



**CCS-2100/
2100LT**

**Automatic
Cold-Cranking
Simulator**

**Instruction
& Operation
Manual**





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INTRODUCTION/INSTALLATION

Overview

Manual

This manual is intended for use with both the CCS-2100 and the CCS-2100LT Cold-Cranking Simulator (CCS) models from CANNON® Instrument Company. It provides information about:

- Installation and operation of the CCS-2100 instruments
- Standard ASTM testing and methods related to the CCS
- Calibration of the CCS for the customer's specific needs
- Use of the CCS computer software
- Maintenance and repair of the CCS

The CCS instruments

The **CANNON**® Cold-Cranking Simulator (CCS-2100) is a solid-state, thermoelectrically-cooled, fully-automatic test instrument for the determination of cold-cranking viscosity of engine lubricants. The CCS-2100 operator initially loads oil samples into the Sample Tray and enters sample identification via the computer keyboard or with a simple software

procedure restores a previously saved test configuration.

Without further operator intervention, the CCS-2100 tests and determines the apparent viscosity for up to 30 test samples at specified sub-ambient test temperatures, and records the results.



New features

The CCS 2000 Series instruments offer several advantages over previous CCS models, including improved temperature management and elimination of the required warm-up sample at the beginning of the test cycle. The thermoelectric system also enhances cell cleaning with a warming cycle, improving measurement precision. An attractive cabinet combines the simulator mechanism and the modular CCS Series II Controller.

Applications

The CCS-2100 is used to determine the apparent viscosity of engine oils at low temperatures at shear rates similar to those at starting conditions of cold engines. CCS instruments are found in quality control oil testing laboratories, major oil corporation laboratories, independent test facilities, blending facilities, and automotive corporation laboratories.

| | |
|------------------------------|---|
| <i>Precision</i> | The CCS-2100 is designed to produce measurements that meet or exceed the accuracy and precision dictated in ASTM test method D 5293. |
| <i>Temperature range</i> | The CCS-2100/2100LT is capable of measuring the apparent viscosity of oils at test temperatures ranging from -5°C to -40°C in increments of 5°C. The refrigerated water chiller must be set to +5°C to facilitate operation of the thermoelectric cooling system. |
| <i>Viscosity range</i> | The CCS-2100 is capable of calculating viscosity values ranging from 900 to 25,000 cP at test temperatures. Alternative ranges are possible. Contact CANNON [®] technical services for more information. |
| <i>Calibration constants</i> | The CCS-2100 will automatically calculate the appropriate calibration constants (refer to Chapter 3 for more information). After calibration, the CCS-2100 will use those constants for future tests without the necessity of operator intervention. |

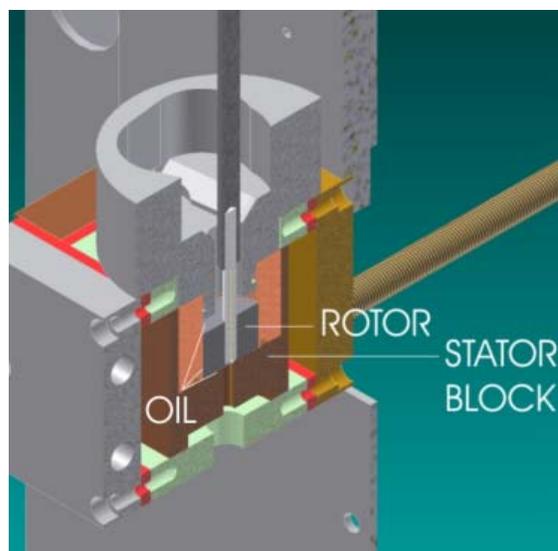
Equipment

The CCS instrument includes a Simulator Mechanism and the integral CCS Series II Controller. The peripheral waste system includes a vacuum pump (for evacuation of the sample) and a waste container.

| | |
|----------------------------|---|
| <i>Simulator Mechanism</i> | The Simulator Mechanism contains a temperature-controlled rotor/stator test mechanism and a constant metering, positive displacement piston pump which transfers the oil samples from the sample bottles to the rotor/stator assembly via an injection tube. The Simulator Mechanism also includes a 30-position automatic X-Y Sample Table. The Sample Table can process up to 30 sequential samples. The CCS-2100 automatically accesses a new sample when the previous test is complete. |
|----------------------------|---|

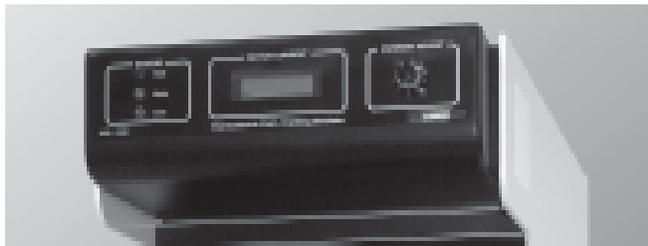
| | |
|---------------------------------|---|
| <i>CCS Series II Controller</i> | The CCS Series II Controller translates input from the CCS sensors and transfers the data to the computer for analysis. The CCS Series II Controller also provides power and relays computer commands to the Simulator Mechanism. |
|---------------------------------|---|

| | |
|---------------------|--|
| <i>Waste system</i> | The waste system is designed to eliminate the need for solvent cleaning. Used sample is flushed from the rotor/stator with a |
|---------------------|--|



CCS rotor/stator assembly

portion of the sample to be tested. The waste system includes the tubing and connections from the CCS to the waste container and vacuum pump. The pump is encased in a protective housing that includes a mounting bracket for the large polypropylene waste container. The container is capable of holding waste from approximately 45 sample tests.



CAUTION

The liquid level in the waste container should be checked frequently and the container should be emptied prior to multi-sample tests.

The CCS-2100 Series II Controller

Required accessories

The CCS requires a refrigerated chiller capable of circulating a distilled water mixture with 10 percent antifreeze to the CCS thermoelectric system at a controlled temperature of $+5^{\circ}\text{C}$ at a rate of at least 1-2 liters/minute (see refrigerated chiller specifications, this chapter). **CANNON**[®] recommends and supplies a Julabo chiller for this purpose. The CCS also requires an IBM or IBM-compatible computer and printer (request current specifications from CANNON) to run the CCS software and produce printouts of the data collected by the CCS.



The CCS waste system

Utilities

AC power input

The customer must be able to provide the appropriate power and grounding for the CCS.

Specifications of the voltage and frequency of the AC power source for the CCS are provided by the customer when placing an order. If you have any questions regarding the correct voltage for your CCS model, call **CANNON®** for assistance.



CAUTION

Only attach the power cord from the rear of the CCS Series II Controller to an AC mains with the power requirements specified on the label on the rear of the Controller.

Grounding

It is very important that the power source for the CCS has an electrical ground. The CCS is equipped with an IEC 320 socket which must be plugged into a grounded outlet.

Safety cautions

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

- 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 CCS 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.
- 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.
- Never operate the equipment with damaged mains power cables.
- Refer all service and repairs to qualified personnel.



General Caution

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 CCS unit.



Protective Conductor

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).

~ MAINS

AC Power Input Symbol

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.



Supply OFF Symbol

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

Hazardous materials

Routine CCS operation may require the use and handling of hazardous chemicals and solutions. **CANNON**[®] Instrument Company strongly urges the operators and technicians working with the CCS 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.

Unpacking**CAUTION**

Some CCS components are quite heavy. To avoid injury, obtain necessary assistance when lifting and moving shipping cartons and heavier unpacked components.

1. Carefully remove all components from their shipping cartons.
2. Consult the packing list to ensure that all items listed have been received. The CCS is usually shipped in three packing crates (including the refrigerated chiller unit, if it is ordered from **CANNON**[®]).
3. Notify **CANNON**[®] Instrument Company if any items are missing.
4. Inspect all components for damage. Report any damage to the shipping company and to **CANNON**[®] Instrument Company immediately. Remove any visible packing materials (packing foam, etc.) from the components.

NOTE

*You should retain all packing materials until the CCS is connected and functioning properly. If any component is returned to **CANNON**[®] Instru-*

ment Company, it should be packed in its original shipping container. You must call **CANNON**® prior to returning any products (see warranty and return information at the conclusion of this manual).

Positioning CCS components

1. Place the CCS on a stable laboratory bench or table.
2. Place the computer adjacent to the CCS.
3. Use the key provided to open the hinged door protecting the Simulator Mechanism.
4. Remove any pieces of foam packing that may have been included to prevent shipping damage to internal moveable components.
5. Close the hinged door.

Sample Tray

6. Place the CCS-2100 Sample Tray on the Simulator Mechanism Sample Table so that the arrow on the tray is aligned with the arrow on the left guide of the Sample Table (see photo). The gear on the underside of the Sample Tray must engage the gear in the center of the base of the instrument. When the alignment is correct, the CCS sampler mechanism at its default position (farthest left) will be centered over sample #1 on the Sample Tray.



Sample Tray [top view] correctly aligned on Sample Table [guides

Computer connections

Ensure that the computer specifications meet the minimum requirements for your CCS instrument. These requirements are listed on the Computer Specifications sheet provided with your *Instruction & Operation Manual*.

RS-232 serial connections

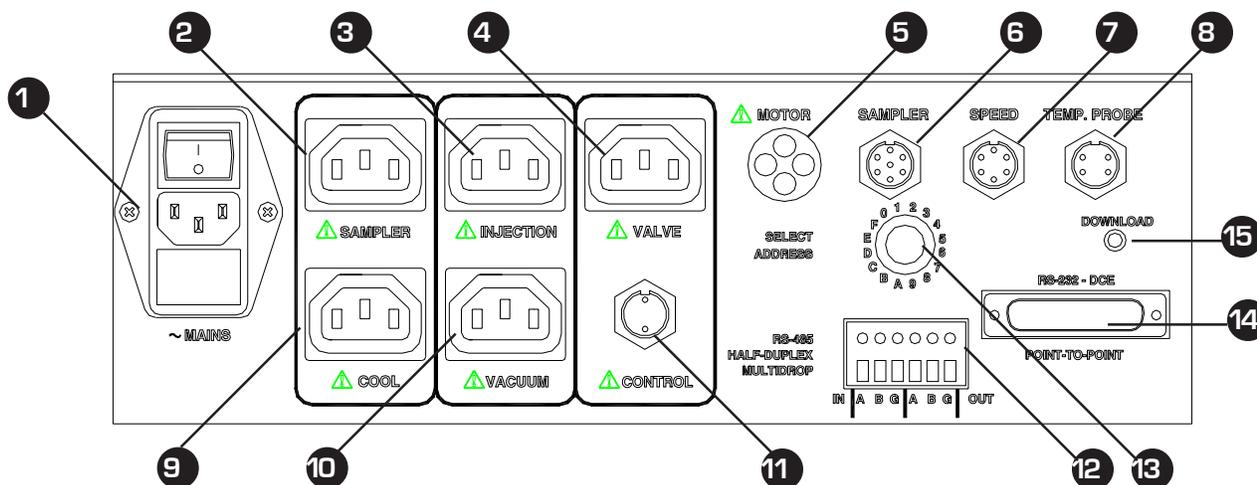
Locate the RS-232 (25-pin) CCS Control Cable. Connect one end to the COM port on the rear of the computer. Connect the other end of this cable to the socket on the rear of the CCS Series II Controller (note that the connectors are “D” shaped, and fit only one way).

Controller power distribution

Receptacle connections

There are five AC power receptacles and one DC receptacle on the rear of the CCS Series II Controller. The AC receptacles provide AC power matching the AC mains input for the various CCS AC devices. The Motor receptacle supplies regulated DC voltage for the rotor motor.

Power for the CCS Simulator Mechanism is supplied via the CCS Series II Controller. AC Power cords from the CCS are labelled to match their receptacles. Connect the power cords as follows:



CCS Series II Controller rear panel with connections marked (see list below)

1. Mains power (to AC power source), ON/OFF switch and fuses
2. CCS sampler mechanism power connection
3. Injection pump power connection
4. Coolant valve power connection (unused)
5. CCS rotor motor power connection
6. CCS sampler control
7. Rotor speed sensor connection
8. CCS temperature probe connection
9. Thermoelectric cooling power connection to internal power supply
10. Vacuum pump power connection
11. Thermoelectric cooling control (from stator assembly)
12. RS-485 connection (for multiple CCS instruments)
13. Address select (unused)
14. RS-232 serial connection (to computer COM port)
15. Download button (for future firmware upgrades—not used for installation)

Mains

~ MAINS

Make certain that the instrument power switch on the Controller rear panel above the Mains power cord connection is turned off. Then attach the Mains power cord from the Mains receptacle to the power supply matching the label on the rear of the CCS unit.

NOTES

Use only the **CANNON**[®]-approved supplied power cables for the CCS unit. Do not use serial or power cables exceeding 3 meters in length. Do not turn on the CCS power switch unless the chiller is attached and operating.

Sampler

Connect the Sampler power cord from the Simulator Mechanism to the SAMPLER receptacle on the CCS Series II Controller.

Injection pump

Connect the power cord from the INJECTION pump receptacle to the Simulator Mechanism, at the receptacle labeled INJECTION.

Cool

Connect the power cord from the thermoelectric power supply to the receptacle labelled COOL on the rear panel of the CCS Series II Controller. This receptacle is energized whenever the controller power is ON.

Vacuum pump

Connect the power cord from the waste container vacuum pump to the VACUUM pump receptacle on the Controller.

NOTE

If an in-house vacuum is to be used to remove oil from the CCS, you may omit the use of the waste container vacuum pump connection.

Motor

Connect the Simulator rotor motor power cord to the MOTOR receptacle.

**CAUTION**

Do not connect any other cable to the MOTOR receptacle. The power draw will damage the motor control circuit.

Control

If it is not already attached, connect the control cable from the stator thermoelectric cooling assembly to the CONTROL receptacle.

RS-232

Connect the RS-232 serial cable from the computer COM port to the RS-232 connector.

Optional connections for non-thermoelectric operation

Valve

The Valve connection (see photo image, page 7) is for optional non-thermoelectric cooling only—it is not used for normal thermoelectric operation. The non-thermoelectric version CCS (earlier version) required a custom-built rotor/stator assembly. If using a non-thermoelectric (older) instrument, connect the power cord from the optional external solenoid valve to the VALVE receptacle on the CCS Series II Controller. The solenoid valve regulates coolant flow from the optional non-thermoelectric cooling device through the CCS cooling system.

**CAUTION**

*Valve (or pump) voltage must match the CCS mains input voltage and frequency. Use only **CANNON**[®]-approved supplied accessories in the VALVE outlet. Do not circulate methanol refrigerants in thermoelectric instruments!*

NOTES

The solenoid valve may be obtained from **CANNON**[®] and must be installed to the coolant return line by the customer. (In some cases, a solenoid valve may already be included in the customer-supplied chiller.) If the refrigerated chiller has a constant-running internal pump, it may not be necessary to connect the pump to the CCS Controller.

Simulator Mechanism/Controller cable connections

Three cables from the Simulator Mechanism must be connected to the matching receptacle on the rear panel of the CCS Series II Controller:

1. Connect the grey cable from the Simulator Mechanism speed sensor to the **SPEED** jack on the CCS Series II Controller.
2. Connect the white temperature probe cable with the metal LEMO plug to the matching **TEMP PROBE** jack on the Controller.
3. Attach the seven-pin connector cable to the seven-pin **SAMPLER** jack on the Controller (see diagram, page 10). Connect the other end of this seven-pin cable to the corresponding jack in the lower left corner of the Simulator Mechanism rear panel.
4. Attach the four-pin connector cable from the thermoelectric cooling unit to the **CONTROL** jack on the Controller (see diagram).
5. Set the **Instrument Address** on the rear panel of the CCS instrument. Ordinarily the address should be set to "0". If other **CANNON** instruments are to be controlled from the same computer, each instrument must have a unique address. Each CCS requires a dedicated COM port.

Tubing connections

Waste system connections

A short 1/4" yellow plastic tube links the sample/solvent waste container with the waste container vacuum pump. This tube is taped to the vacuum pump housing for shipping. Remove the tape and make certain that there are no kinks in the vacuum hose. The longer tube should be attached from the waste container to the CCS (see instructions below).

**CAUTION**

The waste container must be connected properly or waste liquid may severely damage the vacuum pump.

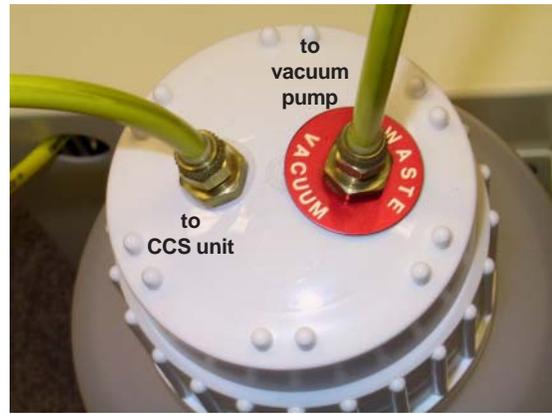
NOTE

If an in-house vacuum is to be used to remove oil from the CCS, you may omit the use of the waste container vacuum pump.

Connection procedure

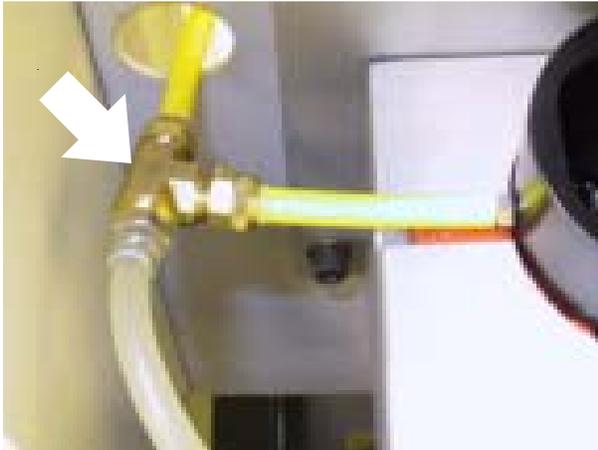
1. If the shorter length of yellow tubing is not already attached to the vacuum pump, it will be necessary to access the pump to attach it to the Waste Vacuum connector by removing the six screws securing the pump housing to the waste system assembly. After the housing has

been removed, connect one end of the yellow tubing to the fitting on the vacuum pump. Attach the other end to the remaining fitting on the waste container (see photo, above).



Waste container lid

2. Connect the longer length of 1/4" yellow plastic tubing to the other fitting on the lid (this fitting includes a hose extension which projects into the bottle).
3. Connect the other end of this longer tube to the vacuum fitting mounted on the right rear panel of the Simulator Mechanism. This fitting completes the vacuum connection to the CCS viscometric cell (see photo).



"T" connection from viscometric cell to rear panel waste container fitting

Coolant connections

There are two tubing connections on the rear of the CCS housing. The fitting on the left is the coolant INLET (for introducing the water/antifreeze mixture from the refrigerated chiller to the CCS) and the fitting on the right of the rear panel is the coolant OUTLET (for returning coolant to the refrigerated chiller). Secure the ends of both hoses to these fittings, then secure both hoses to the appropriate bulkhead fittings on the refrigerated chiller (see photo) using any connection hardware provided with the tubing (if applicable). Route the hose from the CCS OUTLET to the refrigerated chiller INLET, and the hose from the CCS INLET to the refrigerated chiller OUTLET.



Refrigerated chiller coolant connections

Filling the refrigerated chiller

Check the operations manual for the refrigerated chiller to determine its capacity. Then obtain the necessary volume of water and high-quality automotive antifreeze (ethylene glycol) necessary to provide a mix with a ratio of 10 percent antifreeze to 90 percent water. After you have secured the refrigerated chiller tubing connections to the CCS instrument (see previous section) add the necessary quantity of water/antifreeze mixture to the refrigerated chiller. The modified Julabo refrigerated chiller includes a sight glass for monitoring the liquid level. For CCS operation, the temperature for the circulating coolant should be set at +5°C.



CAUTION

Ethylene glycol is a toxic substance. Use proper safety precautions when handling. Follow appropriate MSDS procedures.

Ensure that the chiller is connected to the CCS and functioning properly before providing power to the CCS.

The water-antifreeze mix should be replaced annually for reliable performance and to prevent corrosion of internal components.

