

**BROOKFIELD RHEOCALC SOFTWARE**

Operating Instructions

Version 1.3

Manual No. M/91-220-C



# CONTENTS

I. Introduction.....	3
II. System Requirements.....	4
III. Installation.....	5
IV. The RHEOCALC Screen.....	6
1. Title Line.....	6
2. Current Data Panel.....	6
3. General Information Panel.....	7
4. Main Menu Panel.....	7
5. Directory Tree Panel.....	7
6. Files Panel.....	7
7. Active Key Line.....	7
V. Quick Start.....	8
VI. The File System.....	10
1. Directory Tree Panel.....	10
a. Selecting a Directory.....	10
b. Changing Drives.....	10
c. Adding a Directory.....	10
d. Saving Data/Programs.....	11
2. Files Panel.....	11
a. Loading Data/Programs.....	11
b. File Display Type.....	11
c. Saving Data/Programs.....	12
VII. The Main Menu.....	13
1. Alarms.....	13
a. Enter Alarms.....	13
b. Reset Alarms.....	13
c. Turn Alarms ON/OFF.....	13
2. Buffer ON/OFF.....	13
3. Display.....	14
a. Print Data.....	14
b. Screen Display.....	14
4. Gather.....	14
a. DV-III Buffer.....	15
b. Enter/Edit.....	15
c. Manual.....	16
d. Program.....	17
1. Begin Program.....	17
2. Change Spindle.....	17
3. Edit Program.....	17
4. Load/Save Program.....	17
5. New Program.....	17
a. Geometric Program.....	17
b. Non-Geometric Programs.....	19
c. Temperature.....	19
Rheological Considerations When Running Temperature Programs.....	22
e. Spring Relax.....	22

f. Timed.....	22
5. Math Model .....	23
a. Bingham Plastic .....	23
b. Casson (Standard) .....	24
c. IPC Paste Analysis .....	24
d. NCA/CMA Casson (Chocolate).....	25
e. Power Law .....	26
f. Shear Thinning Index .....	27
6. Plot.....	27
a. Axis Scales .....	27
b. Generate Plot .....	27
c. Printing a Plot .....	28
d. Magnify Range.....	31
e. Select Parameters.....	31
7. Setup .....	31
a. About RHEOCALC.....	31
b. Change Spindle .....	31
c. Date Format.....	32
d. Model Name .....	32
e. Printer Type .....	32
f. RS232 Setup .....	33
g. Sample Name.....	33
h. Units .....	33
1. Measurement .....	33
2. Rotation .....	33
3. Temperature .....	34
i. Zero Rheometer .....	34
8. Quit.....	34
VIII. Hot Key Functions.....	35
1. View Menu .....	35
a. Buffer Data .....	35
b. Directory Tree.....	35
c. Gather Mode.....	35
d. None .....	35
2. Stop Motor.....	36
3. Configuration Window .....	36
4. Direct Speed Entry .....	36
5. Stop Temperature Control.....	36
6. Set Temperature.....	37
Appendix A - RHEOCALC Windows.....	38
Appendix B - Data Buffers .....	42
Appendix C - File Formats.....	43
Appendix D - Problem Solver .....	46
Appendix E - Communications.....	48

This package includes:

Description	Qty.
5-1/4" disk; RHEOCALC Version 1.3	1
3-1/2" disk; RHEOCALC Version 1.3	1
RHEOCALC manual	1
Computer control cable	1

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## I. Introduction

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RHEOCALC is a software program designed for use on IBM compatible Personal Computers (PC's). It is intended for use with the **Brookfield Engineering Labs (BEL) DV-III Rheometer**. It provides users with the ability to run various rheometric programs completely unattended and to use the collected data in the creation of *rheograms*.

RHEOCALC allows up to **200** data points to be collected per program. This data may then be saved to disk for later use, printed, plotted, and analyzed.

RHEOCALC also provides the ability to program the **Brookfield Engineering Labs HT-104 and HT-105 Temperature Controllers** (for use with the **Brookfield Engineering Labs Thermosel and Temperature Baths**, models TC-200 and TC-500, respectively) for use in temperature profiling.

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## **II. System Requirements**

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IBM PC-AT (80286 microprocessor) or 100% compatible  
(80386, 80386SX, 80486, or 80486SX recommended for superior performance)

Fixed Disk Drive

640 Kilobytes of RAM (a minimum of 570 Kilobytes must be available for executable programs)

CGA, EGA, or VGA graphics hardware and monitor (VGA preferred)

RS-232 port ( for Rheometer control; optional second RS-232 port may be used to control the **Brookfield Thermoseal/HT-104** Controller System or the **Brookfield Temperature Bath (TC-200 or TC-500)/HT-105** Controller System)

Parallel port (for printing data - optional)

**NOTE:** Although **RHEOCALC** may be run from a floppy disk or on a PC-XT (8088 or 8086 microprocessor), it is strongly recommended that the above requirements be adhered to due to speed considerations.

### **III. Installation**

- 1) Copy the *rheocalc.exe* file from one of the supplied floppy diskettes to the desired hard disk drive on your computer. For example, suppose you wish to install **RHEOCALC** from the floppy drive your computer designates as drive **A:** to a directory called **RHEOCALC** on the hard disk drive your computer designates as drive **C:**. Type the following command at the DOS prompt to accomplish this:

*copy a:\rheocalc.exe c:\rheocalc*

Use of the above command assumes that a directory named **RHEOCALC** already exists on your hard disk drive. To create a directory, consult your DOS manual.

**NOTE:** If a previous version of **RHEOCALC** exists in the **RHEOCALC** directory, the following command causes that previous copy to be overwritten with the new version of **RHEOCALC**. To preserve any previous version of the program, rename it to something other than *rheocalc.exe* or copy it to an alternate directory.

- 2) Connect the single 9 pin connector of the supplied cable to the 9 pin socket on the rear of the DV-III. Connect either the 9 pin or the 25 pin connector to an RS-232 serial port on your computer.

**NOTE:** **RHEOCALC** only supports the use of either **COM1** or **COM2**. If your computer has more than two serial ports, ensure the connection is made to a port designated as one of these two ports. If your computer has more than one serial port, you may also connect a **Brookfield Engineering Labs HT-104 or HT-105 Temperature Controller** to one of these ports.

**RHEOCALC** may be used without a rheometer connected if it is desired to print, plot, analyze, or edit data saved in disk files.

