>
<td>61.3314</td>
</tr>
<tr>
<td>Relay – SSR Quad 20A</td>
<td>61.3308</td>
</tr>
<tr>
<td>Relay – SSR Single 25A</td>
<td>62.1338</td>
</tr>
<tr>
<td>Air Cylinder</td>
<td>61.3822</td>
</tr>
<tr>
<td>Advance Cylinder</td>
<td>61.3011</td>
</tr>
<tr>
<td>Shift Cylinder</td>
<td>61.3012</td>
</tr>
<tr>
<td>Position Sensor (Load) Position</td>
<td>61.3013</td>
</tr>
<tr>
<td>Sensor (Shift)</td>
<td>61.3014</td>
</tr>
<tr>
<td>Bath Fluid, 10cSt, 1 gal.</td>
<td>9726-L37</td>
</tr>
<tr>
<td>Bath Fluid, 10cSt, 2-1/2 gal.</td>
<td>61.3430</td>
</tr>
<tr>
<td>Bath Fluid, 20cSt, 1 gal.</td>
<td>9726-L38</td>
</tr>
<tr>
<td>Bath Fluid, 20cSt, 2-1/2 gal.</td>
<td>61.3429</td>
</tr>
<tr>
<td>Assorted Tubing Kit</td>
<td>61.234</td>
</tr>
<tr>
<td>Bath Rebuild Kit, CAV-2100</td>
<td>61.3438</td>
</tr>
<tr>
<td>O-ring Kit, assorted</td>
<td>61.3439</td>
</tr>
<tr>
<td>Swagelok Fittings Kit</td>
<td>61.550</td>
</tr>
<tr>
<td>PolyFlo Fittings Kit</td>
<td>62.1510</td>
</tr>
<tr>
<td>Diaphragm Kit – Vac. Pump</td>
<td>62.2500 (100/115V units only)</td>
</tr>
<tr>
<td></td>
<td>61.3485 (230V unit only)</td>
</tr>
</tbody>
</table>
APPENDIX A–REPLACING THE CAV-2200 THERMOMETER

This application describes the procedure for replacing the CAV-2200 thermometer.

**Tools required**

0.05" Allen wrench • Phillips screwdriver

**Procedural overview**

To replace components you will:

• gain access to the bath vessel and other internal components by removing the top panels of the CAV-2200 bath.

• remove and replace components as necessary.

• reassemble the bath.

It is not necessary to drain the CAV-2200 bath to complete this procedure.

**Disassembly/removal procedure**

1. Exit the VISCPRO controlling software. Remove power from the CAV-2200 and allow the bath(s) to cool below 50°C. Unplug the unit from the mains power source.

2. Using the Phillips screwdriver, remove the screws securing the top panels of the CAV-2200 to the Bath Unit frame. Then remove the panels.

3. Locate the thermometer holder assembly, which is inserted through the top bath flange.

4. Lift the entire assembly clear of the bath and wipe excess silicone fluid from assembly components.

5. Carefully remove the thermometer tube top plug, which is held in place by friction between the plug O-rings and the outer tube thermometer holder. Slide the thermometer free of the holder.

6. Loosen the two opposing 0.05" Allen screws securing the thermometer adaptor plate to the connector on the thermometer wire cable.
Assembly procedure

1. Substitute the replacement thermometer and tighten the two opposing 0.05” Allen screws to secure the thermometer adaptor plate of the new thermometer to the thermometer wire cable.

2. Replace the thermometer in the holder and suspend it vertically to make certain that the thermometer scale is visible in the holder aperture. Then push the thermometer tube top plug firmly into place on the top of the holder to seat the two O-rings.

3. Replace the thermometer holder assembly in the bath by inserting it through the circular aperture in the top bath flange. Gravity will hold the assembly in place. View the thermometer through the front of the bath unit and verify that the thermometer scale is still readable. Adjust the thermometer position as necessary by rotating the thermometer holder assembly and/or thermometer tube top plug.

4. Using the Phillips screwdriver, replace the screws securing the top panels of the CAV-2200 to the Bath Unit frame.

5. Restore power to the CAV-2200 and load the VISCPRO controlling software to begin testing samples. The replacement procedure is complete.
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Version 2g — May, 2009; CANNON® Instrument Company
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