Do not set the chiller temperature below the freezing point of water (0°C).

NOTE

Depending on the amount of fluid displacement in the coolant lines, it may be necessary to add additional antifreeze/water mixture to the refrigerated chiller when the unit commences operation. Monitor the liquid level in the refrigerated chiller during normal operation. If air bubbles are consistently visible in the coolant lines, add additional mixture until the refrigerated chiller is full.

REQUIRED REFRIGERATED CHILLER SPECIFICATIONS

| | |
|---------------------------------|--|
| TYPE | Closed reservoir (but not sealed), open to atmospheric pressure. A Julabo modified chiller is recommended and available from CANNON. |
| COOLING MEDIUM | Mixture of distilled water with 10 percent antifreeze |
| HEAT REMOVAL CAPACITY | At least 200 watts at +5°C |
| LOW TEMPERATURE CAPACITY | Control and maintain at +5°C |
| PUMP FLOW RATE | At least 1 - 2 liters (1 - 2.1 quarts)/min. at 1 meter (39 inches) of head |
| COOLING LINES | Approximately 1 meter (39 inches) in length, 6 - 12 mm (0.25-.5 inches) in diameter |

Installing VISCPRO® software

VISCPRO® is a powerful new software product providing a generic instrument interface for controlling and operating your **CANNON®** instrument via computer. VISCPRO® also includes reporting/analysis modules for processing and displaying sample data.

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 calibration data. If you encounter difficulties at any stage in the installation process, call **CANNON®** Technical Services at 814-353-8000.

Windows® installation

1. Turn on your computer. Wait for the Windows® software to load.
2. From the Windows® Start Bar click **Settings/Control Panel**. Insert the first VISCPRO® installation disk or CD-ROM into the disk drive.
3. 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 data 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.

Specifications

| CCS-2100 SPECIFICATIONS | |
|--|---|
| DIMENSIONS | 711 mm (28") high × 333 mm (13-1/8") wide × 660 mm (26") deep (add at least 100 mm (4") to depth for installation) |
| WEIGHT | 61 kg (135 lbs.) for CCS-2100 primary unit / 41 kg (90 lbs.) for Julabo cooling unit (if purchased from CANNON ®); 30 kg (65 lbs.) for accessories |
| SHIPPING WEIGHT | Approximately 120 kg (264 lbs.) for CCS-2100 primary unit and accessories; 57 kg (125 lbs.) for Julabo cooling unit (if purchased from CANNON ®) |
| ELECTRICAL | Model # CCS-2100: 100/115 volts AC ± 10%, 50/60 Hz, 1000W Model # CCS-2100F: 230 volts AC ± 10%, 50/60 Hz, 1000W |
| OPERATING CONDITIONS | 15°-30°C, 10%-90% RH non-condensing, Installation Category II, Pollution degree 2 |
| FUSE RATING | Controller: 100/115 volt unit: M 250V 8A, 5x20mm; 230 volt unit: M250V 4A, 5x20mm |
| COMPLIANCE | EMC directive (89/336/EEC); Low voltage directive (73/23/EEC), HI-POT (1900 VDC, 60 sec.) |
| <i>Use only the approved power cord supplied with your unit.</i> | |

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Configuring the CCS

This chapter contains information on configuring the CCS instrument for successful operation. Additional configuration information may be found in a separate document, *CCS Installation Notes*, provided with your CCS instrument or software upgrade.

Checking/editing configuration settings in VISCPRO

Original installation

Your original software installation package may have included preset instrument configuration data on an accompanying floppy disk. This information should be copied to the VISCPRO® directory on your computer immediately following initial installation of the VISCPRO® software. Consult the *CCS Installation Notes* for further information.



CAUTION

Copying or recopying floppy disk information to your VISCPRO® directory will overwrite existing sample data. If you wish to retain a record of previously-saved configurations, make certain to archive your existing sample data before doing so (see Chapter 11 for information on using the Database Manager software).

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

Configuration protection

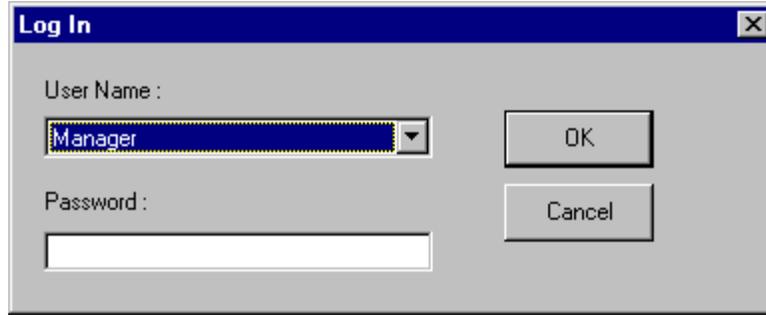
To check the configuration settings for your instrument(s), you must log in to the security system as a manager. The software is installed with a default Manager account. This account has no password, allowing any operator access to manager-level software functions as long as the password is not activated/changed. If you would like to engage the full-release security options, see *Security Options* in Chapter 5 for instructions.

Running the software

To start the VISCPRO® software program, double-click the VISCPRO® icon on your Windows® desktop (Windows® NT® users can click **Start/Programs/VISCPRO/VISCPRO.EXE**).

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**. It is not necessary to enter a password.



5. Click OK to complete the Log In procedure.

NOTE

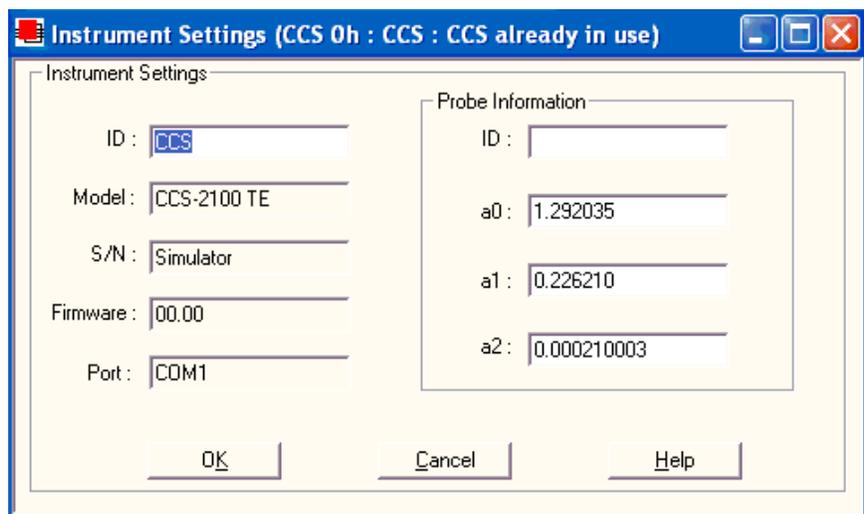
For more information on VISCPRO security options, see page 40.

Checking/editing Instrument Settings

1. Use your mouse to click (select) Configure from the VISCPRO® menu bar (see graphic, next section).
2. Select your instrument from the list of available instruments (there may be only one instrument in the list).
3. Select option 2, 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 CCS instrument operational features. These settings affect the instrument as a whole. Check the instrument settings for your CCS per the instructions below, and make any necessary changes:



The Instrument Settings window

ID : CCS

Use the ID field to input instrument identification information using up to 30 alphanumeric characters.

S/N : 5013

The S/N: field should correspond to the four-digit serial number from the label on the CCS rear service panel.

a1 : 0.226210

The probe constant values (a0, a1, and a2) must be identical to the values on the calibration certificate provided with your temperature probe. Verify that the values correspond.

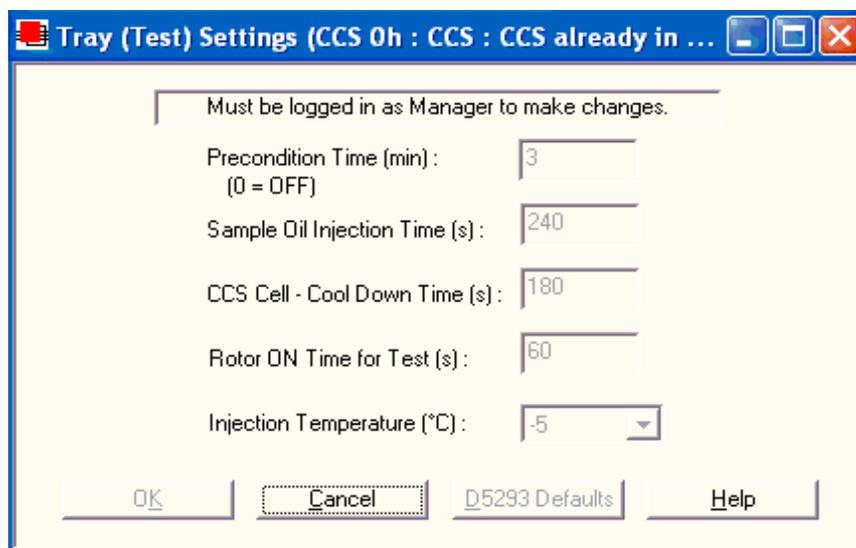
Note that firmware and communication port settings are automatically determined. These values cannot be altered from this window.

When you have verified all settings for all editable fields, click OK.

Viewing/editing other 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 from the list of available instruments.
3. Select **Tray (Test) Settings** from the list of configuration options. The Tray (Test) Settings window will appear.

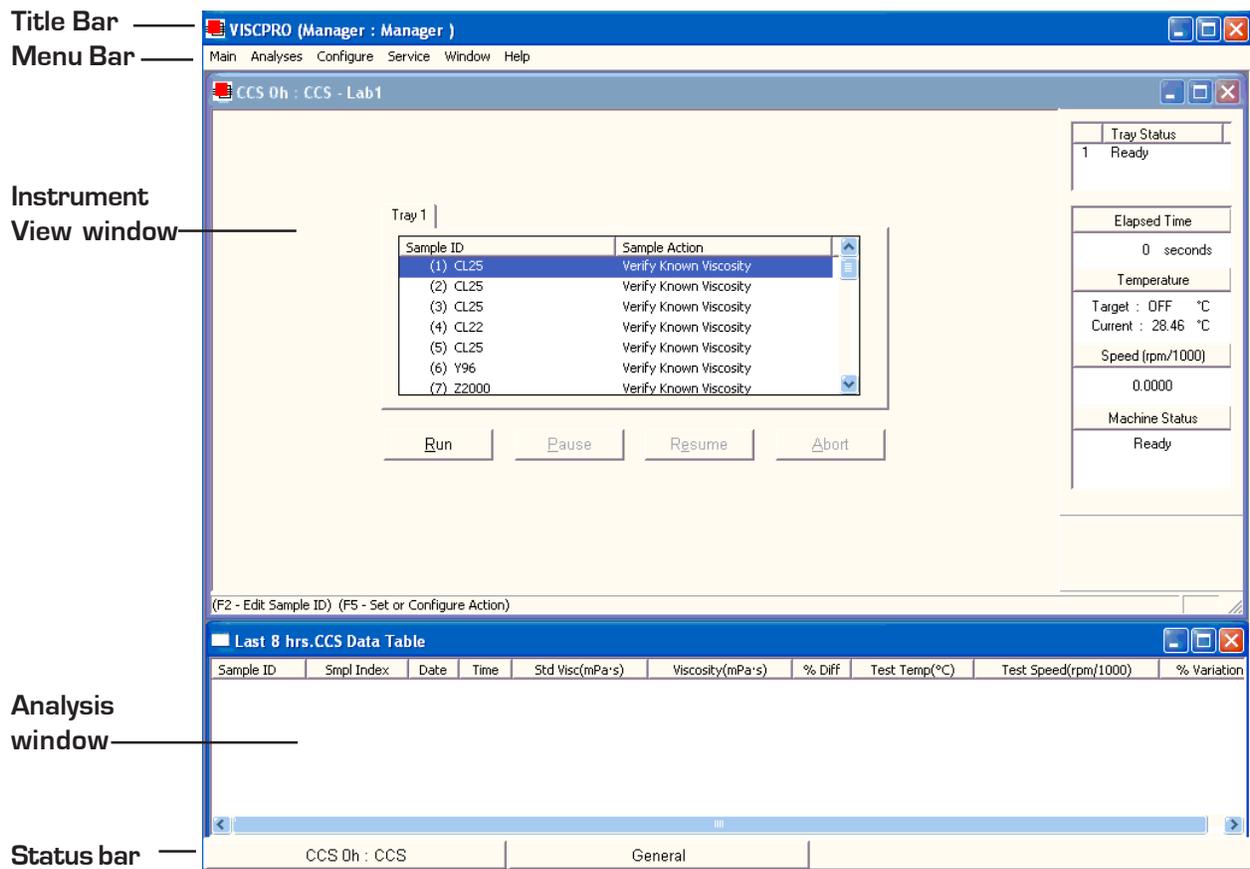


The Tray (Test) Settings window

The Tray (Test) Settings window contains setup information for your instrument. Default test settings (which may be restored at any time by clicking the Defaults button) are specified in ASTM D 5293. In certain circumstances, the user may wish to alter these settings. For more information, see Tray (Test) Settings in Chapter 5.

VISCPRO software interface elements

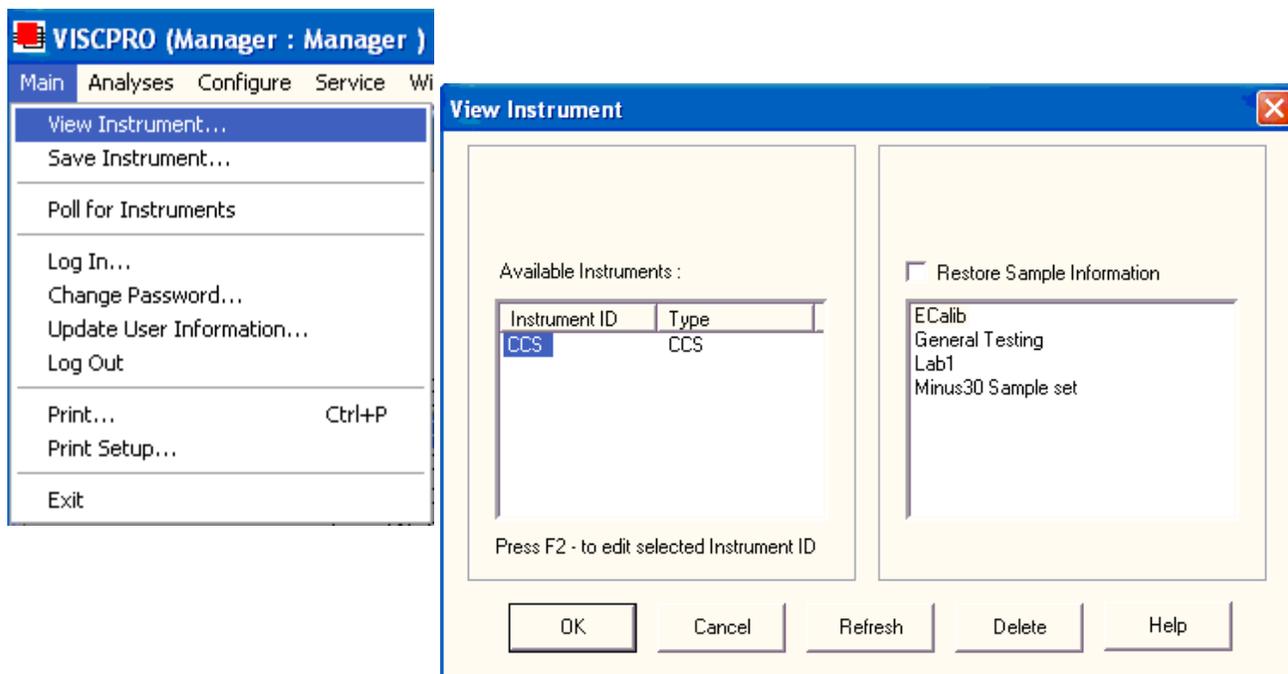
The VISCPRO® primary display window is framed on the top by the VISCPRO® title bar and menu bar, and on the bottom by the VISCPRO® status bar. The application window is usually preconfigured to include two child windows. The first is an Instrument View window, which describes your **CANNON**® instrument and provides controls for CCS testing, and the second is an analysis window that displays data from CCS tests.



The VISCPRO® primary display

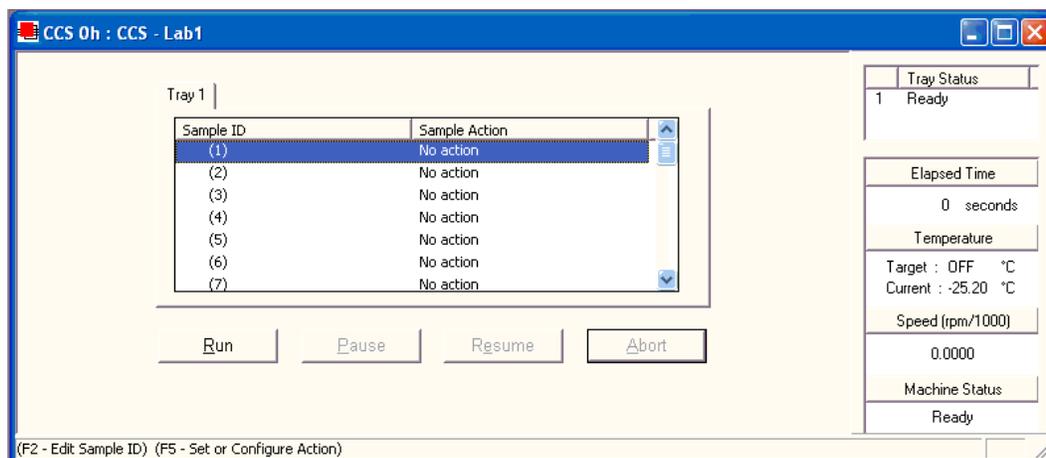
NOTE

If the Instrument View window does not appear, click View Instrument from the Main menu:



The View Instrument window

Then click the desired instrument from the list of available instruments and click OK. If the Available Instruments list box is blank, your CCS instrument may not be on-line. Check cable connections and make certain the instrument is ON.



The Instrument View window

| Last 8 Hours.Check Standard Data Table | | | | | | | | | | | |
|--|-----|-----|-----------|-------------------------|-------------------------------|-----------|--------|--------|--------|------|------|
| Sample ID | INV | TOL | Temp (°C) | KV (mm ² /s) | Known KV (mm ² /s) | % Diff KV | % Diff | T1 (s) | T2 (s) | Date | Time |
| Idle | | | | | | | | | | | |

The CCS Data Table window

NOTE To change the Tray (Test) Settings for your instrument(s), you must log in to the security system as a manager.

4. Edit the values for Tray (Test) Settings as necessary. When done, click OK to save current values and exit the Tray (Test) Settings window.

Initial Stepper Motor Service

Prior to performing instrument actions with the CCS-2100 Automatic Cold-Cranking Simulator, you must first home the Sample Tray mechanism as follows:

1. Make certain that the chiller is connected and operating properly. Then turn the CCS instrument is ON.
2. Load the VISCPRO software by double-clicking the VISCPRO® icon on your Windows® desktop (Windows® NT® users can click Start/Programs/VISCPRO/VISCPRO.EXE).
3. Click Service from the menu bar and select your CCS instrument from the list.
4. Select Stepper Motor Service from the Service options.
5. Click on the Tube Up button until the tube has reached the top of its travel.
6. Ensure that the arrow on the Sample Tray is aligned with the arrow on the Sample Table (Table Forward/Table Back buttons).
7. Click on the Trolley Left button until the sampler has reached the limit of its travel. If the Sample Tray has been aligned properly, the sampler should now be centered over the #1 sample position.



CCS sampler mechanism with tube in home position (raised)



CCS-2100 with tray in home position

8. Click the **Set Home Flag** button. Note that the button will disappear when the home flag has been set successfully. Then click  to close the window.