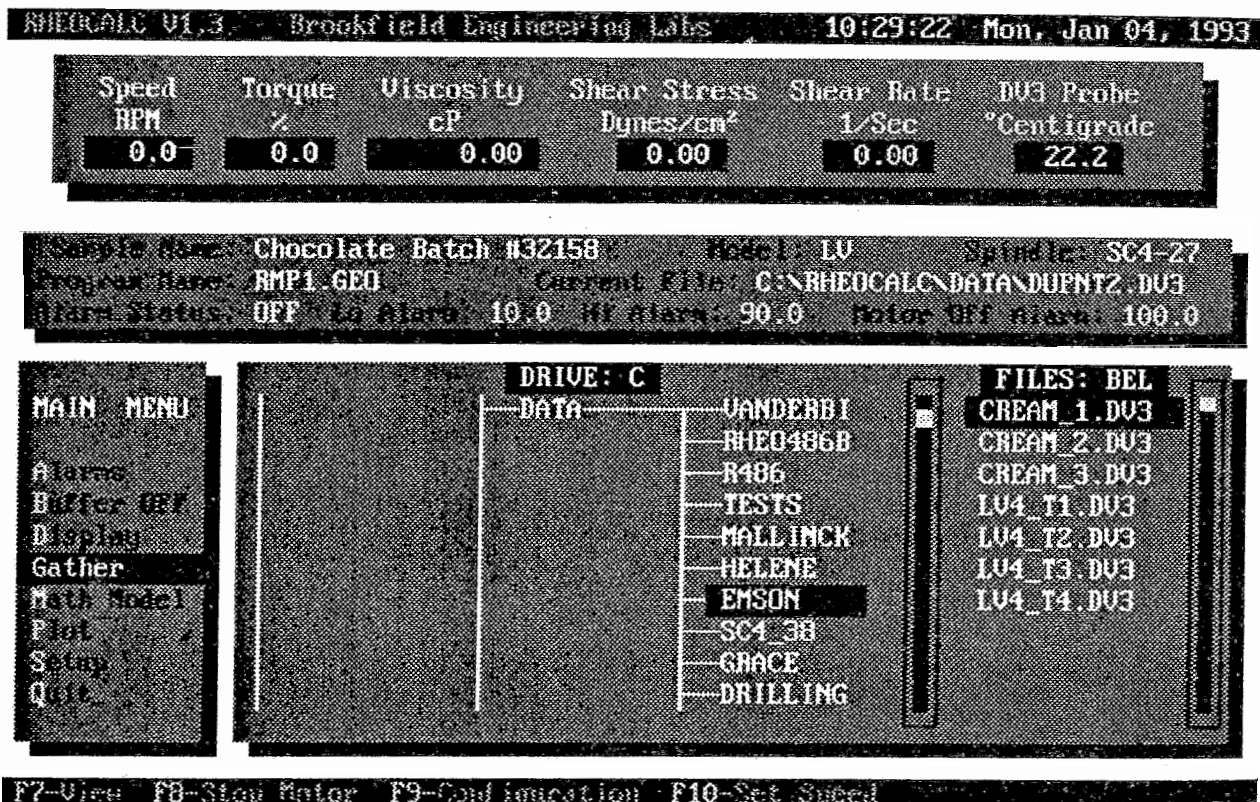
- 3) To run **RHEOCALC**, type *rheocalc* at the DOS prompt. After a few seconds, the screen turns white and the following message appears:

**Checking RS-232 ports for Brookfield instruments...**

After determining which Brookfield instruments are connected (**RHEOCALC** recognizes the **DV-III**, the Rheoset, the **HT-104**, and the **HT-105**), the **RHEOCALC** main screen appears.

**NOTE:** By default, **RHEOCALC** checks all serial ports up to and including **COM2** for the aforementioned Brookfield instruments. **RHEOCALC** can be forced to check only one specific serial port by placing either a **COM1** or a **COM2** on the DOS command line after the *rheocalc* command. For example, typing the command *rheocalc com1* at the DOS prompt causes **RHEOCALC** to scan only communications port one for Brookfield instruments. If a second communications port exists, it is ignored.

## IV. The RHEOCALC Screen



### 1. Title Line

This line contains the name and version of the program, the current time, and the current date.

### 2. Current Data Panel (Red in color)

If a rheometer is communicating with the computer, this panel displays the data currently being sent from the rheometer (and optionally the HT-104 or the HT-105 Temperature Controller). This data includes:

- Speed in RPM
- Torque in % of scale
- Viscosity in centipoise (cP or mPas)
- Shear Stress in dynes/cm<sup>2</sup> (D/cm<sup>2</sup>) or Newtons/m<sup>2</sup> (N/m<sup>2</sup>)
- Shear Rate in 1/sec

Temperature in °Centigrade or °Fahrenheit

The precision of displayed data varies dependent upon the magnitude of the value displayed. The following table summarizes the minimum displayable values at various magnitudes.

Display Precision						
	Speed	Torque	Viscosity	Shear Stress	Shear Rate	Temperature
Below 10.0	0.1	0.1	0.01	0.01	0.01	0.1
Below 100.0	0.1	0.1	0.1	0.1	0.1	0.1
Below 1000.0	0.1	N/A	1	1	1	1

### 3. General Information Panel (Green in color)

This box contains three lines of information each pertaining to a particular aspect of the current program status.

#### Line 1:

- Sample Name: the user entered Sample Name
- Model: the rheometer Model (LV, RV, HA, HB or a variation thereof)
- Spindle: the current Spindle in use

#### Line 2:

- Program: the name of the rheometric program currently in use
- Current File: the name of the disk data file currently loaded into the Load Buffer

#### Line 3:

- Alarm Settings: the current low, high, and motor off alarm settings
- Alarm Status: alarms enabled (ON) or alarms disabled (OFF)

### 4. Main Menu Panel

The Main Menu is where all RHEOCALC functions are initiated. It is the root of the menu system, and all paths ultimately lead back to the Main Menu. The Main Menu contains the following 8 options:

- Alarms
- Buffer ON/OFF
- Display
- Gather
- Math Model
- Plot
- Setup
- Quit

Each option is explained in detail in **Section VII**.

### 5. Directory Tree Panel

The Directory Tree Panel displays a graphical representation of the currently selected disk drive. When this panel is the active window, the user may save or load data or programs, change directories or drives and add directories.

### 6. Files Panel

The Files Panel displays all files in the currently active directory that match the current file type selected. Data file types are DVD, DAT, and DV3. Program file types are GEO, NGO, and NGT. File types are discussed in detail in **Appendix C**.

### 7. Active Key Line

*The Active Key Line is the line at the bottom of the computer screen. This line always displays the active keys and their functions relative to the active window. As windows are opened and closed, this line changes indicating what keys may be pressed at that time.*

**NOTE:** When the ALT or the CTRL keys are pressed, this line displays the RHEOCALC hot keys which are always available regardless of the active window (see **Section VIII** for details on hot keys). When the ALT or the CTRL key is released, the Active Key Line re-displays the valid keys for the active window.



## V. Quick Start

For those who wish to get started right away, the following section describes how to use **RHEOCALC** to collect data using a simple Geometric program.

- 1) Ensure the supplied cable is connected between a **Brookfield Engineering Labs DV-III Rheometer** and **COM1** or **COM2** of your host computer. Turn on the rheometer. The DV-III screen should display a message similar to the following (the version number and model type will vary):

**BROOKFIELD  
DV-III Rheometer  
Vx.x RV  
External Control**

**NOTE:** x.x corresponds to latest version of the DV-III firmware. The DV-III firmware is the software that controls the DV-III itself and is totally separate from the **RHEOCALC** software.

- 2) To run **RHEOCALC**, type *rheocalc* at the DOS prompt. After a few seconds, the screen turns white and the following message appears:

Checking RS-232 ports for Brookfield instruments...

After determining which Brookfield instruments are connected, the **RHEOCALC** main screen appears.

**NOTE:** By default, **RHEOCALC** checks all serial ports up to and including **COM2** for the aforementioned Brookfield instruments. **RHEOCALC** can be forced to check only one specific serial port by placing either a **COM1** or a **COM2** on the DOS command line after the *rheocalc* command. For example, typing the command *rheocalc COM1* at the DOS prompt causes **RHEOCALC** to scan only communications port one for Brookfield instruments. If a second communications port exists, it is ignored.