Setting the CCS Set Motor Current

The CCS Motor Current window in VISCPRO® provides the software interface for adjustment of the CCS motor current. To set the CCS motor current:

1. Select the **Set Motor Current** option from the **Service** menu. The **Set Motor Current Service** window will appear.
2. Prepare a 60 ml bottle of **CANNON**® CL25 viscosity standard and place it in position 1 of the Sample Table. Then press the **Start** button. The CCS will begin the current adjustment procedure.
3. When the rotor/stator has reached the correct temperature, the software will prompt you to adjust the CCS motor current using the dial on the front panel of the Control Unit. Adjust the current until the value in the **Speed:** field of the **Motor Current Service** window indicates a rotor speed of 240 rpm.

The **Set Motor Current Service** window will continue to display cell temperature and cell motor speed. When you have completed the rotor speed adjustment procedure, press the **Close** button to exit the **Set Motor Current Service** window. To terminate the **Set Motor Current Service** process at any time, click **Finished**.

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CALIBRATING THE CCS

Calibration is essential for the proper operation of the CCS. The CCS is calibrated before it is shipped to the customer; however, the CCS should be recalibrated after installation. Frequency of recalibration is at the discretion of the user.

The CCS calibration procedure ensures that the mathematical constants used in calculation of viscosity from CCS measurements accurately reflect the unique properties of the CCS rotor/stator mechanism.

Calibration procedure

During calibration, the software uses calibration standard data from CCS tests of viscosity standards to perform the mathematical calculations necessary to derive three calibration constants— b_0 , b_1 and b_2 . Then the program displays the new constants and recomputes a viscosity (in cSt) for each 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 and calculated viscosities.

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

Preparing/updating the list of calibration standards

During installation of your VISCPRO® software package, a list of current CANNON CL standards (see table, next page) is automatically loaded into the VISCPRO® database. Before testing calibration standards, it will be necessary for you to enter the viscosity data from the standard bottles into the VISCPRO® program using the following procedure:

1. Click **Configure** from the VISCPRO® primary display and select your CCS instrument.
2. Click **CCS Calibration Standards** from the **Configure** menu options. The **CCS Calibration Standards** window will appear (see graphic, following).
3. Assemble your calibration standards and input the viscosity data (in mPa·s) from the standard bottles for each CL standard and temperature in the appropriate fields. If you have additional standards, including user-defined standards, you can enter these by right-

clicking your mouse in the Sample ID field and selecting the Insert New option . To delete an unused standard, right-click your mouse in the Sample ID field and select Delete.

| CANNON® CALIBRATION STANDARDS | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|
| Calibration Oil | Approximate Nominal Viscosity at Indicated Temperature | | | | | | |
| | -5°C | -10°C | -15°C | -20°C | -25°C | -30°C | -35°C |
| CL080 | | | | | | | 900 |
| CL090 | | | | | | | 1200 |
| CL100 | | | | | | 900 | 1700 |
| CL110 | | | | | | 1550 | 2500 |
| CL120 | | | | | 800 | 1600 | 3200 |
| CL130 | | | | | 1500 | 2900 | 4850 |
| CL140 | | | | 800 | 1600 | 3250 | 7000 |
| CL150 | | | | 1700 | 2700 | 4600 | 8050 |
| CL160 | | | | | 2500 | 5500 | 11 000 |
| CL170 | | | 1450 | 2250 | 3700 | 6300 | 11 300 |
| CL190 | | | | 1800 | 3500 | 7400 | 17 000 |
| CL200 | | | 1677 | 2650 | 4300 | 7550 | 13 700 |
| CL220 | | | 1300 | 2500 | 5100 | 11 100 | |
| CL240 | | | 2250 | 3600 | 6000 | 10 700 | 19 800 |
| CL250 | | | 1800 | 3500 | 7400 | 17 200 | |
| CL260 | | 1750 | 2700 | 4400 | 7500 | 13 400 | |
| CL280 | | 1300 | 2500 | 5000 | 9300 | | |
| CL300 | | 2400 | 3750 | 6100 | 10 500 | 19 300 | |
| CL320 | | 1800 | 3500 | 7300 | 15 900 | | |
| CL340 | | 2700 | 4200 | 7000 | 12 194 | | |
| CL380 | | 2900 | 5800 | 13 000 | | | |
| CL420 | | 5200 | 8500 | 14 405 | | | |
| CL480 | 2300 | 4500 | 9500 | 21 000 | | | |
| CL530 | | 6000 | 9843 | 16 881 | | | |
| CL600 | 3700 | 7300 | 15 600 | | | | |
| CL680 | | 9550 | | | | | |
| CL740 | 6000 | 12 000 | | | | | |

NOTE

A minimum of five oils are required for calibration at each temperature in accordance with ASTM D 5293- 08.

**CAUTION**

Make certain to verify the Known Viscosity (calibration standard viscosity in mPa·s) in the calibration list **BEFORE** testing selected standards (see next sections). Incorrect or outdated viscosity data may skew future calibration results.

- After you have entered all ID, temperature and viscosity information into the CCS Calibration Standards list (see graphic), click the **SAVE** button to save the data and exit the window.

| SampleID | Temperature(*C) | Known Visc(mPa·s) |
|----------|-----------------|-------------------|
| CL080 | -35 | 849.6 |
| CL090 | -30 | |
| CL090 | -35 | 1160 |
| CL100 | -30 | 1032 |
| CL100 | -35 | 1691 |
| CL110 | -30 | 1409 |
| CL110 | -35 | 2341 |
| CL120 | -18 | 388.6 |
| CL120 | -25 | 850.4 |
| CL120 | -30 | 1595 |
| CL120 | -35 | 3196 |
| CL130 | -25 | 1646 |
| CL130 | -30 | 2712 |
| CL130 | -35 | 4671 |
| CL140 | -18 | 706.2 |
| CL140 | -20 | 887.4 |
| CL140 | -25 | 1639 |

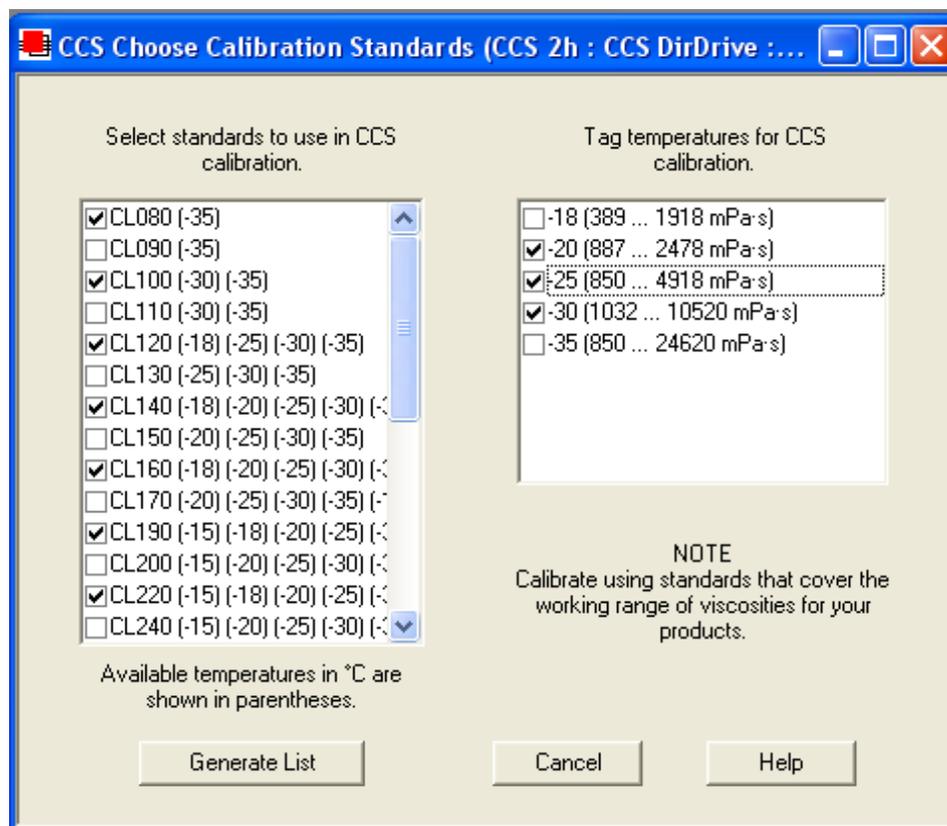
The CCS Calibration Standards list window

Testing calibration standards

To calibrate the CCS instrument, it is first necessary to test samples of known viscosity at the desired calibration temperatures.

Selecting standards

- Assemble a group of **CANNON**[®] standard oils with known viscosities for calibration. Refer to the table on the previous page when choosing the appropriate CL standards.
- Click **Configure** from the **VISCPRO**[®] primary display and select your CCS instrument.
- Click **CCS Choose Calibration Standards** from the **Configure** menu options. The **CCS Choose Calibration Standards** window (see graphic, next page) will appear.
- Click the desired standards to select them for calibration. A check mark indicates that the standard has been selected.



The Choose Calibration Standards window

5. After the desired standards have been selected, click the desired temperatures for calibration. Then click **Generate List**. The VISCPRO software will automatically create a calibration test sequence using the standards you selected and display the test sequence in the Instrument View window.

NOTE *To open a window displaying the complete list of samples to be tested, along with the test temperatures for each sample, click **CCS Sample List Service** from the Service menu.*

6. Prepare the instrument and calibration standards in the same manner as you would prepare samples for viscosity testing (see next chapter).

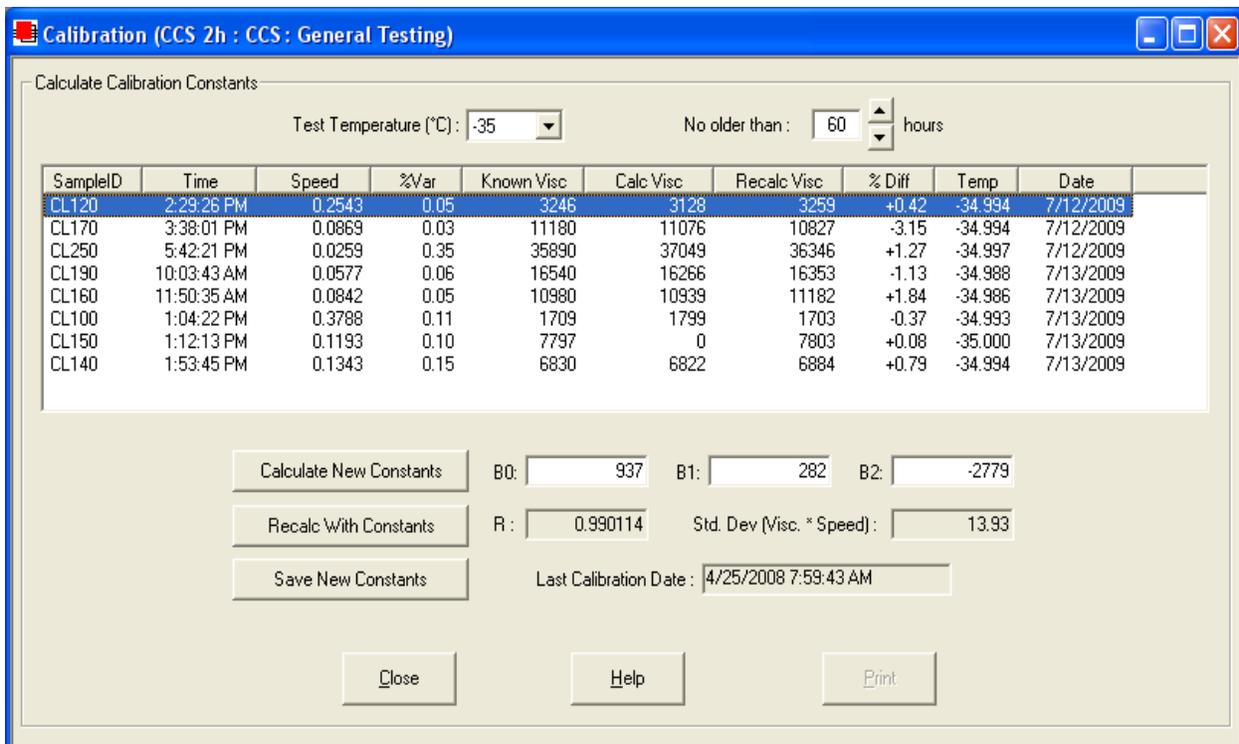
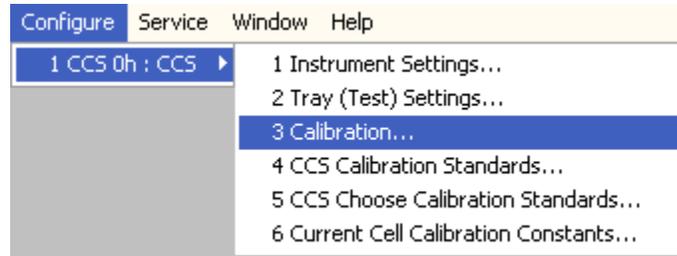
NOTE *CCS-2100 users should place the standards in the sample table in the test sequence indicated, and (if necessary) execute the Stepper Motor Service (see page 19) to home the sampler mechanism.*

7. To initiate the calibration test sequence, click **Run** from the Instrument View window. The instrument will begin testing with the first sample in the test sequence. At the conclusion of testing, the sampler mechanism for the CCS-2100 will return to the home position.

Performing the calibration

After valid calibration data has been obtained by testing calibration standards, the CCS instrument may be calibrated using the following procedure:

1. Use the VISCPRO® software to log on as a Manager (Main/Log In) in order to access the calibration menu.
2. Click **Configure** from the VISCPRO® primary display and select your CCS instrument.
3. Click **Calibration**. The Calibration window will appear.



CCS Calibration window

4. Select the desired calibration Test Temperature. If calibration constants are known, they may be input manually in the appropriate fields and saved by clicking **Save New Constants**. If test data from calibration standards is to be used, select the desired date range for

acceptable calibration data by using the No older than [x] hours spin controls  to set the date search parameters. Any calibration standards successfully tested during the time frame you specified will appear in the window list box.

NOTE

Standards which were not within 0.05°C of the desired test temperature during the test, according to temperature probe readings, will not be displayed in the calibration window.

Selecting samples

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

NOTE

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

Saving new constants

6. When the desired samples have been selected, click on **Calculate New Constants**. The new constant(s) b0, b1 and b2 will be displayed in their respective fields in the window.
7. If the new calibration constants are acceptable (see next section), click on **Save New Constants** to save the constants for the current instrument. If the difference is not within acceptable limits, review the calibration information more closely and select a different range of standards for inclusion in the calibration routine.
8. Repeat steps 4-7 until a satisfactory calibration result is obtained for each calibration temperature. If you are unable to calibrate successfully, refer to Chapter 6 for CCS maintenance/service information.
9. Click **Close** to exit the **Calibration** window. Test several standards to verify a successful calibration.

Checking calibration accuracy

It is very important to check the accuracy of the calibration procedures since any small errors in calibration could result in faulty viscosity readings and erroneous data. The calibration window (see previous page) provides vital calibration data including:

- **Test Visc[osity]**: The viscosity of the standard (from the bottle label)
- **Calc Visc[osity]**: The CCS-calculated viscosity for the standard using the current calibration constants.
- **ReCalc Visc[osity]**: The CCS-calculated viscosity for the standard as calculated using the calibration constants derived from currently-selected calibration data in the calibration window.

- **% Diff[erence]**: The percentage difference between the Known Visc[osity] and the Recalc[ulated] Visc[osity] as determined by the formula:

$$\% \text{Diff} = \left[\left(\frac{\text{Recalc Viscosity}}{\text{Test Viscosity}} \right) - 1 \right] * 100$$

- **%Var**: An indicator of rotor speed variation during the last 5 seconds of each sample/standard run. This value is determined by the equation:

$$\% \text{Var} = 100 * \frac{\sqrt{\frac{\sum x^2 - 5\bar{x}^2}{5}}}{\bar{x}}$$

Where: $x = \{ \text{set of the last 5 seconds of speed readings} \}$

\bar{x} = mean of x

$\sum x^2$ = sum of x^2

You may evaluate the accuracy of the new calibration constants by comparing the Known Visc[osity] for the standard with the Recalc[ulated] Visc[osity] 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.

- **R**: The displayed value is an indicator of how well the raw data fits the calibration equation using the newest calibration constants. A “perfect fit” value is 1.0000. CANNON recommends an “R” value in excess of 0.9. Acceptable values will vary depending on the user’s application.
- **Std. Dev (visc. * speed)**: The displayed value indicates viscosity times rotor speed in the quadratic equation:
 $N * n = b_0 + (b_1 * N) + (b_2 * N^2)$
 Where N = rotor speed and n = viscosity

Recalc with constants

The **Recalc with constants** option will recalculate the %Diff[erence] value using constants input manually by the user. To use this option, input the desired constants in the appropriate fields and then press the **Recalc with constants** button.

Saving new constants

When you are satisfied with the calibration, click the **Save New Constants** button. Then click **Close** to exit the **Calibration** window.

NOTES

Once the Save New Constants 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.

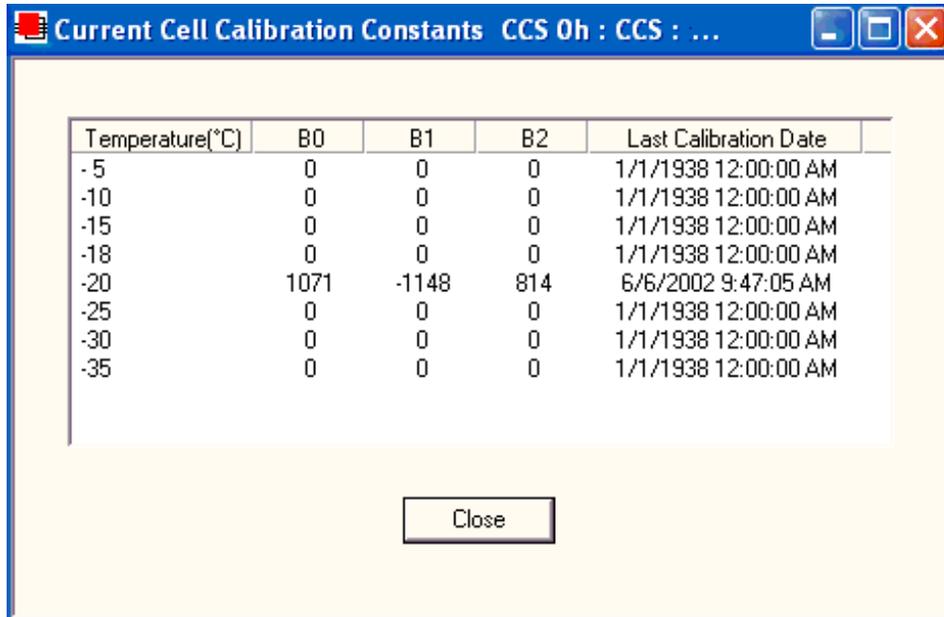
You must click Save New Constants if you wish to save the new calibration constants.

Test several standards to verify a successful calibration.

Viewing current calibration constants

To view current calibration constants for your instrument, click Current Cell Calibration Constants from the Configure menu.

The Current Cell Calibration Constants window will be displayed.



The screenshot shows a window titled "Current Cell Calibration Constants CCS 0h : CCS : ...". Inside the window is a table with the following data:

| Temperature(^C) | B0 | B1 | B2 | Last Calibration Date |
|-----------------|------|-------|-----|-----------------------|
| -5 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -10 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -15 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -18 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -20 | 1071 | -1148 | 814 | 6/6/2002 9:47:05 AM |
| -25 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -30 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |
| -35 | 0 | 0 | 0 | 1/1/1938 12:00:00 AM |

Below the table is a "Close" button.

The Current Cell Calibration Constants window

Saving a calibration

When calibration is complete, the calibration information is only saved to the current instrument configuration. 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.

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

EXAMPLE: 1-10-02 at -20 for CCS

After the instrument configuration has been saved, calibration data may be restored at any time using the View Instrument option from the Main menu. Note that the Restore Instrument Settings must be selected to restore calibration data.

NOTE The Restore Instrument Settings option is security-protected at the Manager level (see manual instructions regarding security).

TESTING SAMPLES WITH THE CCS

This chapter of the manual will provide information on testing samples using the CCS instrument.

The VISCPRO® controlling software offers the advantage of multi-sample testing for up to 30 samples. Sample data is automatically stored to the VISCPRO® database for reporting and data collection. Additionally, several reports (analyses) may be used to calculate and display viscosity values. 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 (LIMS) data collection.

Observe the safety cautions noted in the introductory chapter when operating equipment. The CCS should only be operated by qualified personnel.

NOTE

The CCS instrument must be calibrated before it will be possible to test samples and achieve accurate results. Complete all calibration procedures in Chapter 3 prior to testing samples with the CCS instrument. Frequency of recalibration is at the discretion of the user.

Preparing the CCS and samples

Turning on the CCS

1. Verify that the water chiller is on and is operating at +5°C. If CCS power is off, turn on the CCS by pressing the power switch on the rear panel of the instrument. The (●) symbol indicates the OFF position for the electrical switch for your unit (AC Mains).
2. Pour approximately 60 ml of each oil to be tested into clean 60 ml sample jars.



CAUTION

NEVER test used oil samples in the CCS unless the samples are filtered with a 5-micron filter. Particulate from unfiltered samples will severely damage the copper stator, requiring the replacement of both the rotor and the stator.



CAUTION

Oils with an anticipated test viscosity of less than 1200 mPa·s (cP) or greater than 30,000 mPa·s (cP) should NOT be tested in the CCS. Damage to the motor or rotor/stator mechanism may result.

3. Prepare samples for testing by pouring approximately 55 ml of sample material into the 60-ml sample jars. CCS-2100 users should position up to 30 sample jars in the Sample Tray (see photo) in the desired order for testing.



Placing sample jars on the Sample

NOTES

You may wish to test calibration standards per your established laboratory procedures prior to sample testing. Recalibrate the CCS (see Chapter 3, Calibration) if result variance warrants.

4. Turn on the computer and start the CCS software by double-clicking the VISCPROR[®] icon on the Desktop. CCS-2100 users must execute the Stepper Motor Service (see page 19) to home the sampler mechanism.

NOTES

If you start the VISCPROR software before turning on your CCS instrument, 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.

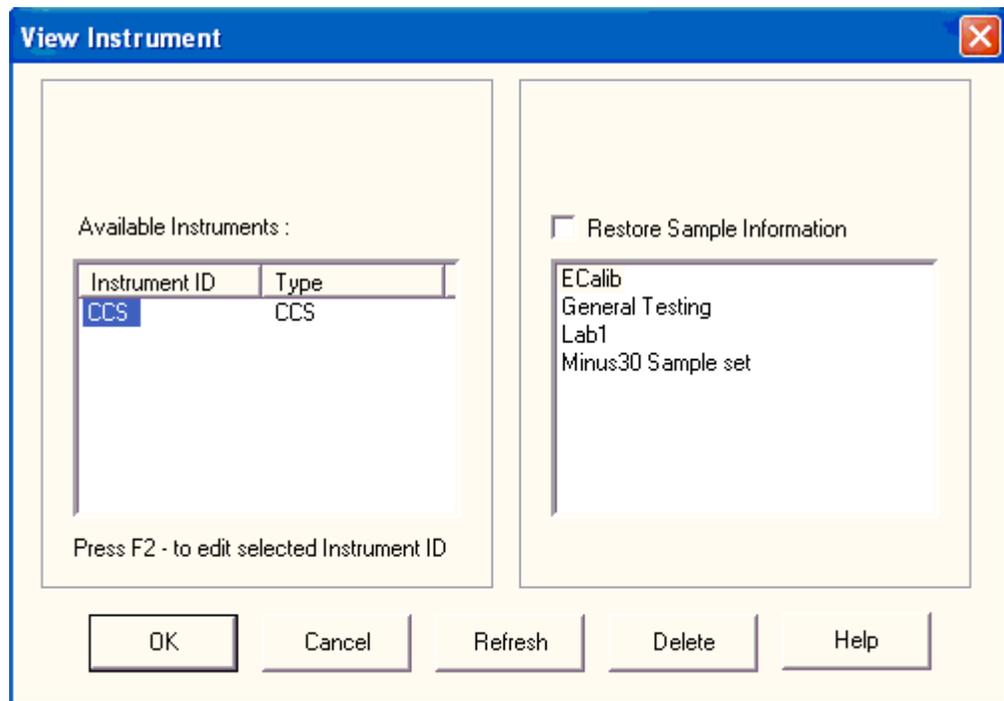
Sample Tray

5. Orient the Sample Tray on the Simulator Mechanism Sample Table so that the arrow on the tray is aligned with the arrow on the left guide of the Sample Table (see photo). The gear on the underside of the Sample Tray must engage the gear in the center of the base of the instrument. When the alignment is correct, the CCS sampler mechanism at its default position (farthest back and left) will be centered over sample #1 on the Sample Tray.



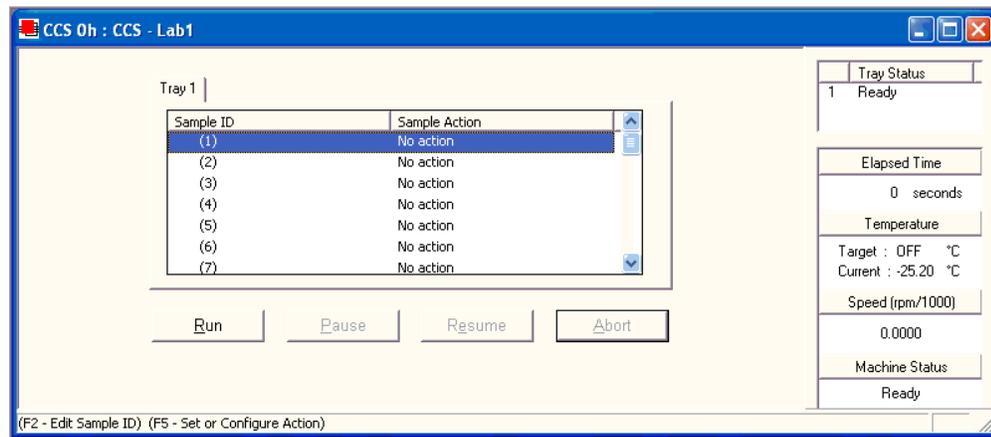
CCS-2100 Sample Tray (top view) correctly aligned on Sample Table

6. Ensure that the current instrument is displayed in the VISCPROR[®] Instrument View window. If it is not, click View Instrument from the Main menu and select the desired instrument configuration from the list box on the left. Then further define/select the desired instrument characteristics using the check box option(s) (see Chapter 5 for more information).



The View Instrument window

- Click OK to display the Instrument View for the desired instrument:



The Instrument View window

- To enter sample information, double-click on Sample ID (1) with the left mouse button to access the sample ID data entry field (or press **F2**).
- 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.

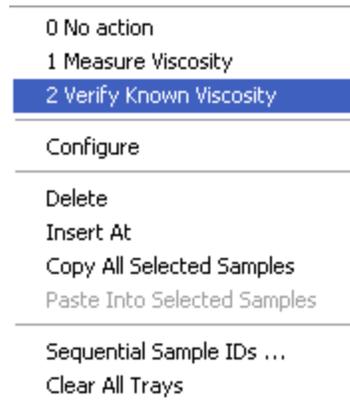
NOTES

Once sample information is entered, the software automatically assigns a sample action, Measure Sample Viscosity, for the sample. If the Measure Sample Viscosity action is unavailable, the CCS has not been calibrated for testing at that temperature.

If you do not enter a sample ID, the sample is automatically labeled Unknown.

For information on saving and restoring sample ID information, see Chapter 5.

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 (or press **F5**) to access sample action options:



Sample action options

Then select the desired action by highlighting it with your mouse cursor 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 5.

Testing calibration standards

If Verify Known Viscosity is selected as the test option for a sample, the Select a Calibration Standard window will open automatically. Click on the desired standard and test temperature from the list of available standards. Then click OK to close the window and complete data entry. To change your selection, right-click on the desired sample ID from the list box and select Configure from the popup menu choices.

NOTE

For additional information on Calibration Standard Options, refer to Chapter 3.

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

Test options

Running a test

Click on the RUN button in the Instrument View window to begin the CCS test(s).

Introducing sample

During testing the oil sample is introduced to the viscometric cell, which contains a rotor/stator assembly. There is a very small clearance (gap) between the rotor and the sides of the stator. The sample oil fills the space below the rotor, the small gap between the rotor and the stator, and the remaining space above the rotor and below the top of the stator.



CAUTION

Do NOT test used oil samples in the CCS unless the samples are filtered with a 5-micron filter. Particulate from unfiltered samples will damage the rotor and the stator walls!

Oils with a Known Test Viscosity less than 1200 mPa·s (cP) or greater than 30,000 mPa·s (cP) should NOT be run in the CCS.

Test details

It takes approximately eight minutes to process each oil sample. Initially, small amounts of the sample oil are used to flush the previous sample from the rotor/stator and tubing lines. The CCS uses a vacuum to draw the waste oil into the large glass bottle.

Calculating viscosity

During testing, the stator temperature is being constantly monitored and regulated and data is being stored in computer memory. Near the conclusion of the test the rotor speed is measured and averaged via the computer and an apparent viscosity is calculated incorporating that average and the temperature and calibration constants in the viscosity equation.

Removing waste oil

At the conclusion of each test, the CCS removes the sample oil using a constant metering, positive displacement piston pump designed to eliminate solvent cleaning. Waste oil is flushed from the viscometric cell with the next oil sample to be tested and waste oil is pumped into the large glass bottle.



CAUTION

The Waste Receiver should be emptied after every 30 samples tested (more frequently if desired).

If the Waste Receiver bottle is overfilled, oil may damage the vacuum pump.

Sampler/sample tray position The Sampler should always begins a run from position #1 on the Sample Tray. The order of testing is always sequential. When placing the Sample Tray on the Sample Table, always align the arrow at the front of the left side of the Sample Table with the arrow on the frame of the Simulator Mechanism.

Injection tube damage If the injection tube becomes bent, it can be realigned by hand, or replaced with the spare tube supplied with the CCS unit.

Pausing a test

To temporarily halt testing for a given sample, click the Pause button from the Instrument View window.

NOTE

If a test is paused immediately (Pause Now), the Resume option (see below) will restart the test cycle for the current sample. If the Pause After Sample is Complete option is selected, the current sample test will be completed before CCS operation will be paused. Then the Resume option will initiate sample testing with the next sample in the sequence.

Resuming a test

To resume test actions when testing has been paused (see note above), click the Resume button from the Instrument View window.

Aborting a test

To permanently and immediately halt testing, click the Abort button from the Instrument View window and click Yes from the Abort window to confirm your selection.

NOTE

Aborting a test clears all sample test information.



CAUTION

Aborting a CCS function halts all instrument operations. It is the responsibility of the user to restore the instrument to a safe state prior to resuming testing. In the event that a sample has spilled, clean affected instrument components thoroughly. Reenter or restore test parameters. If necessary use CCS Stepper Motor controls to reposition the injection tube and/or sampler mechanism.

Concluding a test

After automatic testing has been completed, make certain that the tray status, as indicated in the VISCPRO® Instrument View Tray Status window, is READY. At the conclusion of testing, the sampler mechanism for the CCS-2100 will return to the home position. CCS-2100 users may then remove the Sample Tray from the Sample Table.

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

Wipe any excess oil from the Sample Table and Sample Tray using an absorbent paper towel. If necessary, clean these items by wiping with a paper towel wetted with appropriate solvent.

Viewing 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.
- Error Log Table—lists error messages and related data.
- Error Data and Sample Data Export Analyses—configures data for output to a file, parallel port, or serial port.

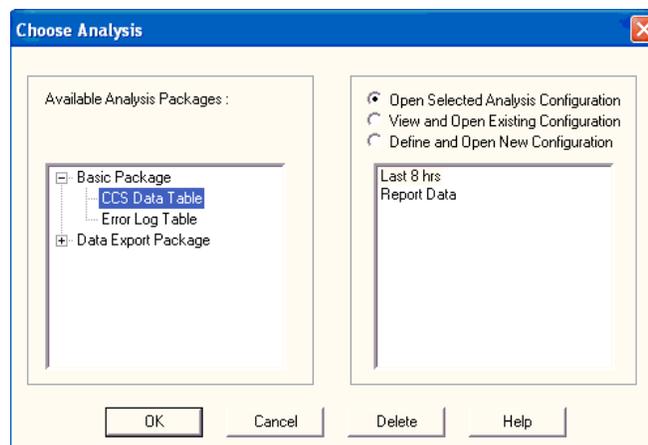
Creating an analysis

The following procedure creates a typical Sample Data Table which will be updated as samples are tested. For additional information on analyses, consult Chapter 7, *Analysis Configuration Options*, as well as the manual chapter corresponding to the specific 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. Click the “+” for the **Basic Package** to reveal available analyses.
4. Click **CCS Data Table**. Previously-saved analyses (if any) will be displayed in the list box on the right side of the window.
5. Click on the **Define and Open New Configuration** radio button  (or verify that the option is selected).



The CCS Choose Analysis window

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 .

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) and click OK. The program will prompt you to save the analysis configuration.
9. Click Yes. (OR click NO to display the analysis without saving it.)
10. If Yes was selected, use your keyboard to type the name you wish to use for the analysis in the text box.
11. Click OK. The analysis will be saved and data obtained during the selected time window will be displayed (see graphic, next page).

| Sample ID | Date | Smpl Index | Test Temp(°C) | Test Speed(rpm/1000) | Viscosity(mPa·s) | Std Visc(mPa·s) | % Diff |
|-----------|-----------|------------|---------------|----------------------|------------------|-----------------|--------|
| CL28 | 6/28/2002 | 3 | -20.00 | 0.1766 | 5142 | 5100 | 0.82 |
| CL38 | 6/28/2002 | 5 | -20.00 | 0.0781 | 12556 | 12500 | 0.45 |
| CL48 | 6/28/2002 | 6 | -20.00 | 0.0475 | 21083 | 21250 | 0.79 |
| CL14 | 6/28/2002 | 1 | -25.00 | 0.4288 | 1653 | 1604 | 3.07 |
| CL16 | 6/28/2002 | 2 | -25.00 | 0.3330 | 2382 | 2309 | 3.18 |
| CL19 | 6/28/2002 | 3 | -25.00 | 0.2417 | 3599 | 3510 | 2.53 |
| CL22 | 6/28/2002 | 4 | -25.00 | 0.1742 | 5306 | 5200 | 2.04 |
| CL25 | 6/28/2002 | 5 | -25.00 | 0.1267 | 7588 | 7480 | 1.44 |
| CL28 | 6/28/2002 | 6 | -25.00 | 0.0866 | 11446 | 11350 | 0.84 |
| CL16 | 6/28/2002 | 3 | -30.00 | 0.1862 | 4955 | 4830 | 2.58 |
| CL10 | 6/28/2002 | 1 | -35.00 | 0.4182 | 1683 | 1701 | 1.08 |
| CL12 | 6/28/2002 | 2 | -30.00 | 0.4339 | 1599 | 1597 | 0.12 |
| CL14 | 6/28/2002 | 3 | -25.00 | 0.4309 | 1593 | 1604 | 0.70 |
| CL14 | 6/28/2002 | 3 | -30.00 | 0.2580 | 3263 | 3270 | 0.22 |

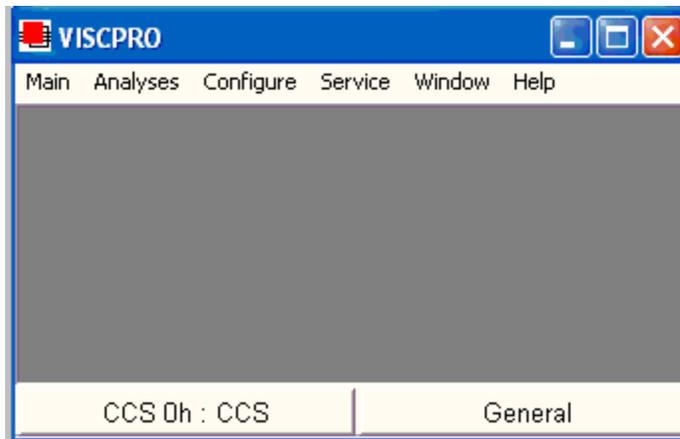
Idle

The CCS Data Table

USING THE CCS 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.



VISCPRO® primary display with menu options

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.

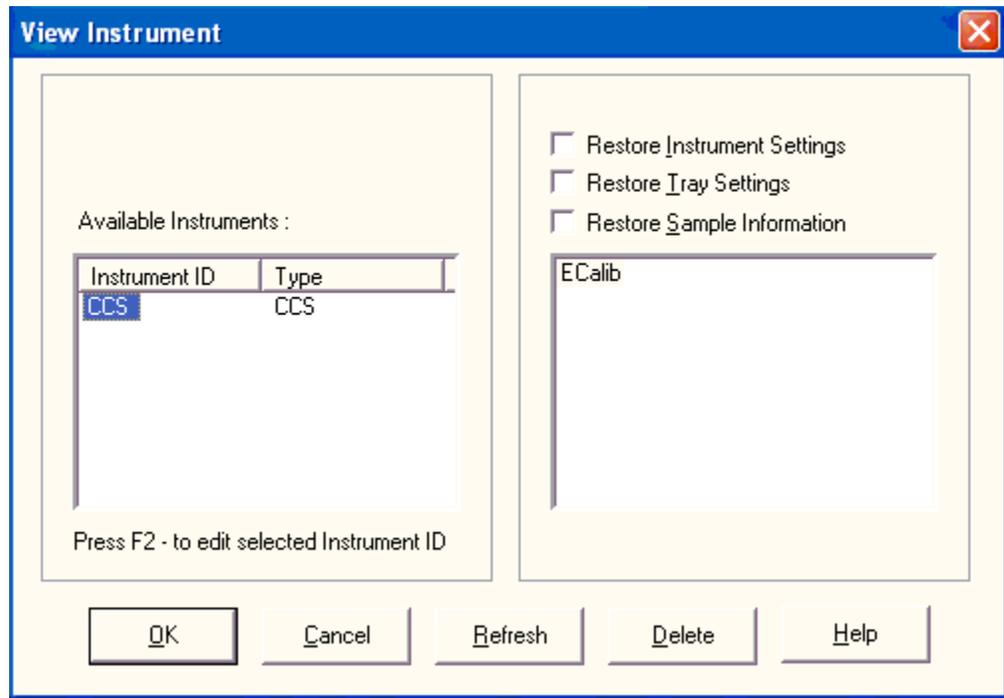
NOTE

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

Main options

View Instrument...

The View Instrument option opens the View Instrument 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 window

The View Instrument window is comprised of:

- Two list boxes (Available Instruments and Saved Configurations)
- Restore ... check boxes (the Restore Instrument Settings and Restore Service Settings options are password-protected managerial/service functions)
- Five button options (OK, Cancel, Refresh (screen refresh), Delete and Help).

Available Instruments: The Available Instruments list box in the View Instrument window displays a list of all on-line instruments for configuration. To view and/or select saved configuration options for an on-line instrument, you must first click on the desired instrument from the list of available instruments.

NOTE

To access the Instrument View window to enter sample information for the selected instrument WITHOUT restoring elements of a saved configuration, click on the desired instrument, then click OK without checking any of the Restore options. The last-used configuration for that instrument will be retrieved.

Saved Configurations: The Saved Configurations list box (located directly under the Restore . . . check boxes) 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 instru-

ment 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  key. Click Yes at the Confirm Delete prompt to immediately and permanently delete the configuration.

Restore ... : The Restore check boxes allow you to restore Instrument, Tray or Sample information from the saved configuration for the selected instrument.

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.

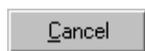
Click the Restore Tray Settings check box if you want to restore all tray settings for the highlighted saved configuration (see *Tray (Test) Settings: ...* sections in this chapter). Tray configuration settings apply to the individual Sample Trays of an instrument and act as default settings for individual sample tests.

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

View Instrument window button options:



Opens the Instrument View window for the selected instrument and restores any selected configuration settings.



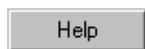
Closes the View Instrument window.



Updates the Available Instruments list box to include instruments which may have come on-line since the software was loaded.



Permanently and immediately deletes the highlighted instrument configuration (functions only when a configuration is selected).



Accesses context-sensitive help.

Save Instrument...

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

To use the Save Instrument 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.

Poll for Instruments

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 may be completed during CCS 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 CCS 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.