- 3) Use the arrow keys to move the highlight bar in the Main Menu to the Setup option then press the **Return/Enter** key to open the Setup menu (you may also simply press the "S" key to open the Setup menu).
- 4) Choose the **Zero Rheometer** option in this menu. A message box appears asking you to ensure there is no spindle attached to the rheometer. After removing the spindle (if one was attached) and acknowledging with a keypress, the rheometer begins its *autozeroing* process. When the *autozero* is complete, a message box reminds you to attach the desired spindle, and press any key to continue.
- 5) Choose the **Change Spindle** option in the Setup menu. If this is the first time **RHEOCALC** is being run or if there have been no spindles added to the user spindle file, a message box informs you that the user spindle file (*userspdl.spl*) could not be accessed. When the User Spindles window opens for the first time, the only spindle appearing in the window is the **SPECIAL** spindle (spindle code 99). To add frequently used spindles to the User Spindles list, press the **F1** key (as seen in the Active Key Line at the bottom of the computer screen). The Standard Spindles window opens above the User Spindles window. Use the arrow keys to select the spindle to be added to the User Spindles list. Press the **Return/Enter** key to add the selected spindle.
- 6) After adding all desired spindles to the User Spindles list, press the **Esc** key to close the Standard Spindles window and return to the User Spindles window. Use the arrow keys to select the spindle you wish to use in your data gather. Press the **Return/Enter** key to accept the selection.

- 7) Press the Esc key to close the Setup menu and return to the Main Menu. Select the Gather option from the Main Menu.
- 8) Select the Program option from the Gather menu. From the Program menu, select Geometric.
- 9) From the Geometric Program menu, select the New Program option. At this point you are asked if you wish to run an *Up/Down* program. For now, press the "N" key to answer no.
- 10) The Geometric Program Entry window opens to the left. This window requires the entry of four program parameters: a) Start RPM b) End RPM c) Step RPM d) Time Interval. Use the appropriate keys to enter the above parameters. To cycle through the four entry fields, use the Tab key (again note the allowable keys on the Active Key Line). Allowable RPM values are 0.1 RPM through 250.0 RPM with a minimum increment of 0.1 RPM. Time Intervals are entered in minutes and seconds (MM:SS), and all four digits must be entered (you need not enter ":" as it is automatically inserted for you).  
  
**Example:** 10 minutes and 30 seconds (10:30) is entered as *1030*.
- 11) When program entry is complete, press the **Return/Enter** key to accept the program. Select the **Begin Program** option from the Geometric Program menu. The Gather Status and Gather Data windows open with the latter underneath the former. The spindle begins to rotate at the Start RPM. The following pertinent gather information appears in the Gather Status window:  
a) Current program step b) Total program steps c) Current spindle speed d) Time remaining to the next program step e) Next program speed and time interval. The Gather Status window toggles on and off (allowing you to see the Gather Data window underneath) by pressing the **F3** key.
- 12) After each Time Interval has elapsed, a data point is taken and displayed in the Gather Data window before ramping to the next speed.
- 13) When the program is complete, you are asked to press a key to acknowledge this. The Gather Status and Gather Data windows close, and the Review Data window displays the freshly gathered data. At this point, the cursor keys are available to review the data. You may also elect to save the data (via the File System; see **Section VI**) by pressing the **F2** key.

For complete details on writing, saving, loading, and running rheometric programs to generate rheograms, see **Section VII.4**.

## VI. The File System

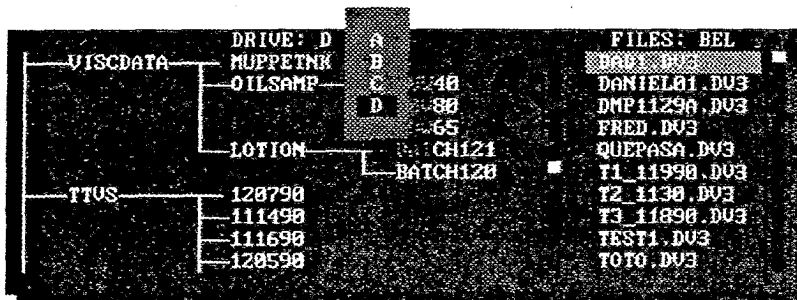
### 1. Directory Tree Panel

#### a. Selecting a Directory

To enter the Directory tree panel, press the **TAB** key while in the main menu. Entry into this window is indicated by the word "Drive" blinking on and off in the directory panel. The highlighted directory indicates the current directory. The cursor keys (**up**, **down**, **left**, and **right** arrows; **PgUp** and **PgDn**; **HOME** and **END** keys) are used to move throughout the directory of the disk drive displayed at the top of the window. As you move to a new directory, the files matching the file specification shown at the top of the files panel are displayed in the files panel. Right or left pointing arrows appearing at the right or left (respectively) of the panel indicate further sub-directories not seen in the current window view. You may use the **right** or **left** arrow keys to move these directories into view. Parent and sub-directory pairings are connected by horizontal lines while vertical lines are used to show equal level directories with a common parent directory. Pressing the **ESC** key at any time takes you out of the Directory panel and back to the point of entry.

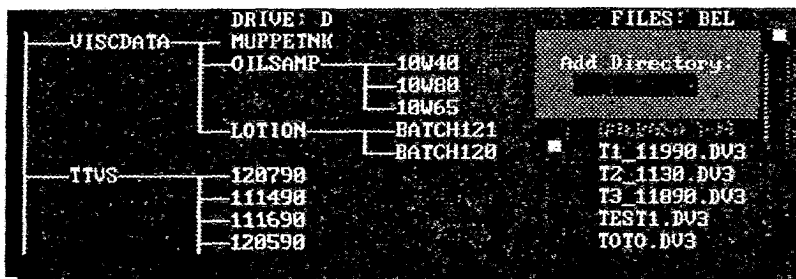
#### b. Changing Drives

Pressing the **F2** key while in the Directory panel displays a list of all available drives on the host computer. You may use the **cursor** and **RETURN/ENTER** keys to select a new disk drive, or you may simply press the letter key corresponding to the drive you wish to select. A message window informs you that the new drive is being scanned, and the directory structure is being processed. When the new tree structure is complete, the Directory panel displays the directory tree of the selected disk drive.



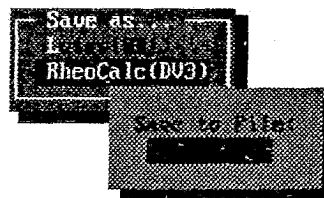
#### c. Adding a Directory

Pressing the **F3** key while in the Directory panel allows you to add a sub-directory onto the highlighted directory. An Entry window appears allowing you to input a valid **DOS** directory name (*RHEOCALC allows the use of letters, numbers, and the underscore ( ) character in directory names*). After pressing the **RETURN/ENTER** key to accept your new directory entry, the directory tree is updated reflecting the addition, and the new directory becomes the current data/program directory.



**d. Saving Data/Programs**

Pressing the **F4** key while in the Directory panel allows you to save a data set or a program. The Geometric, Non-Geometric, or Temperature program in memory may be saved if you are in the corresponding program mode. If you are not in a program mode, the data currently in the Capture Buffer may be saved. Data and programs are saved in the directory highlighted in the Directory panel. Data may be saved in RHEOCALC and Lotus-123 formats.



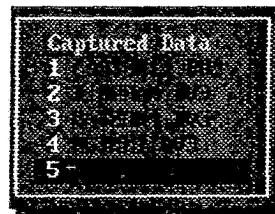
**2. Files Panel**

**a. Loading Data/Programs**

To enter the files panel, press the **TAB** key while in the Directory panel. Entry into this window is indicated by the word "**FILES**" flashing on and off in the files panel. Use the cursor keys (in this case the **up** and **down** arrows, **PgUp** and **PgDn**, **HOME** and **END**) to highlight the file you wish to select.