Log In...

Use the **Log In** feature to identify the CCS 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**.

Change Password...

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.

Update User Information...

Use the **Update User Information** feature to update the security list of authorized CCS 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.

Log Out

To use the Log Out feature, click Log Out from Main. The current user will be logged out of the security list of authorized CCS technicians and managers. The software will automatically reset to the lowest security level. Any ongoing test operations will continue.

Print/Print setup options**Print...**

Ctrl+P

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*).

Print Setup...

Select this standard Windows® print option to access the print setup window. Check your printer driver documentation for additional information on print setup options.

Exit

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 CCS to a safe state before resuming CCS testing.

Analyses options

The Analyses options are used to create, revise and restore reports based on CCS test data. 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 7 of the manual for general information on using the analysis options. For specific information regarding the individual analysis packages shipped with your software, consult the manual chapter describing 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

- **CCS Data Table**—displays test data.
- **Error Log Table**—lists error messages and related data.
- **Export analyses**—configures data for output to a file, parallel port, or serial port.

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 7 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.

[View Analysis ...](#)

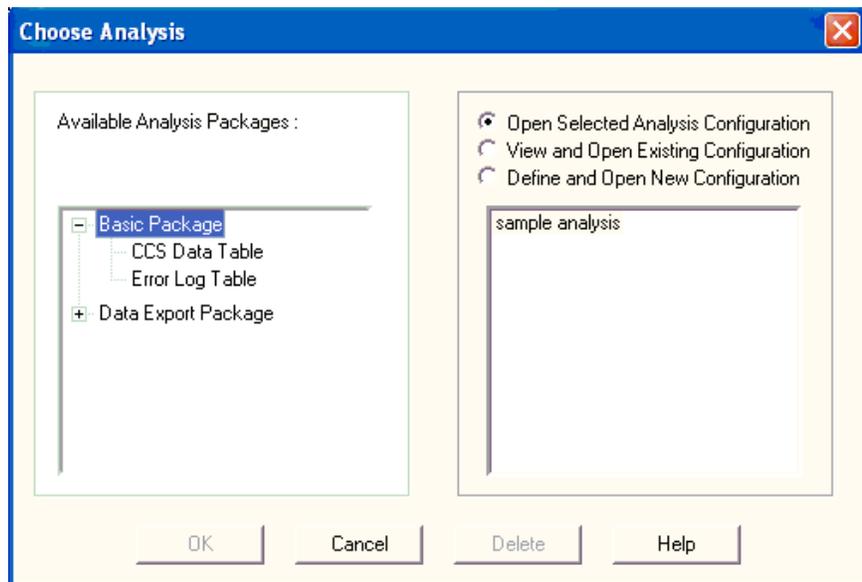
Select Analyses from the VISCPRO® primary display to select an analysis from a list of available analyses or define a new analysis.

Displaying an existing analysis To display an existing 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.

NOTE

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

Select the desired analysis from the directory tree (see graphic, next page). 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.



The Choose Analysis window

- 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** if you wish to open the configuration window using default settings for the selected analysis.

Click the appropriate radio button corresponding to the desired option. Then select the desired saved configuration (if any) and click **OK**.

For more information on defining and using configurations, see Chapter 7.

NOTE **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 VISCPR® screen configuration, including any currently-open analyses and Instrument View windows. To restore the saved configuration to the VISCPR® display, click **Restore Window Layout** (see below).

Restore Window Layout

This function restores the saved VISCPR® screen configuration. Any currently-open analysis windows will be closed before the saved configuration is loaded. Restoring a saved window configuration does not affect current CCS sample testing operations.

Also note that currently-open windows may be obscured by the restored configuration. To view these obscured windows, click **Window** from the VISCPR® primary display and select the desired window.

CCS module menu options

In addition to the VISCPR® 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 VISCPR® software menus and windows. The CCS software module generates menu choices from the VISCPR® primary display. These menu choices (under the **Configure** and **Service** headings) access important CCS configuration and operation options.

Configure options

The **Configure** menu provides the user with a powerful tool for description of CCS instrument capabilities, and for customizing CCS 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 variety of 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 (instrument type, temperature probe, etc.).

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

Print Instrument and Tray (Test) Settings

Print instrument settings

The Print Instrument and Tray (Test) Settings option prints instrument and tray settings. When you select this option, a Windows® 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.

Instrument Settings

Select Instrument Settings to open the Instrument Settings window, which provides features for describing the CCS and storing the temperature probe constants for the instrument.

ID :

Use the ID field to input instrument identification information using up to 30 alphanumeric characters.

S/N :

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

The CCS Instrument Settings window

Probe constants

Constants a0, a1 and a2 for the temperature probe are entered here whenever the temperature probe is replaced. Values should be obtained from the calibration certificate accompanying the probe.

See Checking/editing instrument settings in Chapter 1 for additional information.

Instrument Settings window button options:

saves the current instrument settings and exits the Instrument Settings window.



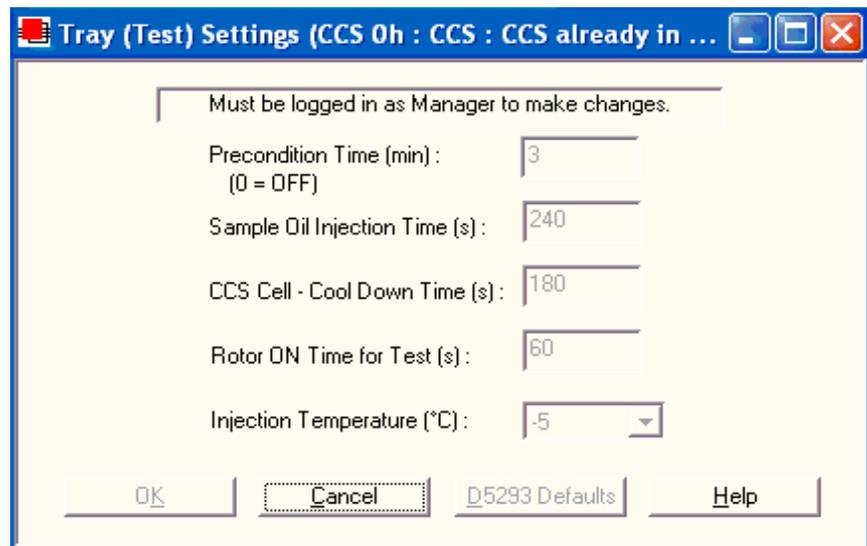
closes the Instrument Settings window without saving any configuration changes.

Tray (Test) Settings

Use the Tray (Test) Settings window to set default test parameters for individual sample tests. 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**.

NOTE

To change the Tray (Test) Settings for your instrument(s), you must log in to the security system as a manager.



- The **Precondition Time (min)** is the initial warmup period immediately prior to testing the first sample. This warmup period permits thermal stabilization of the CCS motor and power supply. It supersedes the optional protocol of running two or three "throwaway" samples prior to sample testing. The default **Precondition Time** (recommended) is 3 minutes. Acceptable values are 0-9 minutes.
- The **Sample Oil Injection Time (s)** is the amount of time (in seconds) required to complete injection of 50-55 ml of oil sample into the rotor/stator mechanism. It is not usually necessary to adjust this parameter. However, setting the injection time to "0" will permit

the user to run a test with the sample previously injected in the rotor/stator (no further injection will occur). The default **Sample Oil Injection Time** is 240 seconds.

- The **CCS Cell Cool Down Time (s)** is the amount of time (in seconds) allotted to cool the sample to the test temperature and stabilize the sample temperature. The default **CCS Cell Cool Down Time** is 180 seconds. Smaller values may enhance throughput for multiple samples but may result in greater imprecision in viscosity measurement. Use of smaller values is *not* in conformity with the ASTM D 5293 test protocol. Larger values may enhance precision in circumstances where the ambient temperature is unstable or unusually high. Use of values above 180 seconds is in conformity with the language of ASTM D 5293.
- The **Rotor ON Time for Test** is the total amount of time (in seconds) that the rotor is spinning during the CCS test protocol. Viscosity readings are taken during the final five seconds of the **Rotor ON Time**. The default **Rotor ON Time** of 60 seconds is specified in ASTM D 5293 and should only be changed for research purposes. Sample test protocols using spin times other than 60 seconds are not in conformity with ASTM D 5293.
- The **Injection Temperature** is the temperature at which sample injection will be initiated. Available temperatures are +25°C ... -25°C in 5° increments. Select a temperature high enough that injected sample will adequately displace the oil remaining in the stator block from the previous sample test. The default setting is +25°C. This temperature may be reduced in unusual situations, including conditions where ambient temperatures make it more difficult for the thermoelectric unit to attain 25°. Using a lower temperature setting with non-thermoelectric CCS units may enhance throughput.

Saving a configuration

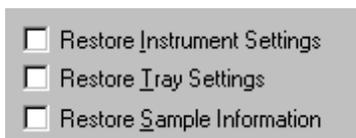
Whenever you have altered instrument or test configuration, you may wish to save the resulting settings as a new or existing configuration. To save current settings, use the **Save Instrument** option:

Procedure

1. From the VISCPRO® primary menu options, select **Main**.
2. Click on **Save Instrument**. The **Save Instrument** window will appear.
3. Select an instrument to apply the current Instrument/Tray/Sample settings to.
4. Type a name for the new configuration in the **Save As:** box. Or double-click an existing configuration from the configuration list box.
5. Click **OK** to save the configuration. Or click **Cancel** to exit the **Save Instrument** 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 View Instrument 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 View Instrument from the Main menu options.
2. Select the desired instrument from the left list box.
3. Select the desired saved configuration from the right list box.
4. 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 default test settings from the saved configuration.
 - Restore Sample Information restores all sample ID setup information for the Instrument View window from the saved configuration.
5. 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.

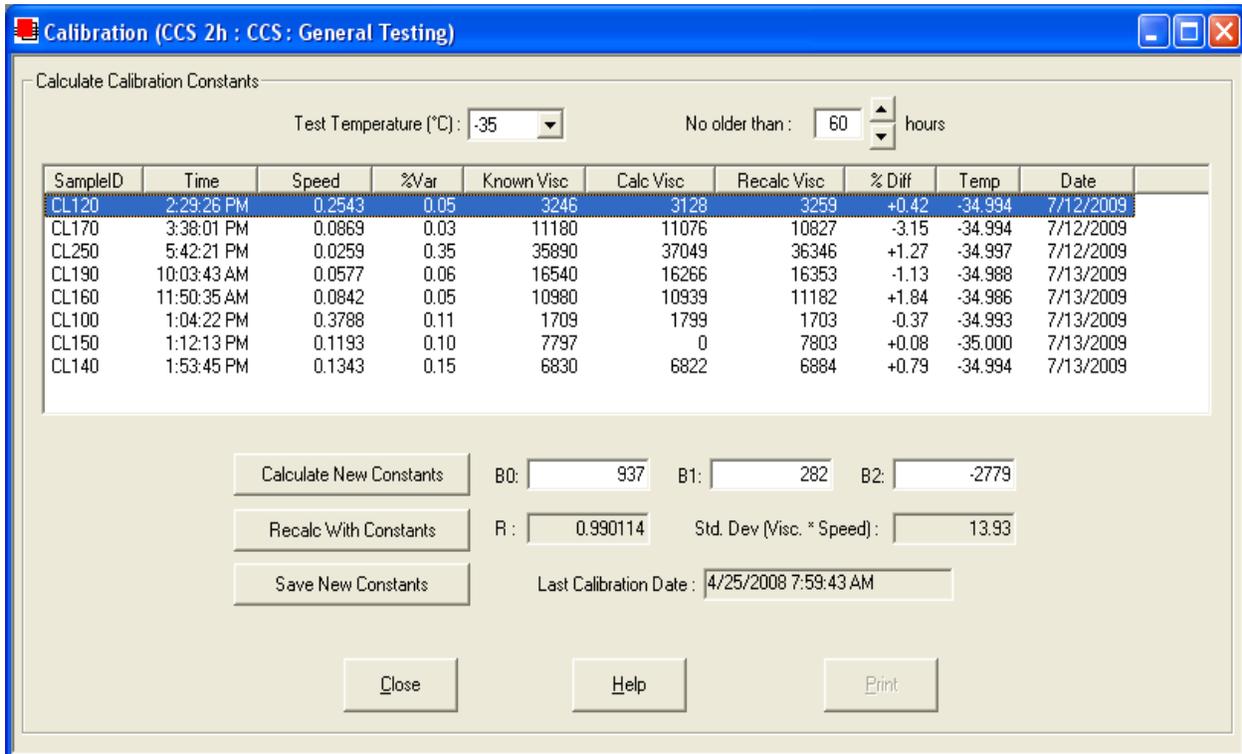
NOTE

If you have updated the settings, you may wish to save the current instrument/tray/sample configuration by selecting Save Instrument from the Main menu, inputting the configuration name in the Save As: text box, and clicking OK.

Calibration

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

For detailed information regarding the CCS calibration procedure, see Chapter 3, *Calibrating the CCS*.



The Calibration window

The Calibration window options are described briefly below:

Test Temperature: Use the spin controls  to select the desired calibration temperature.

No older than: Use the spin controls to select the time frame from which calibration test data is to be obtained.

Data selection: Test data from standards run with the CCS 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 **Ctrl** key 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 **Ctrl** key.

Calculate new constants: After selecting desired data for calibration, click Calculate new constants to derive new values for b0, b1 and b2.

NOTE

Sample test data from at least three different standards for each calibration temperature must be available for calibration calculations to be performed.

 Calculate new constants

Click on Calculate new constants to display new calibration values.

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.

If the difference is too great, repeat the calibration process until the difference falls within acceptable limits (refer to the precision statement in ASTM D 5293).

Recalc with constants

Recalc with constants: When initial calibration results are unsatisfactory, you may use the **Recalc with constants** option to compare various calibration options, including manual data entry of calibration constant data. See Chapter 3 for more information.

Save New Constants

Save New Constants: When you are satisfied with calculation results, click on **Save New Constants** to save calibration values.

NOTES

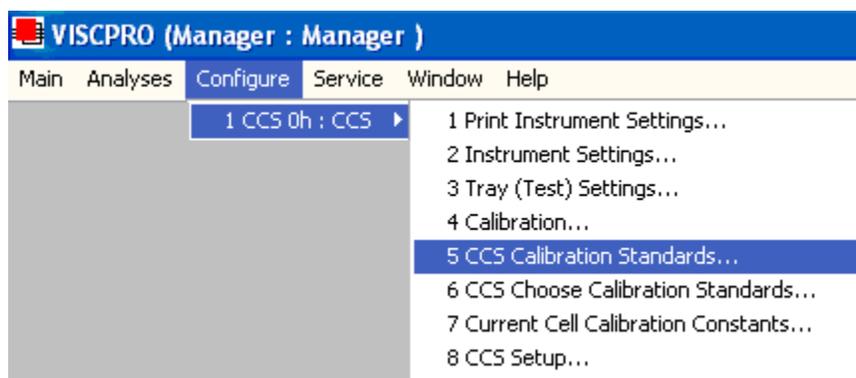
Once the Save New Constants button is pressed, the updated calibration constants are associated with the selected instrument, and will remain the same regardless of the instrument configuration defined for that instrument.

You must click Save New Constants if you wish to save the new calibration constants.

CCS Calibration Standards

The CCS Calibration Standards window provides controls for modifying, adding, and deleting a list of calibration standards maintained in your laboratory. You must be logged onto the system as a manager to make changes to all data except standard viscosity.

To access the CCS Calibration Standards window, click **Configure** and select your CCS instrument. Then click **CCS Calibration Standards**.



The CCS software is installed with a standard set of **CANNON**® CL calibration standards and temperatures:

| SampleID | Temperature(°C) | Known Visc(mPa·s) |
|----------|-----------------|-------------------|
| CL10 | -35 | 1700 |
| CL12 | -30 | 1600 |
| CL12 | -35 | 3200 |
| CL14 | -25 | 1600 |
| CL14 | -30 | 3250 |
| CL14 | -35 | 7000 |
| CL16 | -25 | 2500 |
| CL16 | -30 | 5500 |
| CL16 | -35 | 11000 |
| CL19 | -20 | 1800 |
| CL19 | -25 | 3500 |
| CL19 | -30 | 7400 |
| CL19 | -35 | 17000 |
| CL22 | -15 | 1300 |
| CL22 | -20 | 2501 |
| CL22 | -25 | 5100 |
| CL22 | -30 | 11100 |

To edit the list of calibration standards, triple-click on the desired cell. Then input your information. To save your changes, click **Save**. To exit the Calibration Standards window without making changes, click **Cancel**.

For additional information regarding the CCS calibration procedure, see Chapter 3, *Calibrating the CCS*.

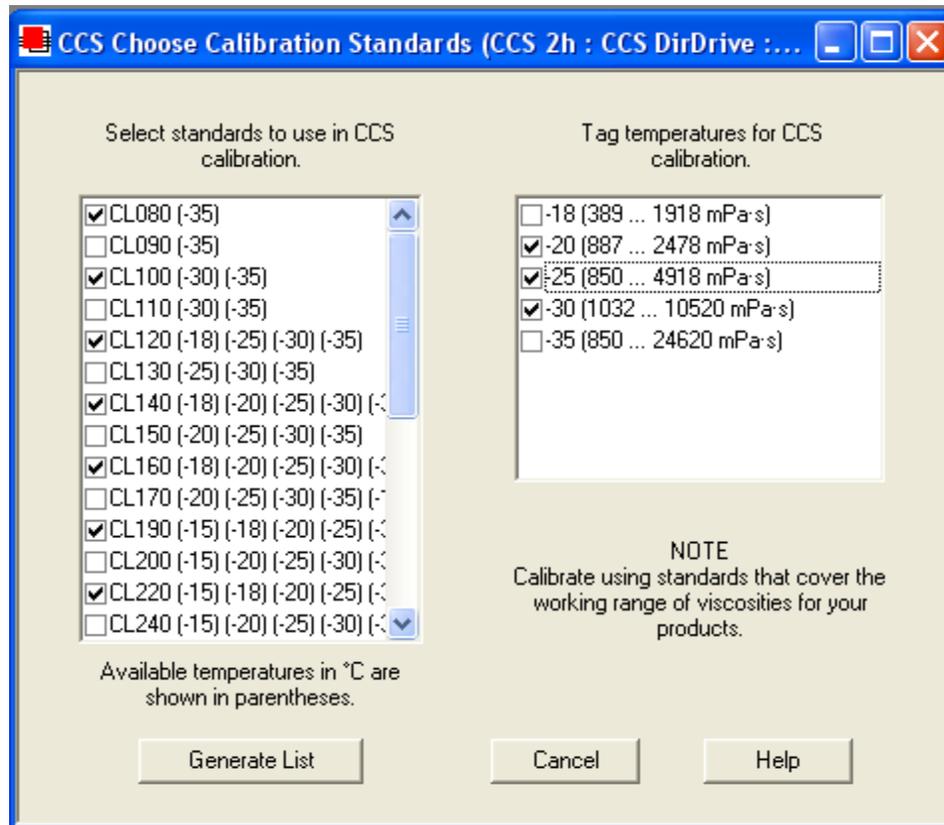
CCS Choose Calibration Standards

The CCS Choose Calibration Standards window is used to initiate an automated calibration procedure using standards available in your laboratory. The CCS calibration involves testing standards of known viscosity and comparing the results with the known values for viscosity.

To open the window, click **Configure** and select your CCS instrument. Then click **CCS Choose Calibration Standards**.

Standards available from the calibration list (see previous section) will be displayed in the CCS Choose Calibration Standards window.

Click the desired standards to select them for inclusion in a calibration test run. If necessary, click again to de-select a standard from the test sequence.



The CCS Choose Calibration Standards window

When you have selected at least three standards with the same valid calibration temperature, valid temperatures for calibration will appear in the Tag temperatures ... list box.

After all desired standards have been selected, select the desired calibration temperatures from the list box by clicking on the check box in front of them. Then click **Generate List** to create a sample test sequence for the calibration standards. To exit the **Choose Calibration Standards** window without making changes, click **Cancel**.

For additional information regarding the CCS calibration procedure, see Chapter 3, *Calibrating the CCS*.

Current Cell Calibration Standards

The CCS Current Cell Calibration Standards window displays a list of temperatures and cell calibration constants for each temperature.

For additional information regarding the CCS calibration procedure, see Chapter 3, *Calibrating the CCS*.

CCS Setup

The CCS Setup window provides controls for defining your instrument serial number and instrument type. These settings should not ordinarily be changed.

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 diagnostic values for the CCS instrument. These settings may be helpful to **CANNON**® technical personnel when troubleshooting difficulties with the CCS.

Sample List Service

The CCS Sample List Service window displays a sequential list of current samples and the temperature(s) at which each will be tested.

CCS Set Motor Current ...

The CCS Motor Current window provides the software interface for adjustment of the CCS motor current. To set the CCS motor current:

1. Select the **Set Motor Current** option from the **Service** menu. The **Set Motor Current Service** window will appear.
2. Prepare a 60 ml bottle of **CANNON**® CL25 viscosity standard and place it in position 1 of the Sample Table. Then press the **Start** button. The CCS will begin the current adjustment procedure.
3. When the rotor/stator has reached the correct temperature, the software will prompt you to adjust the CCS motor current using the dial on the front panel of the Control Unit. Adjust the current until the value in the **Speed:** field of the **Motor Current Service** window indicates a rotor speed of 240 rpm.

The **Set Motor Current Service** window will continue to display cell temperature and cell motor speed. When you have completed the rotor speed adjustment procedure, press the **Close** button to exit the **Set Motor Current Service** window. To terminate the **Set Motor Current Service** process at any time, click **Finished**.

Stepper Motor Service

The CCS Stepper Motor Service window provides an interface for initial orientation of the CCS-2100 sampler mechanism. The **Stepper Motor Service** window also provides convenient controls for relocating the sampler during troubleshooting or diagnostic procedures. The CCS Stepper Motor Service window controls are described below:

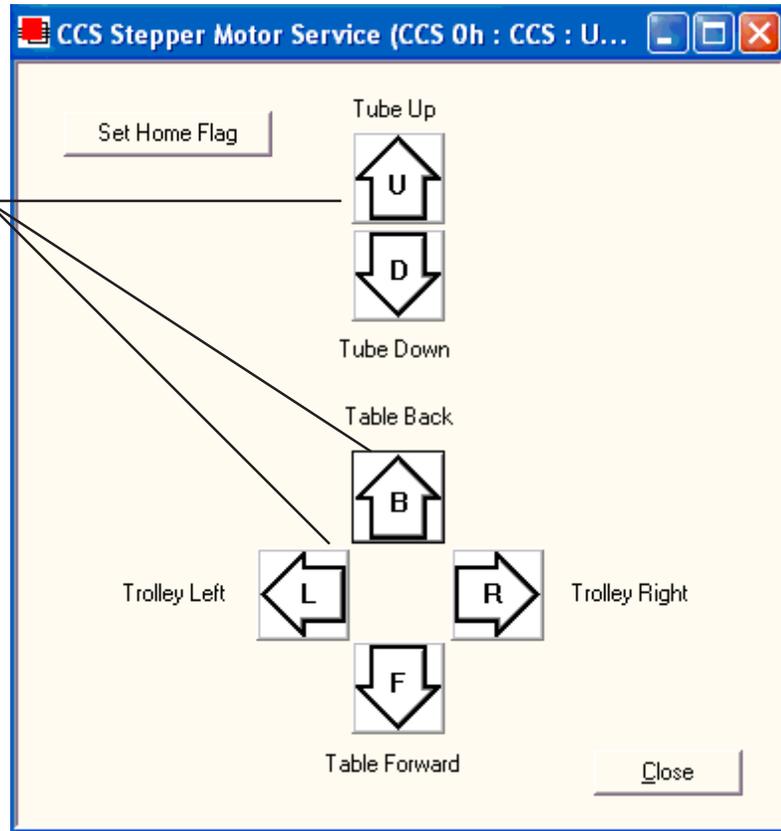
Initial orientation of Sampler Mechanism (CCS-2100 only):

Use Tube Up, Table Back and Trolley Left buttons to orient the sampler mechanism over Sample #1 with tube in raised position. Then click Set Home Flag.

Tube Up and Tube Down buttons raise/lower tube. Other buttons move sampler mechanism forward/backward and left/right.

Use buttons only when setting home flag or executing diagnostics or troubleshooting procedures.

NOTE: Stepper Motor Service actions are not functional during CCS testing.



The CCS Stepper Motor Service window

Testing samples—software options

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

Entering sample ID information

1. From the VISCPRO® primary menu options, click on Main.
2. Select View Instrument from the menu options.
3. Select the desired instrument from the list box on the left side of the View Instrument window and (if necessary) select a preset instrument configuration from the list box on the right side of the window.

NOTE

If you do not see the desired instrument listed in the left 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 on-line instruments.

NOTE

If you are restoring a saved configuration, select the elements of the configuration that you wish to apply to the current instrument (Instrument

Settings, Tray Settings or Sample Information) by clicking on the check box to the left of the element. If no boxes are checked, no preset configuration information will be restored (the current configuration will be used).

4. When you are done, click OK. The Instrument View window for the selected instrument will appear.
5. To input sample identification information for the samples to be tested, click on the sample number in parentheses (or press **[F2]**) to access the sample ID field.

NOTE

To select more than one sample at a time from the list box, highlight the first sample and then 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 the highlighted samples.

6. Enter the desired sample ID, using up to 21 alphanumeric characters; then press the **[Tab]** or **[Enter]** key.

Selecting sample actions

7. 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.
8. Select the desired sample action from the window by clicking on it.

| | |
|-----------------------------|--|
| 0 No action | |
| 1 Measure Viscosity | |
| 2 Verify Known Viscosity | |
| Configure | |
| Delete | |
| Insert At | |
| Copy All Selected Samples | |
| Paste Into Selected Samples | |
| Sequential Sample IDs ... | |
| Clear All Trays | |

The Sample Action popup

Sample actions

Sample actions are listed and described briefly below and in greater detail in succeeding sections.

- **No action**—clears Sample ID and action columns for highlighted samples. No testing will take place for this tray position.
- **Measure Viscosity**—measures sample viscosity.
- **Verify Known Viscosity**—measures calibration standard viscosity and tags data for possible use in CCS calibrations.
- **Configure**—permits adjustment of sample test specifications for selected individual samples/standards. The **Configure** options will vary depending on the selected sample action (Measure Sample Viscosity or Verify Known Viscosity).
- **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**—Deletes all sample testing information from the Instrument View window.

Measure Viscosity

When the Measure Viscosity action is selected, the Action Parameters window (see graphic) permits users to alter important test parameters:

| Temperature(°C) | Test Time(s) |
|----------------------------|--------------|
| 0.00 | 60 |
| Click here to add new item | |

Sample Oil Injection Time (s): 240

CCS Cell - Cool Down Time (s): 180

OK Cancel

Action Parameters window

The Temperature field allows you to select the desired test temperature from a list of temperatures at which the CCS has been calibrated.

The Test Time option permits you to input a value (in seconds) for the duration of the test. The default test time of 60 seconds is analogous to the manual CCS procedure described in ASTM D 5293. This default manager-level security setting should normally remain unchanged.

The Sample Oil Injection Time is the amount of time prior to testing during which the sample is injected into the test cell. The default manager-level security setting of 240 seconds should normally remain unchanged.

The CCS Cell -- Cool Down Time is the amount of time prior to testing during which the sample is first cooled to the test temperature and then maintained at that temperature prior to testing. Longer times will help ensure that the temperature has stabilized prior to testing. Shorter times will enhance throughput. This is also a security-protected function accessible only to Manager-level personnel. The default setting, 180 seconds, is described in ASTM D 5293.

Verify known viscosity

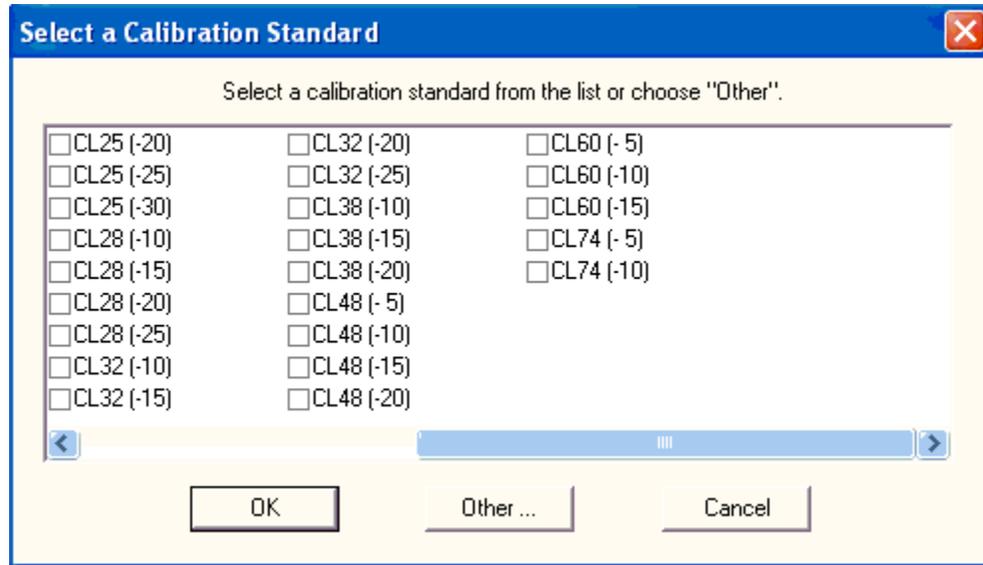
When the Verify Known Viscosity action is selected, the Select a Calibration Standard window opens (see graphic, next page) and prompts you to select the desired calibration standard and test temperature from the previously-saved list of calibration standards. Select the standard by clicking on it. Then click OK to exit the Select a Calibration Standard window.

Inserting a new standard

You can also input an unlisted standard by clicking the Other button to open the Action Parameters window. Enter the temperature and known viscosity in the appropriate fields and click OK.

NOTE

The unlisted standard will not be added to the list of calibration standards. If you would like the unlisted standard to appear in future calibrations, add it to the calibration list (Configure/CCS Calibration Standards).



Select a Calibration Standard window

Sequential sample IDs

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.

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).

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.

The dialog box titled "Assign Sequential Sample IDs" contains the following fields and controls:

- Prefix: A text input field with a dropdown arrow.
- Suffix: A text input field with a dropdown arrow.
- Starting ID: A text input field containing the number "1".
- Number of Samples: A spinner control set to "5".
- Use As Format: An unchecked checkbox.
- OK: A button.
- Cancel: A button.

Assign Sequential Sample IDs window

Clear All Trays

Clear All Trays—Deletes all sample ID and test information from the View Instrument window.

NOTE

If you have stored sample information in a saved configuration, you can restore sample information by clicking on View Instrument from the Main menu options, selecting the desired configuration from the list box in the View Instrument window, clicking on the Restore Sample Information check box, and then clicking OK.

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 test sequence, highlight the desired sample location in the 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 sequence.

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 7, *Analysis Configuration Options*. For information on a specific analysis module included with your CCS package, see the chapter on the particular analysis.

Custom analysis modules may be purchased from **CANNON**® Instrument Company.

Status bar CCS error tracking

VISCPRO® errors

The VISCPRO status bar at the bottom of the primary display window includes two buttons. One is labelled with the name of the CCS instrument (usually CCS:OH) and the other is titled **General**.

When the VISCPRO software generates an error message, one of these buttons will blink steadily and repeatedly to provide a visual clue to the occurrence of the error and the nature of the error.

To display a report of current errors, click on the desired button on the status bar. This analysis may be useful in diagnostics and troubleshooting by **CANNON**® service personnel.

NOTE

When you close the error window, the current errors will be deleted from the display. Error data will remain in the VISCPRO database in the event that an analysis of error data is to be prepared.

To generate a report of past errors, follow the instructions in the chapter on the Error Log Table analysis.

MAINTAINING AND SERVICING THE CCS

This chapter of the CCS Instruction & Operation Manual contains information regarding maintenance and service of the CCS instrument.

CCS components

The standard CCS installation includes two primary components:

- CCS Unit
- Waste system



CCS Unit

The CCS Unit includes the Control Chassis, the rotor/stator mechanism comprising the test cell, the sample table and Sample Tray. The Control Chassis houses the primary control and operating systems for the CCS, including the onboard microprocessor.

Waste system

The Waste System includes the external waste container, enclosed vacuum pump, and assorted tubing for conveying waste sample from the instrument to the waste container.

Emptying the waste container



CAUTION *Always check the volume of the waste container prior to beginning CCS testing, to avoid waste spillage or overflow.*

The waste container collects sample residue drained from the rotor/stator mechanism during the cleaning/flushing process. The drain system operates with a vacuum pump.



CAUTION *The vacuum lines should be kept short and neat (no loops or knots).*

Procedure

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



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

2. Pour the collected waste from the waste container into a proper waste storage container.
3. Replace the drain tube(s) in the waste container.



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

Waste container connections For information regarding waste container connections, refer to Chapter 1.

Repairs/diagnostics

The CCS is designed for long-lasting service with a minimum amount of maintenance on equipment and replacement of supplies. However, certain components may need special attention and/or periodic replacement. These parts/supplies and various troubleshooting procedures are described below:



CAUTION *Turn off CCS power and remove power cord before performing maintenance and/or cleaning procedures. Do not clean the instrument unless the cell temperature is within 10°C of ambient.*

Rotor/stator assembly

It may be necessary to return the rotor/stator assembly to **CANNON**[®] Instrument Company for service for one of the following reasons:

1. A foreign particle has become lodged between the rotor and the stator, and is preventing rotation.
2. The rotor and stator are damaged as a result of operating with dirt particles present in the sample, or as a result of starting the motor without oil having been charged in the unit.
3. The flexible shaft on the rotor has broken or become detached.
4. Preventive maintenance (**CANNON**[®] recommends replacement of the rotor/stator mechanism every 4,000 hours of operation or every two years, whichever comes first.)

Removing the assembly

Before attempting to remove and/or replace the rotor/stator assembly, obtain the most current procedural documentation by calling the service department at **CANNON**[®].

Checking/reseating the thermistor probe

The thermistor probe may develop an electrical short, or a lead may break, producing an open circuit. Use an ohmmeter to determine the probe resistance (it should be approximately 5,000 ohms at room temperature). A short may occur between the two terminals on the plug or between one of the leads and the metal sheath. The resistance between the plug and sheath should exceed 50,000 ohms.

More often, poor temperature control can be caused by poor contact between the thermistor probe and the stator block.

Reseating thermistor probe

If poor thermistor contact is suspected, the thermistor probe should be removed from the stator well and the contact points cleaned and prepped per the following procedure:

1. Remove the thumbscrew which attaches the thermistor clamp to the stator block cover.
2. Remove the thermistor probe from the well hole in the stator block.
3. Clean the thermistor well by hand with a sharp, #31 twist drill (approximately 3.05 mm (0.120") in diameter) until surface impurities at the bottom have been scraped away. Remove the accumulated debris by vacuum from an air jet.
4. Locate the small vial of thermal compound (or other suitable thermal joint compound) contact solution shipped with the CCS. Stir the thermal compound thoroughly with a small screwdriver or similar tool, then apply the material to the tip of the thermistor probe.
5. Replace the thermistor probe in the well hole.

6. Replace the foam insulation above the probe.
7. Replace the thermistor clamp and thumbscrew.

Thermoelectric modules

The water/antifreeze mixture removes excess heat from the thermoelectric modules during CCS testing. If the unit is not cooling properly, check the temperature of the liquid coolant. It should be maintained by the chiller at approximately +5°C. If the water chiller temperature is set too high, or if the chiller is not operating, the hot side of the heat sink on the thermoelectric modules will overheat, tripping a protective thermostat. No further cooling will take place until the temperature drops sufficiently to avoid damage to the thermoelectric modules.

Replacing the vacuum pump diaphragm



CAUTION

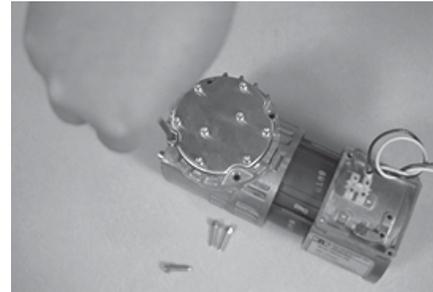
Turn off CCS power and remove power cord before performing maintenance and/or cleaning procedures.

NOTE

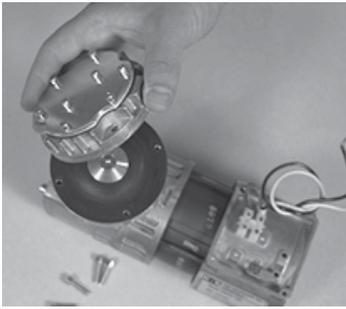
It is not necessary to remove the vacuum pump from the waste container for the diaphragm replacement. The pump has been isolated from the waste container to enhance clarity of photography.

Replacement procedure

1. Turn the CCS instrument OFF.
2. Locate the vacuum pump in the waste container.
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).
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. Make sure to line up the hole in the center of the diaphragm with the hole in the vacuum pump.
8. Replace the 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 screws and tighten securely.



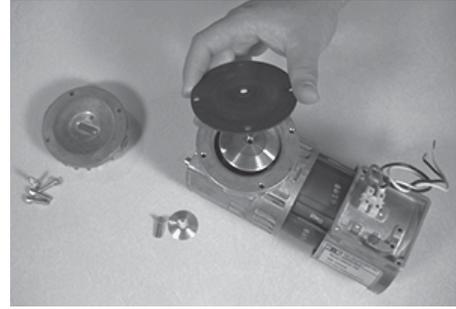
Removing screws securing pump housing



*Removing pump housing
pump*



Releasing pump diaphragm

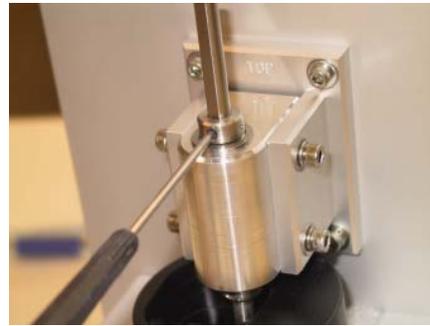


*Removing diaphragm from
pump*

Gapping the rotor in the stator well

The rotor should be suspended 1/16" above the bottom of the stator well. To achieve this, follow the procedure below:

1. Loosen the 1/16" Allen set screws securing top and bottom ring collars to the flats of the rotor and make certain that the rotor is resting on the bottom of the stator well.
2. Place one of two 1/16" Allen wrenches (or a 1/16" gage—see photo) between the shaft-bearing hanger assembly and the bottom collar (see photo). Then pinch the bottom collar against the wrench/gage and tighten the set screw to secure the collar against the flats of the rotor.



3. Remove the gage and slide the bottom collar up against the shaft-bearing hanger assembly. The rotor will be raised 1/16" from the bottom of the stator well.
4. Make certain that the bottom collar is resting against the bottom shaft-bearing hanger assembly and use a 1/16" Allen wrench to tighten the top collar set screw against the flat of the rotor to lock the collar in place.

NOTE

To check the gap, loosen the top collar set screw and allow the rotor to drop to the bottom of the stator well. Then measure the space between the bottom collar and the shaft-bearing hanger assembly. The distance should be 1/16". If it is not, repeat the gap procedure. To restore the gap, repeat steps 3 & 4 above.

Preventive maintenance

The following checklists provide guidelines for properly maintaining your CCS instrument:

Biannual maintenance

- Replace coolant antifreeze/water mixture annually.
- Clean Sample Table and painted surfaces of the instrument with a damp cloth and mild detergent solution.
- Check for loose parts/connections and secure if necessary.
- Check motor drive belt for signs of wear (cracks, fraying) and replace if necessary.
- Check thermistor probe connections. If necessary, clean the thermal well and reorient the probe per instructions in this chapter.
- Check clearance between the bottom of the rotor and the bottom of the cup (should be 1.0-1.5 mm). Gap rotor if necessary (see preceding section).
- Check refrigerated chiller temperature setting and temperature. Adjust if necessary.
- Check coolant fluid level. Add additional fluid if necessary.
- Check coolant lines between the tank and the CCS instrument for cracks, leaks, kinks, and integrity of insulation.
- Check integrity of the vacuum pump diaphragm. Replace if necessary (see previous section for procedure).
- Clean the fan in the RA box. (It will be necessary to remove the interface box housing to clean the fan. Remove the four screws and lift the housing to access the fan.)
- Calibrate the CCS instrument. Check accuracy with **CANNON**[®] standards.