If a program is being loaded, simply pressing the **F3** key loads the selected file into program memory. If the spindle type saved in the program file differs from the currently selected spindle, you are asked if you wish to continue using the current spindle or if you wish to switch to the program spindle.

If a data set is being loaded, pressing the **F3** key opens a menu allowing you to select which slot (1 through 5) you wish to load the data file into. When this menu is opened, the selection bar is positioned to the first empty slot if one is available. If one is not available, the selection bar is positioned to slot number one.

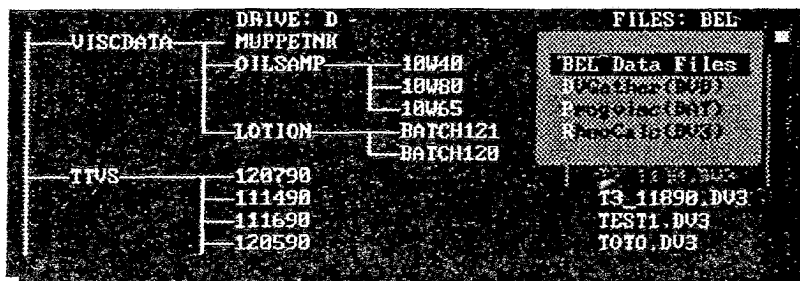


**b. File Display Type**

Pressing the **F2** key opens a menu allowing the selection of the type of data files you wish to be displayed.

- BEL** - All BEL data files (includes data files saved with RHEOCALC, DVGather, and Progvise).
- DVD** - Data files saved with BEL's DVGather program.
- DAT** - Data files saved with BEL's Progvise program.
- DV3** - Data files save with BEL's RHEOCALC program.

Program files are only displayed if the Files panel has been entered while in a program mode. If in the Geometric, Non-Geometric, or Temperature program mode, files with the ".GEO", ".NGO", or ".NGT" extension respectively are displayed.



### c. Saving Data/Programs

Pressing the **F4** key while in the Files panel allows you to save a data set or a program. The Geometric, Non-Geometric, or Temperature program in memory may be saved if you are in the corresponding program mode. If you are not in a program mode, the data currently in the Capture Buffer may be saved. Data may be saved in **RHEOCALC** and **Lotus-123** formats. Data or programs are saved in the directory highlighted in the Directory panel.

## VII. The Main Menu

### 1. Alarms

#### a. Enter Alarms

Allows input of low, high, and motor off alarm settings. The values entered are torque values in units of percent of scale. Alarms are used to notify the user of undesirable low or high torque conditions. Using the motor off alarm, the user is able to cause the motor to stop if that alarm value is exceeded. If alarms are *enabled (ON)* and the motor off alarm is tripped during a program, the rheometer stops until the next program step is reached at which point the rheometer begins running at the speed or shear rate of that step.

When alarms are enabled and the rheometer speed is greater than 0 RPM, *any torque value below the low alarm, above the high alarm, or above the motor off alarm causes an alarm condition.* When an alarm is tripped, the offending alarm's label flashes in the General Information Panel accompanied by a beeping sound. In addition, if the torque exceeds the motor off alarm value, the rheometer speed is set to 0 RPM, and the beep continues until a key is pressed to acknowledge that the motor off alarm was tripped.

**NOTE:** Two important things to note when the Motor Off alarm trips during a data gather are:

- 1) The speed is set to 0 RPM for the current program step. As soon as the time interval for the step expires, the rheometer runs at the speed of the succeeding step.
- 2) Although the rheometer speed is set to 0 RPM when the alarm is tripped, the programmed speed is shown (surrounded by *asterisks (\*)*) in the gather and data view windows so that the cause of the alarm is readily apparent. All other values displayed in the gather and view data windows are based on the actual speed of 0 RPM.

#### b. Reset Alarms

Resets the alarm values to the following default settings:

Low Alarm	-	10%
High Alarm	-	100%
Motor Off Alarm	-	115%

#### c. Turn Alarms ON/OFF

Turns the alarms **ON** (enabled) or **OFF** (disabled). Alarms can only be tripped if they are **ON**.

### 2. Buffer ON/OFF

Turns the free-running buffer **ON** or **OFF**. The free-running buffer allows data to be captured as quickly as the host computer allows.

**NOTE:** All times in the Capture Buffer are shown in seconds and tenths of second with 0.1 second being the smallest time interval observed.

When the buffer is turned **ON**, the data capture window opens, and data immediately begins to fill the window. Up to 200 data points may be collected. After 200 data points have been captured, succeeding data points gathered are placed in the bottom of the Capture Buffer (the 200th point), and all preceding data is shifted up one location in the buffer. Each time this occurs, the first point in the buffer is lost.

While the free-running buffer is **ON**, all other program options may be exercised with the exception of those that *gather* or *edit* data. To turn the free-running buffer **OFF**, simply select the **Buffer ON/OFF** option from the main menu again. After turning the buffer **OFF**, data capture ceases, and the Review Data window appears allowing review of the freshly gathered data.

0.5RU		SC4-27		01/03/80		10:03	
011 Grade Test Batch #1				UNSAVED DATA			
010	100.0	20.5	256.3	87.1	34.0	69.9	00:10
011	100.0	20.4	255.0	86.7	34.0	69.9	00:10
012	100.0	19.7	246.3	83.7	34.0	69.9	00:10
013	100.0	19.8	247.5	84.2	34.0	69.9	00:10
014	100.0	19.7	246.3	83.7	34.0	69.9	00:10
015	100.0	19.0	237.5	80.8	34.0	69.9	00:10

**NOTE:** The Buffer ON/OFF option is disabled if a data gather (as selected with the Gather option) is already in progress or if there is currently no communications with a rheometer.

### 3. Display

#### a. Print Data

Allows data from any of the current data sets to be printed on a printer connected to the host computer. After selecting this option, a menu is displayed allowing the user to choose which data set to print. After making that choice, the user is given the opportunity to add his/her own notes to the printed data. To do so, answer YES by pressing the "Y" key when prompted to enter Print Notes. The Print Notes window appears with the cursor positioned in the upper left corner of the window awaiting input. The Print Notes window can accommodate up to ten lines of notes. All alphanumeric and symbol characters may be included in your Print Notes. The cursor may be positioned anywhere in the window by using the cursor keys, and all typed input appears at the current cursor location. The Backspace key may be used to delete the character to the left of the cursor. The printed notes appear exactly as they do in the window. You format the notes in any manner you choose.

#### b. Screen Display

Displays data from any of the current data sets. After selecting the appropriate data set, the review data window opens to display the selected data. Data that appears *red* in color is data that was loaded from a disk file. Data that appears *yellow* in color is unsaved data (captured or edited). This includes gathered data, data taken directly from the DV-III, or data altered using the Enter/Edit data option.

**NOTES:** 1) The Display option of the main menu is disabled if both of the data buffers are empty.  
2) Remember that although there are only two data buffers, the Load Buffer provides a window for up to five loaded data sets (see Appendix B).

### 4. Gather

The Gather option provides a full set of data gathering methods that can be run unattended and in the background (with the *exception* of the Spring Relax method). Once a gather operation has been started, it may be moved to the background while RHEOCALC's other *non-data gathering* features are exercised. To move a data gather to the background once it has commenced, press the Alt-F7 key combination to display the View menu. Choose any of the options other than the Gather Mode option (which is the current option) to hide the Gather Status and Gather Data windows and move the operation of the data gather into a background mode. If a data gather running in the background runs to completion, two double beeps alert you to this fact.

**NOTES:** 1) RHEOCALC does not allow you to print a graph while a data gather is running in the background due to speed considerations.  
2) The Gather Data window only applies to the Manual, Timed, and Program data gather methods.  
3) The Gather Status window only applies to the Timed and Program data gather methods.

Upon completion of any data gather operation, once the data gather has been brought to the foreground, the Review Data window opens to display the newly collected data as *yellow* text on a *cyan* background. A data gather is completed when the programmed number of data points (with 200 being the maximum allowable) have been collected, or when a program has run to completion, or when stopped by the user by pressing the **Esc** key.

**a. DV-III Buffer**

Retrieves the last data set captured with the **DV-III** in its **StandAlone** mode. The **DV-III** can store up to 25 data points when used in **StandAlone** mode. This data is retained even when power is removed from the rheometer. The **DV-III Buffer** option extracts a *copy* of this data and places it in the Review Data window (a copy of the data set remains in the **DV-III**). This data is treated as *unsaved data* and may be saved to disk, printed, plotted, and edited just as any other **RHEOCALC** data. If the last data set taken with a **DV-III** in Stand Alone mode used a number 99 spindle, when the data is retrieved by **RHEOCALC**, a spindle name of **DV3 Int** is assigned to the data set.

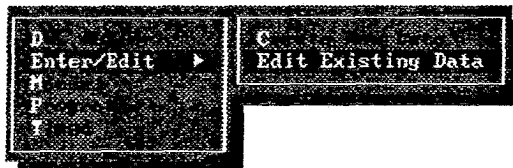
**NOTE:** The DV-III Buffer option is disabled if the program is not communicating with a **DV-III** Rheometer.

**b. Enter/Edit**

Allows for the creation of sample data or for the alteration of existing data. After choosing between Creating New Data or Editing Existing Data, the Edit window opens with the model field highlighted and the cursor flashing at the current data entry position. In the top portion of the edit window, a valid **BEL** rheometer model identifier, a valid **BEL** spindle name or code, a valid date, and a valid time must be entered. The standard Brookfield two digit codes can be entered in the spindle field.

**NOTE:** If 01 through 07 are entered, the spindle name is based on the model already entered. If no model has been entered, entries of these numbers are prefixed by **HA**.

A valid date consists of any 6 numeric characters while a valid time consists of any 4 numeric characters. Standard date and time delimiters ("/" and ":" respectively) are automatically inserted. The date may be in USA or non-USA format while time must be entered in 24 hour format. Entry of a sample name is recommended but not required.



**Edit Menu**

**NOTE:** If a data set from a disk file is loaded into the Edit window and a Special spindle was stored in the data set, the Edit window performs all calculations based on the SMC and SRC values in the data set, even if a special spindle of the same name but different parameters exists in your User Spindles list. If, on the other hand, a new data set is being created and, a special spindle name is entered in the spindle field, the Edit window uses the special spindle parameters from your User Spindles list as long as that spindle exists in the list.



When data entry in the upper edit window is complete, pressing the **Return/Enter** key activates the lower edit window. The % Torque field of the first data line is highlighted awaiting user input. In this portion of the window, the only fields that are alterable by the user are the **RPM**, **% Torque**, **Temperature**, and **Time** fields. **Viscosity**, **Shear Stress**, and **Shear Rate** values are calculated automatically based upon the other values entered. Each time a new value is entered in a field, the program re-calculates any values in the current data line dependent upon the changed field. This re-calculation does not occur until the user changes to a new field indicating he/she is finished editing the current field. The active field is selected by using the **cursor** keys. The **Return/Enter** key is to jump between the upper and lower sections of the edit window. If the model or spindle is changed in the upper portion, the next time the **Return/Enter** key is pressed to return to the lower portion, all data in the lower portion is re-calculated based upon the model and spindle in the upper portion.

**NOTE:** If there is a large amount of points in the data set (i.e. greater than 50), the recalculation may take a few seconds so be patient.

In the lower edit window, the **F3** key is used to *Delete a complete data line*. All succeeding data points are shifted up one position in the buffer to fill the void created by the deleted data point. The **F4** key is used to *Insert a blank data-line* at the line containing the highlighted field. All succeeding data is shifted down one position in the buffer.

Keep in mind that as soon as a change is made to any of the fields in the edit window, the data in the window becomes *unsaved* data even if it was originally loaded from a disk file.

Press the **F1** key when data entry/alteration is complete. If at least one data point has been entered, the Review Data window opens displaying the newly created data, otherwise you are returned to the Enter/Edit menus.

Some suggested uses for the Enter/Edit option:

- if data is gathered without a model, spindle, or sample name, it may be given these parameters at a later time in the edit window.
- simulation of "ideal" data for use in overlay plotting with actual data
- if a rheogram required that the rheometer pre-shear a fluid, but it is desired that the pre-shear data not be saved with the rest of the data, the pre-shear data may be deleted with the Edit option

**NOTE:** Because it uses the Capture Buffer, the **Enter/Edit** option is disabled while any other data gathering operation is in progress.

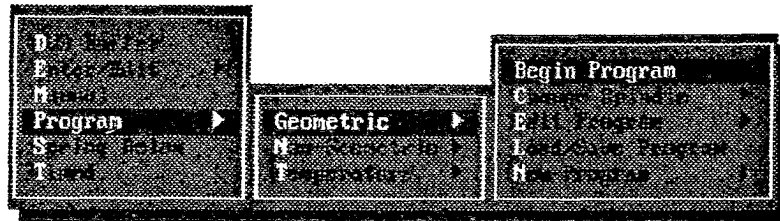
### c. Manual

Allows a data point to be placed in the buffer upon a user keypress. Selecting this option opens the Gather Data window. Pressing the **F1** key places the current rheometer data packet into the Capture Buffer and displays it in the Gather Data window. The time interval displayed for each data point is the time elapsed since the last press of the **F1** key (one second is the minimum allowable interval). Pressing the **Alt-F10** key combination allows you to change rheometer speed (or shear rate) at any time during this gather mode. The data gather completes when the user presses the **Esc** key or 200 data points have been collected. After completion of the the data gather, the Review Data window opens displaying the freshly gathered data.

**NOTE:** The Manual option is disabled if a **BEL** rheometer is not communicating with the computer.

**d. Program**

Allows the use of three different rheometric program methods. After selecting the Program option, a menu appears offering the choice between Geometric, Non-Geometric, and Temperature programming modes. Selecting one of the three modes causes a menu to appear with the following options listed:



**Program Menus**

**1. Begin Program**

Executes the Geometric, Non-Geometric, or Temperature program currently in the program buffer. The progress of each program step may be monitored by watching the information in the Gather Status window. At any time, if it is desired to view the data collected thus far, press the F3 key to hide the Gather Status window allowing a full view of the Gather Data window. To return to the Gather Status window, simply press the F3 key again.

**NOTE:** This option is disabled if a program is already running or if the RHEOCALC program is not communicating with a rheometer.

**2. Change Spindle**

Allows the current spindle to be changed without exiting the Gather menus. You may enter either the two digit spindle code or the Brookfield spindle name of any standard BEL spindle. If a special spindle entry is desired, it must be one that exists in the User Spindles list.

**3. Edit Program**

Allows you to change the Geometric, Non-Geometric, or Temperature program currently in memory.

**NOTE:** This option is disabled if there is no program in memory or a program is already running.

**4. Load/Save Program**

Opens the File System windows and allows you to load or save a Geometric (GEO), Non-Geometric (NGO), or Temperature (NGT) program from or to a disk file.