Cleaning the instrument housing



CAUTION

Before cleaning the CCS, turn off the instrument and unplug the power cord. Do not clean the instrument unless the cell temperature is within 10°C of ambient.

Periodically clean the outside of the unit with a damp cloth moistened with water and/or a mild detergent solution.

ANALYSIS CONFIGURATION OPTIONS

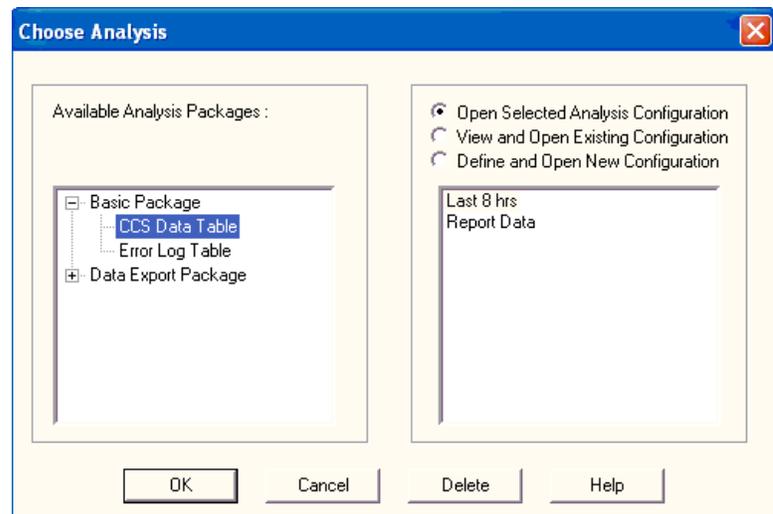
Data obtained from all instruments during sample testing is stored in the central VISCPR® database. To view data, you must create an analysis configuration requesting the desired sample information in the desired format. Analysis configurations can be saved and later restored. The analysis configuration 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 VISCPR® 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.

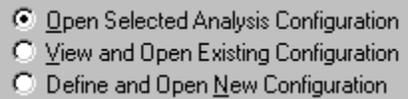


NOTE

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

- Click on the radio button  corresponding to the desired analysis action:

The **Open selected Analysis** option will open the selected analysis without providing an opportunity for modification of the analysis.

- 
- O**pen Selected Analysis Configuration
 - V**iew and Open Existing Configuration
 - D**efine and Open **N**ew Configuration

Radio button options for analysis configuration

The **View and Open Existing Configuration** option will permit the user to view/modify an existing analysis (see notes and procedure following).

The **Define New Analysis** option will create a new analysis (see notes and procedure following).

NOTES

If no analyses have been created, none will appear in the text box on the right side of the window, and only the Define New Analysis option will be available. If you have already configured and saved an analysis, its name will appear in the list box. If you select 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.

- Click **OK**. If the **Open Selected Analysis** option was selected, the analysis will be immediately displayed. If the **View and Open Existing Configuration** or **Define New Analysis** options were selected, the **Analysis Configuration** window will appear. The **Analysis Configuration** window consists of tabbed pages with filter options appropriate for the analysis.
- Click on the tab corresponding to the filter you wish to set and complete the configuration options. For further information on selecting filter options, see the following sections of this chapter, as well as the chapter corresponding to the specific analysis.
- When you have completed the configuration, click **OK**. The program will prompt you to save the configuration.
- 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 click the name of a preexisting configuration in the **Existing Configurations** list box (If you select this option, you will replace the existing configuration with the new configuration settings).
- 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

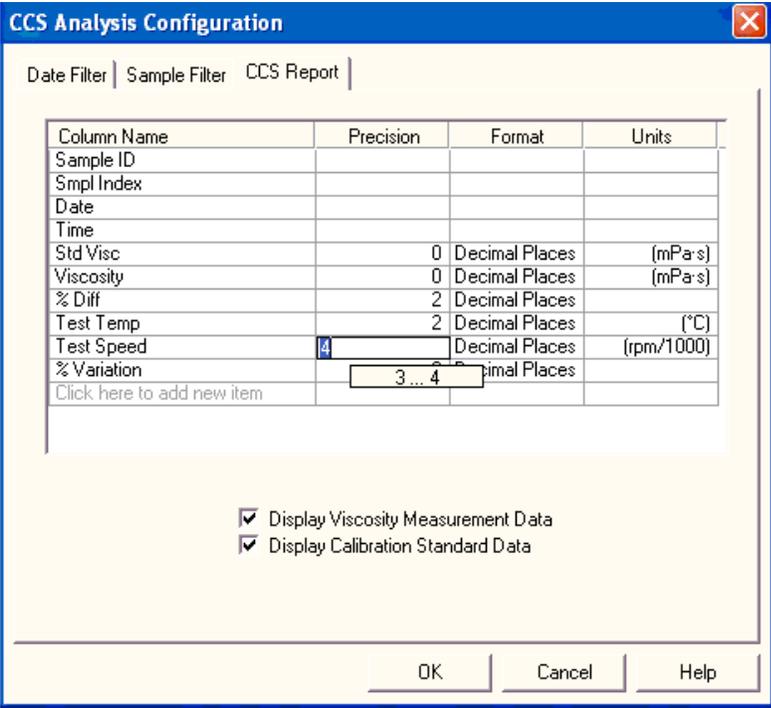
After you have displayed an analysis, you may sort alphanumerically by any of the table headings (the default sort for most reports is Time Stamp). To sort, simply click on the desired column heading. The table will be displayed with the new sort order.

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.



CCS Analysis Configuration

Date Filter | Sample Filter | CCS Report

| Column Name | Precision | Format | Units |
|----------------------------|-----------|----------------|------------|
| Sample ID | | | |
| Smpl Index | | | |
| Date | | | |
| Time | | | |
| Std Visc | 0 | Decimal Places | (mPa·s) |
| Viscosity | 0 | Decimal Places | (mPa·s) |
| % Diff | 2 | Decimal Places | |
| Test Temp | 2 | Decimal Places | (°C) |
| Test Speed | 4 | Decimal Places | (rpm/1000) |
| % Variation | 3...4 | Decimal Places | |
| Click here to add new item | | | |

Display Viscosity Measurement Data
 Display Calibration Standard Data

OK Cancel Help

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 tested 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/error filter

Use the sample filter to limit the analysis to samples which have been tested with certain instruments, temperature probes, by certain technicians, or which have certain Sample ID characteristics. To filter samples using these variables, click the Sample Filter tab from the analysis configuration window.

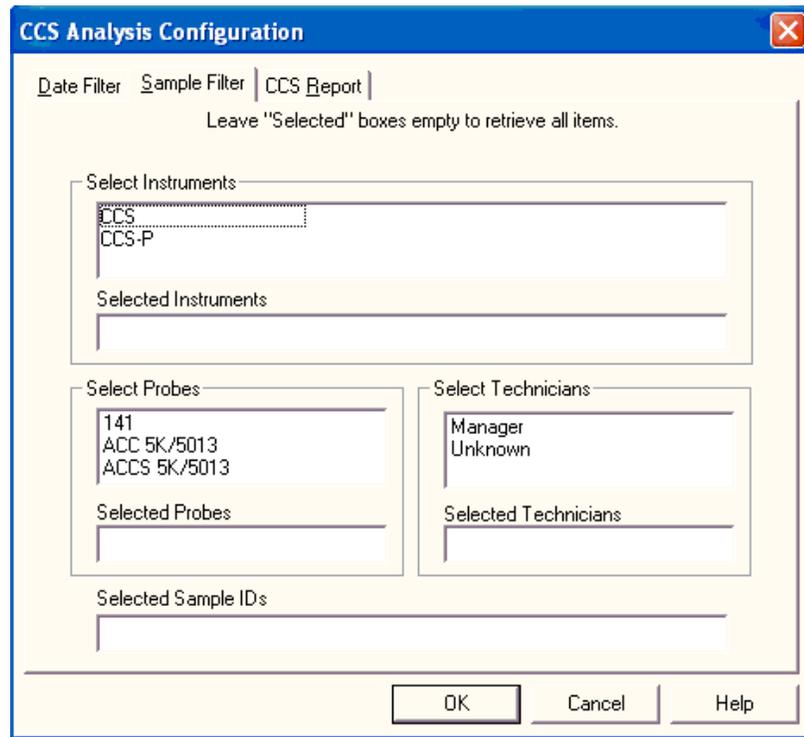
NOTE *For the error analysis, this tab is labelled Error Filter and the filter options are limited to instrument and technician).*

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 include this data. Unsuccessful samples, which have no flow time, will be listed with a viscosity value of “0”.

Then select the desired instruments and probes from their respective list boxes. To select a range of probes/instruments, click on the first desired item and then hold down the  key while clicking on the last desired item in the sequence. To individually select probes/instruments from the list boxes and add them to the analysis, hold down the  key while clicking on each desired probe/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. 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, CL%,CCS% would display all samples beginning with CL or CCS.



NOTE *If no instruments/probes/Sample IDs are selected, the analysis will display data for ALL instruments/probes/Sample IDs.*

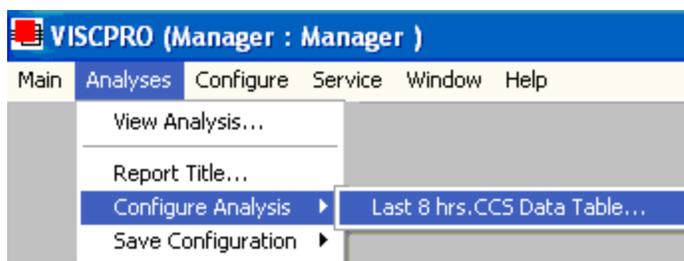
Using the report/port output filter

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 data to laboratory collection systems or to an ASCII file.

There are two different data export analyses. For step-by-step instructions on exporting data from the VISCPRO® database, consult Chapter 10:

- Error Data Export—(export of error information)
- Sample Data Export—(export of sample 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 Calibration Standards

CCS DATA TABLE

The CCS Data Table analysis is designed to permit convenient viewing of data collected from samples which have been tested using the Measure Sample Viscosity and Verify Known Viscosity sample action options.

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

- Sample ID—Sample identification information
- Date—Date the sample was measured
- Time—Time the sample was measured
- Probe ID—Probe identification information
- Sample Index—Position of the sample in the numeric test sequence (Sample Table position)
- Technician—Technician name (the individual logged in at the time the test was completed)
- Instrument Type—The instrument model identification
- Instrument ID—The unique instrument identification information
- Rotor ON Time (s)—Time for test (in seconds)
- Std Viscosity—Viscosity of calibration standard
- Viscosity—Viscosity of sample
- % Diff—Percentage difference between calculated and known viscosities
- Targ Temp—Desired target temperature for the test
- Test Temp—Cell temperature as calculated during testing
- {1,5}Speed %d—Variation in rotor speed during viscosity measurement
- Test speed—Rotor speed during viscosity measurement
- % Variation—The coefficient of variation for the compared values
- {0,2}Cell Constant b%d—The cell constants at the time of the test

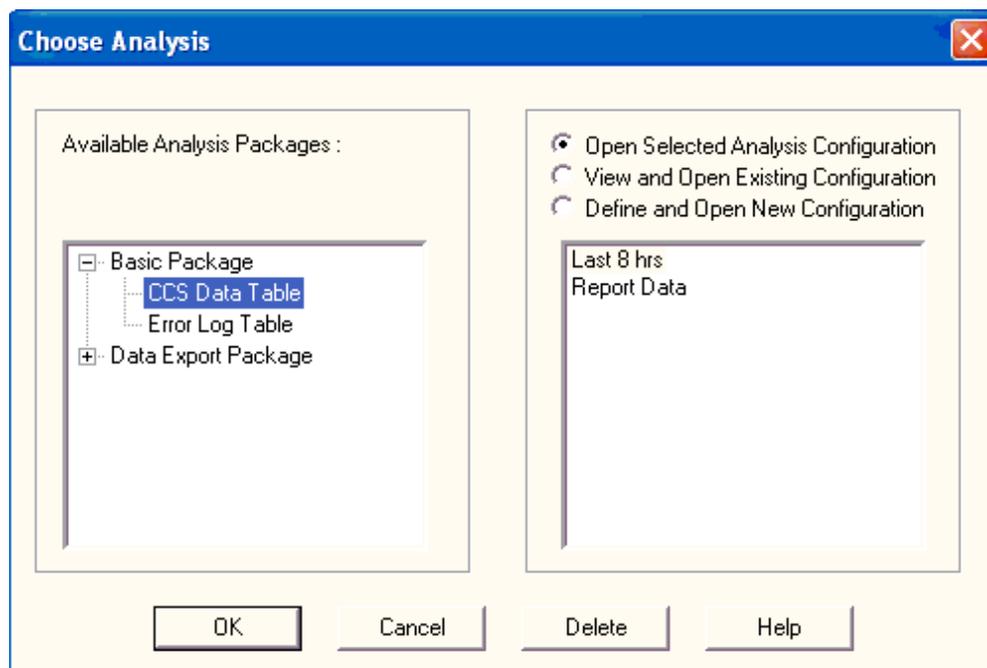
Reporting options

The CCS Data Table analysis can present 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 CCS Analysis Configuration window. Once the appropriate filters have been designated, the resulting report configuration can be saved for future use.

Configuring the CCS Data Table

For general information on using analyses, see Chapter 7. To access and configure the CCS 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** (or click the adjacent “+” sign) from the list of **Available Analysis Packages**.
4. Select **CCS Data Table** from the **Basic Package** report options.



The Choose Analysis window

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 **CCS Analysis Configuration** window will appear.

The **Sample Analysis Configuration** window consists of three tabbed pages:

Date Filter | Sample Filter | CCS Report

- **Date Filter**—allows you to select date/time parameters for the analysis (see Chapter 7 for additional details).
 - **Sample Filter**—allows you to select which tests will be included in the analysis (see Chapter 7 for additional details).
 - **CCS Report**—allows you to select what sample data will appear in the Sample 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:

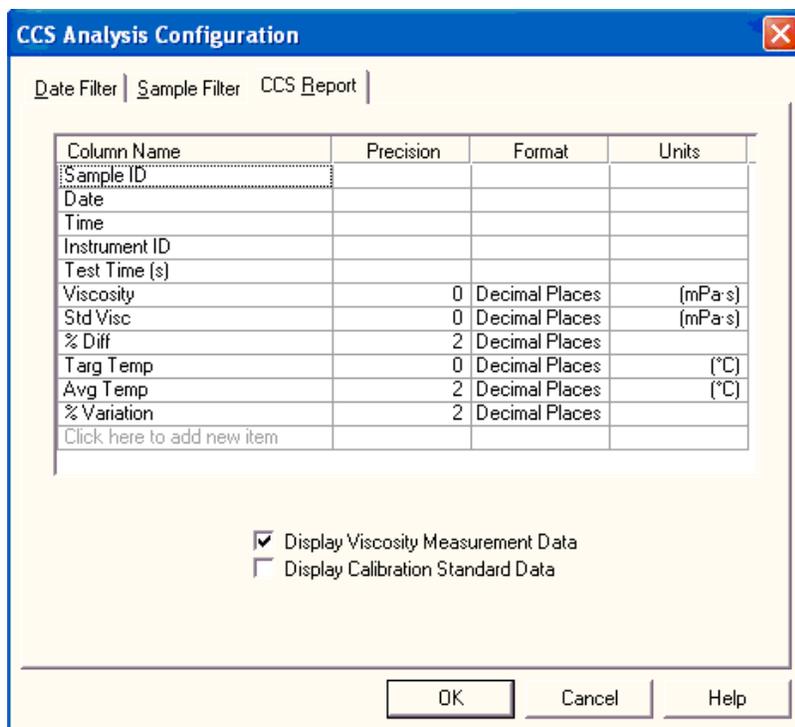
Date/Sample filters

Complete selection of Date and Sample Filter options per the instructions in Chapter 7.

CCS Report filter

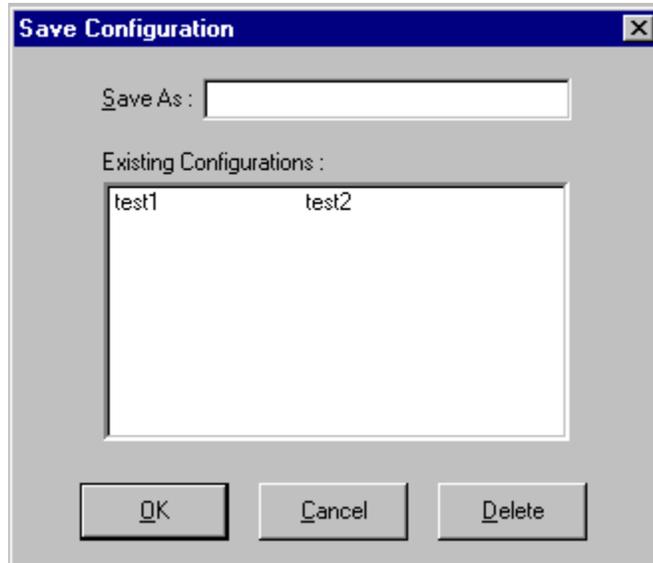
To select specific data for the analysis, click **CCS Report**. Then click in the **Column Name** field to select desired data. You can also click the right mouse button in the **Column Name** field to delete or to insert additional columns of data. To change precision values for data, *triple-click* in the Precision field and type the number desired.

After individual options have been selected, use the related spin controls  to determine the appearance of data (precision/rounding, unit of measure, etc.) for viscosity, temperature and other selected items. Use the check boxes to filter by data type (sample data, calibration data or both).



CCS Report data filter options

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.



The Save Configuration window

10. Type the name of the new configuration in the Save As: field. Or 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).