**NOTE:** This option is disabled if a program is already running.

**5. New Program**

Allows you to enter a new Geometric, Non-Geometric, or Temperature program.

**NOTE:** This option is disabled if a program is already running.

When entering programs, there are two types of rate entries possible (See Units;Rotation, under the Setup option in Section VII.g, for complete details). Rheometer speeds may be entered as direct speeds in units of RPM (rotations per minute) or as shear rates in units of 1/Sec (reciprocal seconds).

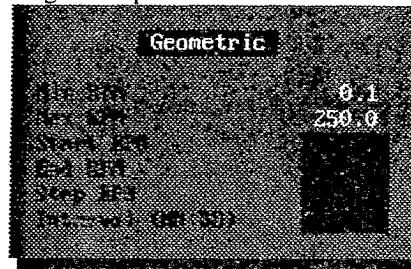
**a. Geometric Programs**

Geometric programs consist of the following parameters:

- Start Speed** - The speed at which the program begins execution.
- Step Speed** - The change in rheometer speed that occurs at the end of each time interval. This speed change is constant for each step of the program. *The change is an increase if the End Speed is greater than the Start Speed and a decrease if the End Speed is less than the Start Speed.*
- End Speed** - The last speed at which the rheometer runs before execution of the program ceases.
- Interval** - The amount of time the rheometer runs at the current step speed. At the end of this time interval, the current data packet is placed in the Capture Buffer before the rheometer changes to the next speed in the program. Time intervals are entered in minutes and seconds (MM:SS). The maximum allowable time interval is 99 minutes and 59 seconds. The minimum suggested time interval should be that which allows the % torque reading to properly settle before capturing a data point.

**Example:**

- Start Speed = 25 RPM
- End Speed = 250 RPM
- Step Speed = 25 RPM
- Interval = 10:15  
(10 minutes, 15 seconds)



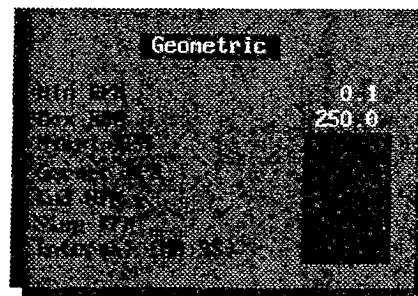
When the program begins, the rheometer starts running at 25 RPM. After 10 minutes and 15 seconds, a data point is placed in the Capture Buffer, and the speed increases to 50 RPM. The program continues to place data in the Capture Buffer every 10 minutes and 15 seconds followed by increasing the speed by 25 RPM. This continues until the rheometer has run at a speed of 250 RPM for 10 minutes and 15 seconds and a data point is collected. At this point the rheometer returns to a speed of 0 RPM. The Capture Buffer now contains the 10 data points collected during the execution of this program.

In addition to the single direction Geometric program, an Up/Down (or Down/Up) program may be selected. In order to input a program of this type, answer YES when you are prompted to do so after selecting the New Program option. An Up/Down program operates just as a standard Geometric program with one difference. Instead of running the rheometer from the start speed to the end speed, it is run from the Start Speed to an intermediate speed called the *corner speed* and then to the end speed.

- Corner Speed** - This parameter is only used if you wish to run an Up/Down (or Down/Up) program. This is an intermediate speed that is reached after the start speed and before the end speed in the course of a program run. It is also known as the *turn around speed*.

**Example:**

- Start Speed = 25 RPM
- Corner Speed = 250 RPM
- End Speed = 25 RPM
- Step Speed = 25 RPM
- Interval = 10:15



The rheometer begins at 25 RPM. After every 10 minutes and 15 second interval, a data point is collected, and the speed increases by 25 RPM. After the data point has been collected for the 250 RPM step, the speed then decreases by 25 RPM. This continues until a data point has been captured for the second 25 RPM step at which point the rheometer stops. After completion of the program, 19 data points are in the Capture Buffer.

## b. Non-Geometric Programs

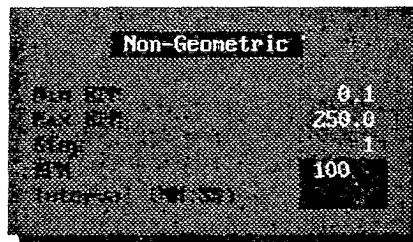
The Non-Geometric program mode allows the entry of programs that don't necessarily follow a linear speed and time progression. After selecting the Non-Geometric mode, select the New Program option to create a Non-Geometric program. You are prompted to enter both the rheometer speed (or shear rate) and the time interval for each step of the program. After completing a step, press the **Return/Enter** key to advance to the next step. Press the **F1** key when your program is complete. Pressing the **Esc** key at any time during program entry abandons the changes and/or additions you have just made. Execution of a Non-Geometric program causes the rheometer to run at the speed of each step for the time interval of each step. As in a Geometric program, a data point is collected at the end of each time interval before the speed changes. Up to 200 separate steps may be entered for a Non-Geometric program.

### RPM

(or Shear Rate) - The desired speed or shear rate at which the rheometer should run for each program step.

### Interval

- The amount of time the rheometer should run at the current step speed (shear rate) before taking a data point and advancing to the next program step.

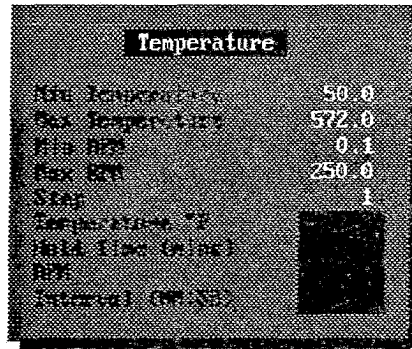


## c. Temperature

The Temperature program mode may *only* be used in conjunction with the **Brookfield Engineering Labs HT-104** or **HT-105 Temperature Controllers**. The **HT-104** is used to control the temperature of the **Brookfield Engineering Labs Thermosel** while the **HT-105** is used to control the temperature of the **Brookfield Engineering Labs Temperature Baths** (models **TC-200** and **TC-500**).

**NOTE:** If RHEOCALC does not detect the presence of one of these two instruments, the Temperature program option is disabled.

A Temperature program allows you to control the temperature of your test at every step of your rheometric program. Like Non-Geometric programs, Temperature programs do not necessarily follow a linear speed and time progression, and they also require both a speed and time interval for each program step. In addition, these programs require a *set point temperature* and a *thermal equilibrium (or soak) time*.



**Temperature** - The desired sample temperature for the current program step. This value is sometimes called the *set point* temperature. The units of this temperature are °Centigrade(C) or °Fahrenheit(F) depending on units you have chosen in the Setup menu.

Temperature Limits of the HT-104 and HT-105 (°C)		
	Minimum	Maximum
HT-104	10	300
HT-105	-15	130

**Hold Time** - The amount of time to hold at the set point temperature before setting the rheometer to the speed of the current program step and beginning the countdown of the current step time interval. This value is sometimes called the *thermal equilibrium (or soak)* time. The hold time is always expressed in minutes.

When advancing to each succeeding step during Temperature program entry, notice that the Hold Time, RPM(or Shear Rate), and Interval fields retain the values entered in the previous step. Only the Temperature field blanks as each new step is reached. This feature facilitates the entry of the most basic type of Temperature program wherein the rheometer speed and time interval are kept constant while the sample temperature is ramped upward or downward. This type of program provides useful data in determining the effects of temperature on viscosity. Keep in mind that although the Hold Time, RPM, and Interval fields remain unchanged from the previous step, they may still be changed for any step providing the flexibility to create a wide range of rheometric programs. Simply use the **Tab** key to cycle through the fields and make any desired changes in the usual manner. Press the **F1** key when your program is complete. Pressing the **Esc** key at any time abandons the changes and/or additions you have just made.

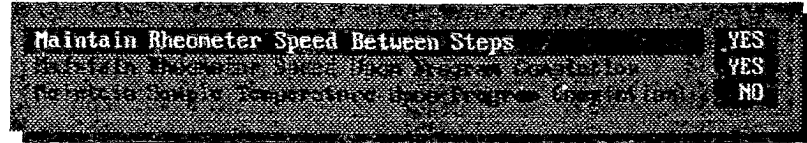
Execution of a Temperature program causes the following to occur:

- 1) A menu appears offering a YES/NO choice for the following three options:

**Maintain Rheometer Speed Between Steps** - While the sample is being brought to thermal equilibrium for each step, should the rheometer continue to run at the speed of the previous program step; YES or NO?

**Maintain Rheometer Speed Upon Program Completion** - After the program completes its final step, should the rheometer continue to run at the speed of the last program step; YES or NO?

**Maintain Sample Temperature Upon Program Completion** - After the program completes its final step, should the sample be kept at the setpoint temperature of the last program step; YES or NO?



After answering these three questions with a YES or a NO (using the "Y" and the "N" keys), press the **Return/Enter** key to accept these choices.

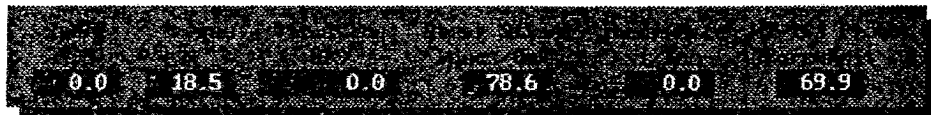
- The HT-104/HT-105 increases or decreases to the setpoint temperature of the first program step. The **RUN** light on the HT-104/HT-105 front panel lights indicating it is attempting to control to the setpoint temperature. If the *sensed* temperature is *below* the setpoint temperature, the **HEAT ON** light on the HT-104/HT-105 front panel remains on or blinks intermittently indicating that the Thermosel or the Temperature Bath is being heated by its associated controller. While RHEOCALC is waiting for the appropriate temperature control device to reach the desired setpoint temperature, the text

*Waiting for the HT -104(5) to reach setpoint temperature.*

appears at the top of the Gather Status window.

**NOTES:** 1) The Thermosel and the TC-200 Temperature Bath without the TC-350 Cooler have no cooling capabilities. If the temperature sensed by either of these instruments is greater than the set point temperature, RHEOCALC and the HT-104/HT-105 waits for the instrument to cool down to the setpoint temperature. The amount of cooling time is dependent upon the temperature difference.

2) The *sensed* temperature is that received by the HT-104/HT-105 temperature probe (connected at the rear of the instrument). When an HT-104/HT-105 is connected to the computer running RHEOCALC, the temperature sensed by the DV-III temperature probe is not used.



- When the sensed temperature is within **0.5 degrees** of the set point temperature (°Centigrade or °Fahrenheit), the text at the top of the Gather Status window changes to

*Waiting for thermal equilibrium.*

The Gather Status window displays the countdown of the step's Hold Time (thermal equilibrium time).

- When the Hold Time has elapsed, the rheometer begins to run at the speed of the current program step, the countdown of the current step's Time Interval begins, and the text at the top of the Gather Status window changes to

*Counting down to next reading.*

The Gather Status window displays the countdown of the Time Interval.

- 5) This sequence continues for each program step. When the program is complete, a message appears stating this fact, and a keypress is required to continue. After a keypress the Review Data window appears displaying the freshly gathered data.

#### Rheological Considerations When Running Temperature Programs

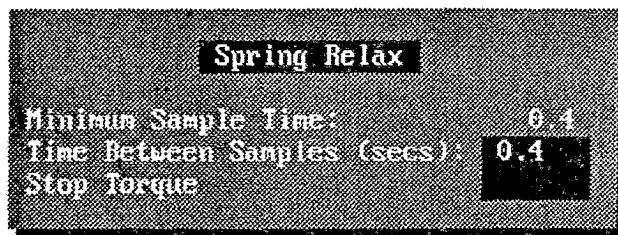
- If the sample being measured is Newtonian (viscosity is independent of shear rate (RPM)), data may be gathered using different rheometer rotational speeds at different temperatures. If the sample is Non-Newtonian (viscosity is dependent upon shear rate (RPM)), the same rheometer rotational speed should be used at each step of the program to insure proper correlation of viscosity versus temperature.
- If multiple rheometer rotational speeds are programmed at each temperature step, the resulting data must be edited (using the Edit option) prior to plotting.
- Data gathered under temperature program control with varying temperatures should not be plotted as % Torque, Viscosity, or Shear Stress versus RPM, Shear Rate, or Time. Temperature should be the only value used on the X-axis.

Geometric, Non-Geometric, and Temperature programs may be paused by pressing the F2 key while the Gather Status and Gather Data windows are visible on the screen. When a program is paused, a message appears indicating this, and the rheometer stops. At this point, you may resume the program by pressing the F1 key or cancel the remainder of the program by pressing the Esc key. If the program is resumed, the step that was executing when the program was paused is rerun in its entirety.

#### e. Spring Relax

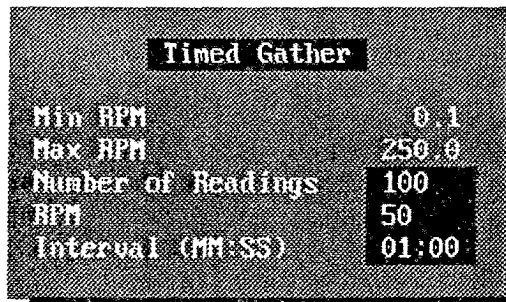
Spring Relax data gathering allows you to take data without running the rheometer motor. After selecting the time between readings (0.4 seconds minimum) and the %torque at which the data gather should cease, you are instructed to manually turn the spindle until you hear a *beep* (RHEOCALC beeps when 100% torque is reached). At this point the spindle should be released, and RHEOCALC takes readings at the specified time intervals as the spindle unwinds through the sample.

**NOTE:** During a Spring Relax, you may notice that time intervals between data taken may vary slightly from the requested interval. This gather method attempts to maintain the requested interval as an average time between readings over the course of the complete data gather.



#### f. Timed

Allows you to enter a program that runs the rheometer at a constant speed (or shear rate) and takes data samples at a constant time interval. After selecting this option, you are required to enter a speed, the number of data points required, and a time interval. After pressing the Return/Enter key to accept these parameters, the Gather Status and Gather Data windows open. To begin the Timed gather, press the F1 key. Once the program has begun, it functions as all other data gather programs. Pressing the F2 key pauses the program, pressing the F1 key resumes a paused program, and pressing the Esc key cancels the remainder of the program.


**5. Math Model**

The Bingham Plastic, Casson (Standard), NCA/CMA Casson (Chocolate), and Power Law math models provide a means to numerically and graphically analyze the behavior of data sets. After choosing a math model and a data set to analyze, a window opens displaying the name of the math model, the corresponding equation of the math model, and the calculated model parameters.