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**—Time at which the error occurred
- **Date**—Date at which the error occurred
- **Error Source**—Source of error
- **Instrument ID**—Instrument identification (if applicable)
- **Sample ID**—Sample identification
- **Tray Index**—Identifies the Sample Tray number (always “1” for the CCS instrument)
- **Smpl Index**—Indicates the position of the sample in the numeric test sequence (Sample Table position)
- **Smpl Index**—This VISCPRO reporting option is not applicable to CCS analyses
- **Technician**—Technician logged on at the time of the error

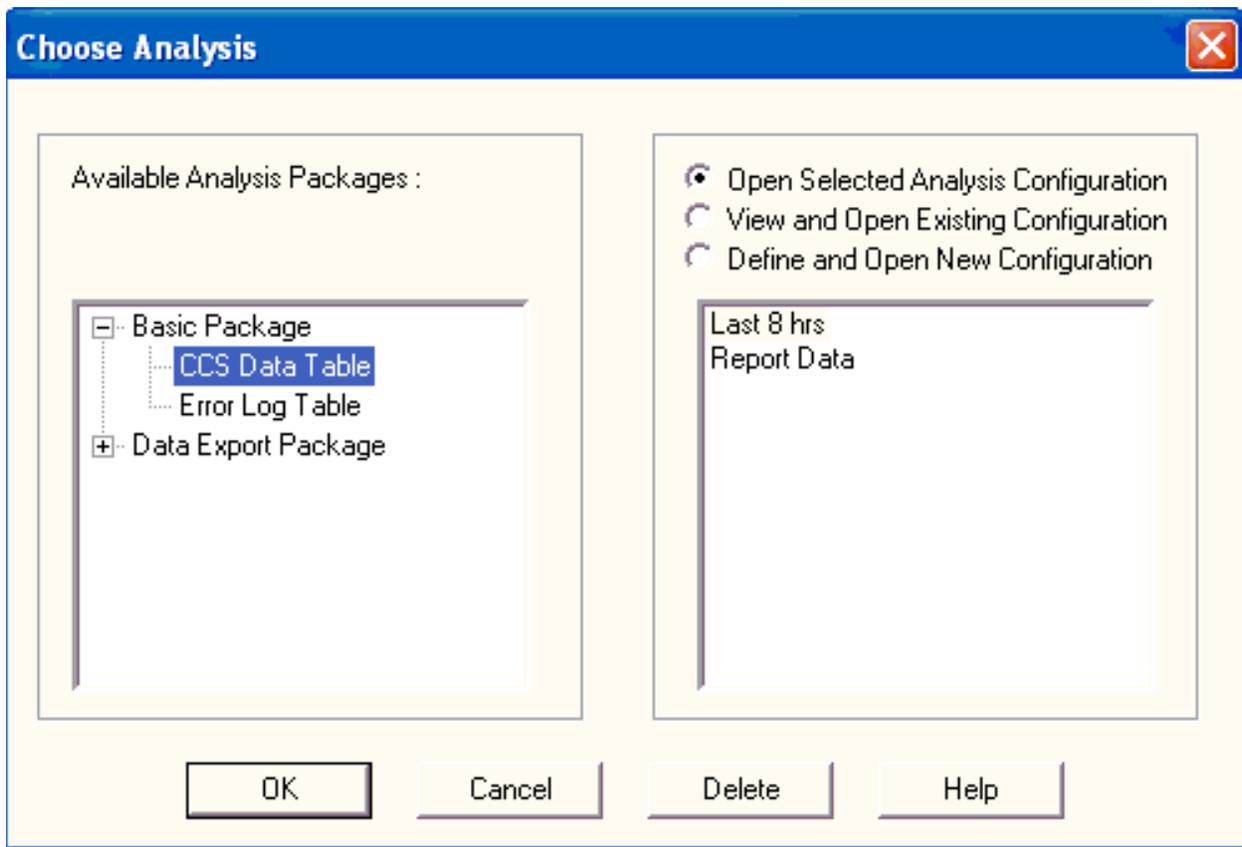
Reporting options

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 7. 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 Table analysis

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

NOTE

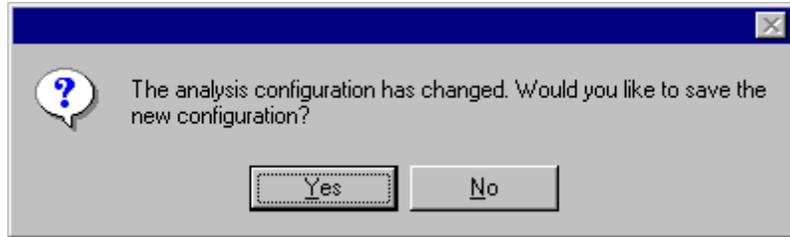
If you have already configured and saved an analysis, its name will appear in the list box on the right side of the window. If you click on an existing configuration and click OK, the analysis will be performed using the selected configuration settings. It will not be necessary to complete the remaining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

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

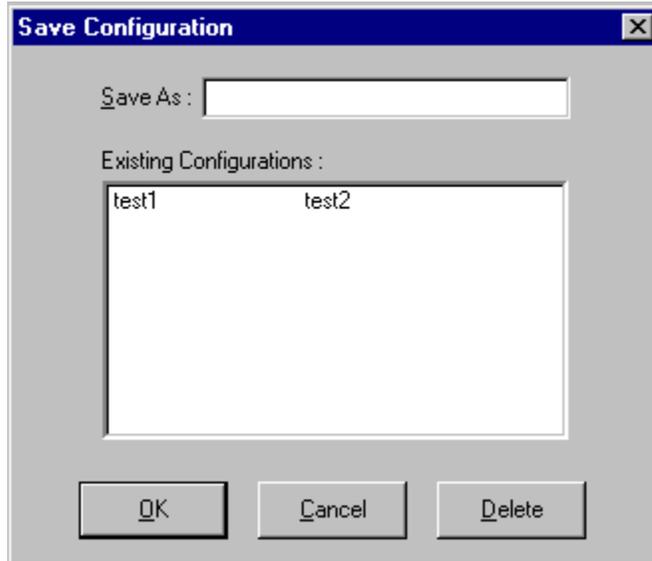
The Error Log Configuration window consists of tabbed pages with filter options.

- **Date Filter**—allows you to select date/time parameters for the analysis (see Chapter 7 for additional details).
- **Error Filter**—allows you to select which probes/technicians/tests will be included in the analysis (see Chapter 7 for additional details).
- **Error Report**—allows you to select what sample data will appear in the Error Log Table and how the data will be displayed.

- Click on the tab corresponding to the filter you wish to set and complete configuration options. Use the check boxes to select which data to include in the report.
- When you have completed the configuration, click OK. The program will prompt you to save the configuration.



- Click Yes to save the configuration. The Save Configuration window will appear.



The Save Configuration window

- 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.
- 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).

EXPORT ANALYSES

The VISCPRO® Export analyses (CCS Data Export and Error Data Export) provide a convenient operator interface for configuring sample or error information from the sample database for serial output and exporting it in ASCII text format. The three port output filters (Date Filter, Sample Filter/Error Page and Port Output Format) permit the user to select and output desired data to a file, LPT port or serial port.

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 re-send data, close the analysis window (you may save the configured analysis if you desire) and then recreate the analysis.

Analysis descriptions

The CCS Data Export analysis replicates the reporting options of the CCS Sample Data Table, making it possible to export any data associated with sample tests. The Error Data Export analysis provides a means of exporting error and instrument status information in a report that may be useful for troubleshooting instrument performance.

Available data for analysis

In addition to exporting the selected data, the VISCPRO data export analyses display it on the computer screen in a tabular format. The following data is included in the Sample Data Export Analysis:

- Sample ID—Sample identification information
- Viscosity—Measured viscosity of the sample
- Speed—Average speed of the rotor at the time of the test
- Date—Date the sample was measured
- Probe ID—Probe identification information
- Std Viscosity—Viscosity of the calibration standard (if applicable)
- Smpl Index—Position of the sample in the numeric test sequence (Sample Table position)
- Test Time—The time when test data was saved to the database
- Temp °C—The test temperature (in °C)
- Targ Temp—The target (desired) temperature for the test
- Technician—Technician name (the individual logged in at the time the test was completed)
- Instr Type—The instrument model identification
- Instrument ID—The unique instrument identification information
- Test Time (s)—Time for test (in seconds)
- {0,2}Cell Constant b%d—The cell constants at the time of the test
- Space—Inserts a space in the report
- CR—Carriage Return (returns to the beginning of the line)
- LF—Line Feed (starts a new line in the report)

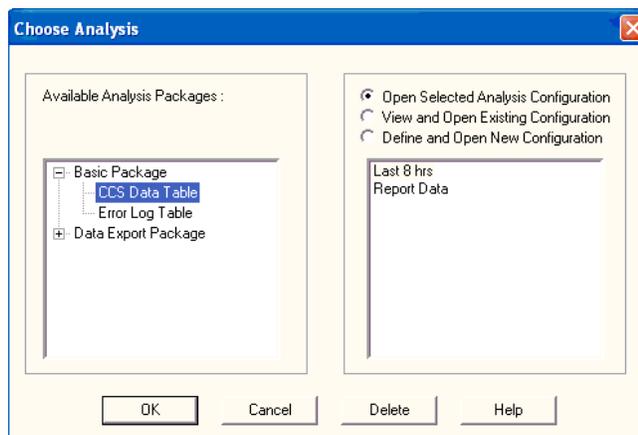
- Delay—Delay time before transmittal of serial data
- ASCII Code—An ASCII character as defined by its byte code

The following data is included in the Error Data Export analysis:

- Error—Displays text associated with the error
- Source—Identifies the source of the error (machine, software, etc.)
- Instr. ID—Identifies the specific instrument associated with the error
- Technician—Technician name (the individual logged in at the time the test was completed)
- Tray Index—Identifies the Sample Tray number (always “1” for the CCS instrument)
- Smpl Index—Indicates the position of the sample in the numeric test sequence (Sample Table position)
- Bulb—Not Applicable for CCS instrument
- Sample ID—Sample identification information
- Date—Date the sample was measured
- Time—Time the sample was measured
- Delay—Delay time before transmittal of serial data
- ASCII Code—An ASCII character as defined by its byte code
- Space—Inserts a space in the report
- CR—Carriage Return (returns to the beginning of the line)
- LF—Line Feed (starts a new line in the report)

Configuring the Port Export analyses

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.



Choosing an analysis

4. Select the desired **Data Export** analysis option. The **CCS Ports Output Configuration window** will open.

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 (see Chapter 7 for additional details).
 - **Sample Filter/Error Page**—allows you to select which temperature probes/errors/technicians/instruments will be included in the analysis (see Chapter 7 for additional details).
 - **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:

Filters

- a. Complete selection of Date and Sample/Error filter options per the instructions in Chapter 7.

Ports

- b. Click the Port Output Format tab and click Add Port from the 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 note below).*

Configuring output

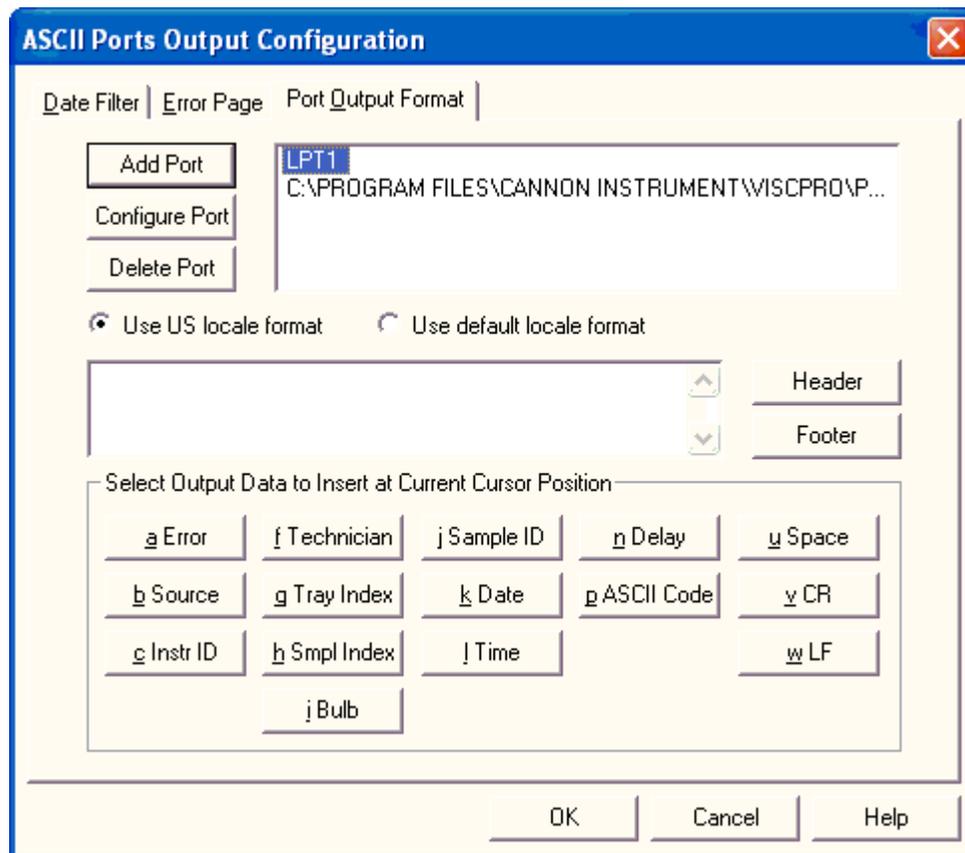
- d. Select the desired port/file for configuration by clicking the name of the port/file in the port list box. Then click the radio button  corresponding to the desired locale format (U.S. or local). Your choice will determine the formatting of numeric data, dates and choice of decimals or commas as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

*The Port Output tab***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 clicking in the text box to place 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**.

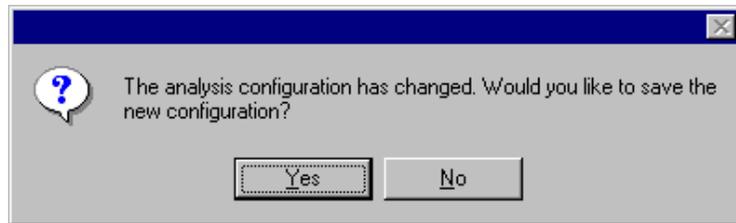
Adding a footer

- 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 Space, Carriage Return (CR) and Line Feed (LF) options. Then click **OK**. (Space—Inserts a blank space, CR—Inserts a carriage return code, and LF—Inserts a line feed code)

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.

For additional information on creating analyses, see the chapter corresponding to the specific analysis.

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. See Chapter 7 for more information on using sample filter options.

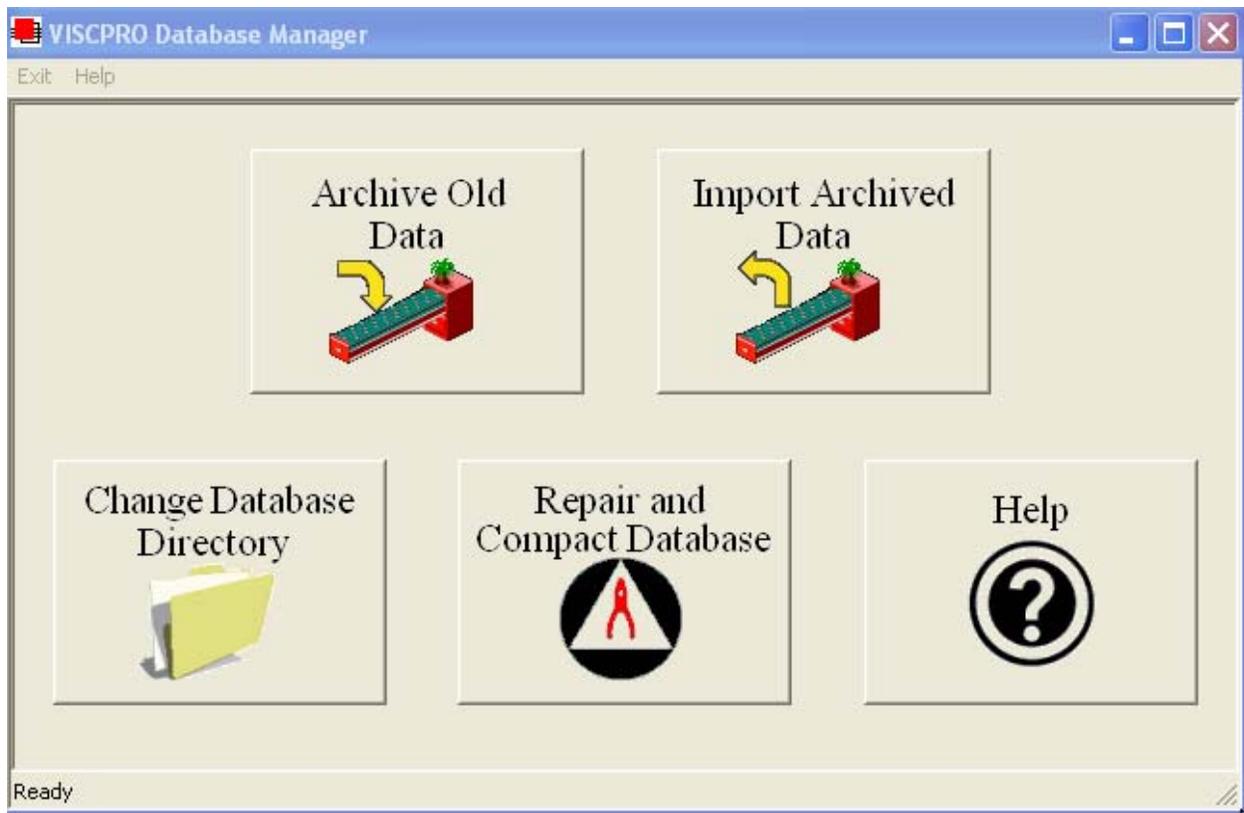
Port selection

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.**

USING THE DATABASE MANAGER

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/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 .

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REPLACEMENT PARTS LIST

Following is a list of CCS replacement parts included with the service kits provided by **CANNON**[®] Instrument Company.

KIT, SPARE PARTS (CCS-2100) 75.7000

The following parts are included in the kit:

| <u>Description</u> | <u>Part Number</u> |
|--|--------------------|
| Felt Pad CCS..... | 75.2555 |
| Thermal Grease 4gram Plastic Pack | 75.0000 |
| Ball Driver 7 Piece Hex Set | 61.3417 |
| Wrench, Allen Hex L-Key Long-Arm, .035 | 75.8137 |
| O-Ring, 016 FKM | 74.1240 |
| Clamp Hose Plastic 1/4" Nom (.220 - .27) | 75.5070 |
| Tube, Sample | 75.2565 |
| Gage, CCS Rotor | 75.8088 |
| Tubing SUPERTHANE 1/80D x 6 in | 74.8031 |
| Tubing MARPRENE 1/16OD x 15 in | 74.8032 |
| Tubing SUPERTHANE 1/80D x 12 in | 74.8033 |
| Wrench 1/16" Allen | 74.1410 |

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WARRANTY/RETURN INFORMATION

Products limited warranty

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

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

Reagent and chemical warranty

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

Returning a product to CANNON®

Procedure

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

| | |
|---------------------------------|--------------|
| CANNON® Telephone Number | 814-353-8000 |
| CANNON® Fax Number | 814-353-8007 |

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

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

Please include the following:

Required information

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

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

Hazardous materials

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

Shipping notification

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

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

APPENDIX A— WEISSENBERG EFFECT

The Weissenberg Effect is the tendency for viscoelastic liquids to flow in a direction normal to the direction of the applied stress. In the CCS viscometric cell, the stress is applied through the turning of the rotor inside the stationary stator. Thus, flow in a direction normal to the applied stress is in the upward (or downward) direction.

The following text, taken from *Viscosity and Flow Measurement*, by Van Wazer, Lyons, Kim and Colwell (Interscience Publishers, 1963), describes the Weissenberg Effect:

The experimental difficulty arising from the Weissenberg effect is that, after some lapse of time sufficient materials will have left the gap so that the original value for the height of the gap cannot be used. Hence the material must either be confined in the gap or the measurement of each point must be made rapidly, with the gap being repacked between points.

Some polymeric solutions are highly viscoelastic, and exhibit the Weissenberg Effect to a lesser or greater degree, which causes depletion of the test sample from the shear area of the viscometric cell of the CCS. For Newtonian and non-viscoelastic solutions, the viscometric cell of the CCS does not exhibit a tendency for the shear rate to be depleted.

Compensating for the Weissenberg Effect

The CCS instruments treat all oils in the same manner. In the case of strongly viscoelastic oils, no provisions are made in either instrument for special injection or testing procedures.

CANNON® Instrument Company is not aware of any strongly viscoelastic oils in the automotive lubricating market. However, such oils are known to appear in lubricant research programs.

ASTM Method D 2602, which includes comments and procedures for working with viscoelastic oils, was withdrawn in 1994 and replaced by D 5293. In the new method, Annex A1. Special Procedure for Highly Viscoelastic Oils describes procedures for running viscoelastic oils but this procedure is applicable only to the CCS-2B instrument.

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APPENDIX B—

SAE VISCOSITY CLASSIFICATIONS FROM -10°C to -40°C

The SAE has approved a specification, J300 DEC99, which incorporates the use of the CCS test method (ASTM D 5293) at temperatures from -10°C to -40°C. The SAE low-temperature engine oil viscosity classifications include the following:

SAE cranking-viscosity classifications

| SAE low-temperature engine oil Viscosity Classifications: | | |
|--|-----------------------|---------------------|
| OIL GRADE | MAXIMUM CCS VISCOSITY | |
| | CENTIPOISE (cP) | TEMPERATURE (°C) |
| 0W | 6200 | -35°C |
| 5W | 6600 | -30°C |
| 10W | 7000 | -25°C |
| 15W | 7000 | -20°C |
| 20W | 9500 | -15°C |
| 25W | 13 000 | -10°C |

NOTES

SAE J300D has been withdrawn. Thus, the set of viscosity standards at -18°C (as described in ASTM D2602) and specified for use in SAE J300D has been withdrawn. It is highly recommended that the current revision of SAE Specification J300 be used.

CANNON® Instrument Company can supply special viscosity standards, and on special order provide certification at -18°C or at other temperatures.

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