The Review Data window may be opened beneath the results of any of these three math models to display the data set being analyzed by pressing the F3 key. You may press the F2 key to display a plot of the *actual data* versus the *math model results*. The actual data points are marked with circles while the fitted model data is shown as a solid line on the plot. The plot may be printed on a connected printer by *pressing the "P" key* once the plot has been displayed.

**NOTES:** 1) The data sets that may be used with these math models must adhere to the following restrictions:

- The data sets must contain valid shear stress and shear rate values.
- All shear stress and shear rate values must be greater than 0.
- There may not be two equal adjacent shear rate values.
- % torque values of all data points must be between 0.1 % and 100% torque

2) The *Confidence of Fit* parameter used in all four of the above models is an indication of how well the selected data set fits the selected math model (100% being the best fit).

3) Further information on all math models is available from **Brookfield Engineering Labs**.

**a. Bingham Plastic**

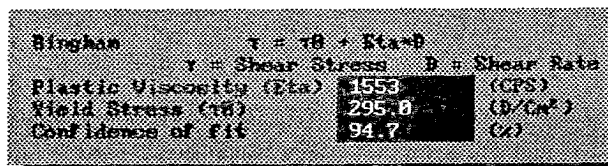
The Bingham equation is  $\tau = \tau_0 + \eta D$  where

- $\tau$  = shear stress
- $\tau_0$  = yield stress (shear stress at zero shear rate)
- $\eta$  = plastic viscosity
- $D$  = shear rate

The calculated parameters for this model are:

- Plastic Viscosity** (cP or mPas)
- Yield Stress** (Dynes/Cm<sup>2</sup> or N/m<sup>2</sup>)
- Confidence of fit** (%)

A plot of shear stress versus shear rate is displayed for this model when the F2 key is pressed.





## b. Casson (Standard)

The Standard Casson equation is  $\sqrt{\tau} = \sqrt{\tau_0} + \sqrt{\eta D}$  where

- $\tau$  = shear stress
- $\tau_0$  = yield stress (shear stress at zero shear rate)
- $\eta$  = plastic viscosity
- $D$  = shear rate

The calculated parameters for this model are:

- Plastic Viscosity** (cP or mPas)
- Yield Stress** (Dynes/Cm<sup>2</sup> or N/m<sup>2</sup>)
- Confidence of fit** (%)

The Standard Casson method is a direct implementation of the original Casson equation. A plot of the *square root* of shear stress versus the *square root* of shear rate is displayed for this model when the F2 key is pressed.

<b>Casson</b>	$\tau = \tau_0 + \eta D$
	$\tau$ = Shear Stress $D$ = Shear Rate
Plastic Viscosity ( $\eta$ )	<b>1553</b> (CP)
Yield Stress ( $\tau_0$ )	<b>295.0</b> (D-Cm <sup>2</sup> )
Confidence of fit	<b>94.7</b> (%)

## c. IPC Paste Analysis

This method is intended to calculate the Shear Sensitivity Factor and 10 RPM Viscosity of pastes. A prime example of its use is in the solder paste industry thus the name IPC (Institute for Interconnecting and Packaging Electronic Circuits).

The Paste equation is  $\eta = k R^n$  where

- $\eta$  = viscosity (cP)
- $k$  = consistency multiplier
- $R$  = rotational speed (RPM)
- $n$  = shear sensitivity factor

The calculated parameters for this model are:

- Shear Sensitivity Factor** (no units)
- 10 RPM Viscosity** (cP or mPas)
- Confidence of fit** (%)

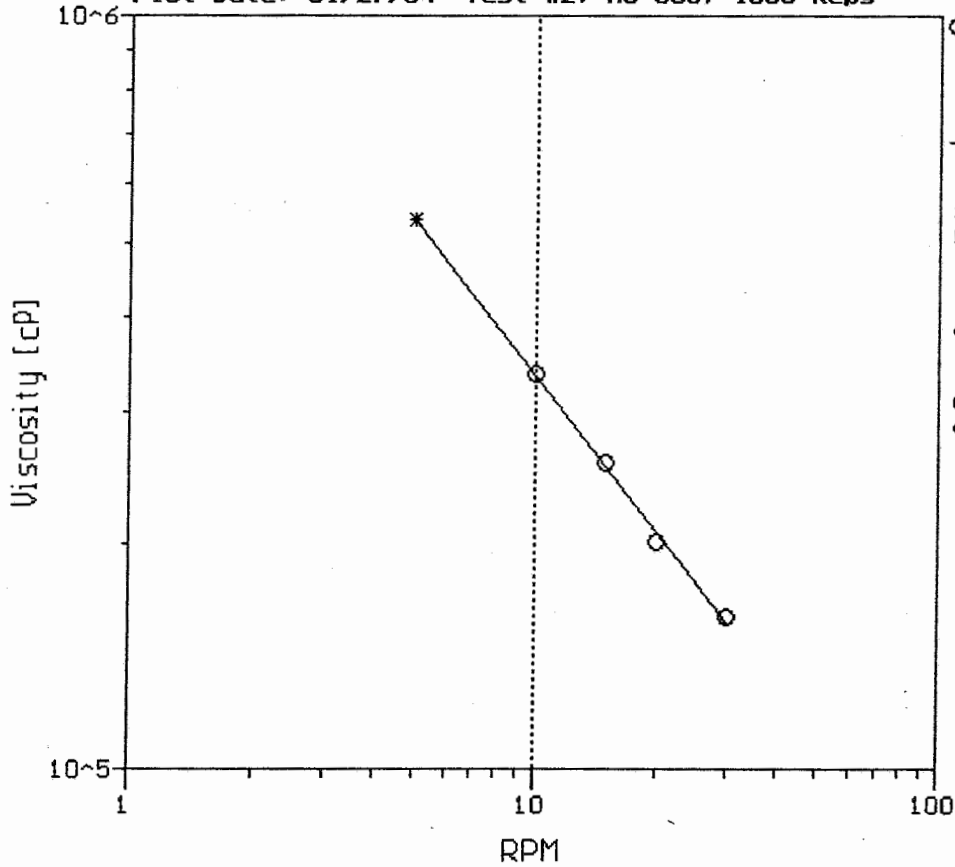
A plot of the LOG of viscosity versus the LOG of speed (RPM) is displayed for this model when the F2 key is pressed.

```

Paste Analysis   $\eta = kR^n$ 
                 $\eta$  = Viscosity       $R$  = Rotational Speed
Shear Sensitivity Factor (n) 0.688
10 RPM Viscosity           333836      (cP)
Confidence of fit          98.6        (%)
    
```

Brookfield Engineering Labs RHEOCALC

Plot Date: 01/27/94 Test #2: hC-830: 1000 Kcps



Paste Analysis

○ Actual Data  
 TEST2.DU3  
 Mod: HB  
 Spdl: SP-3Y  
 Date: 08/20/93

- Fitted Data

Shear Sensitivity  
 Factor:  
 0.688

10 RPM Viscosity  
 (cP):  
 333836

Confidence  
 of fit(%):  
 98.6

Paste Analysis Plot

**d. NCA/CMA Casson (Chocolate)**

This Casson method is derived from the standard set forth by the National Confectioners Association(NCA) and the Chocolate Manufacturers Association(CMA). Although based on the original Casson equation, this implementation has been tailored by the NCA and CMA specifically to applications involving chocolate.

The Chocolate Casson equation is  $(1 + a)\sqrt{t} = 2\sqrt{t_0} + (1 + a)\sqrt{\eta D}$  where

- $\tau$  = shear stress
- $\tau_0$  = yield stress (shear stress at zero shear rate)
- $\eta$  = plastic viscosity
- $D$  = shear rate

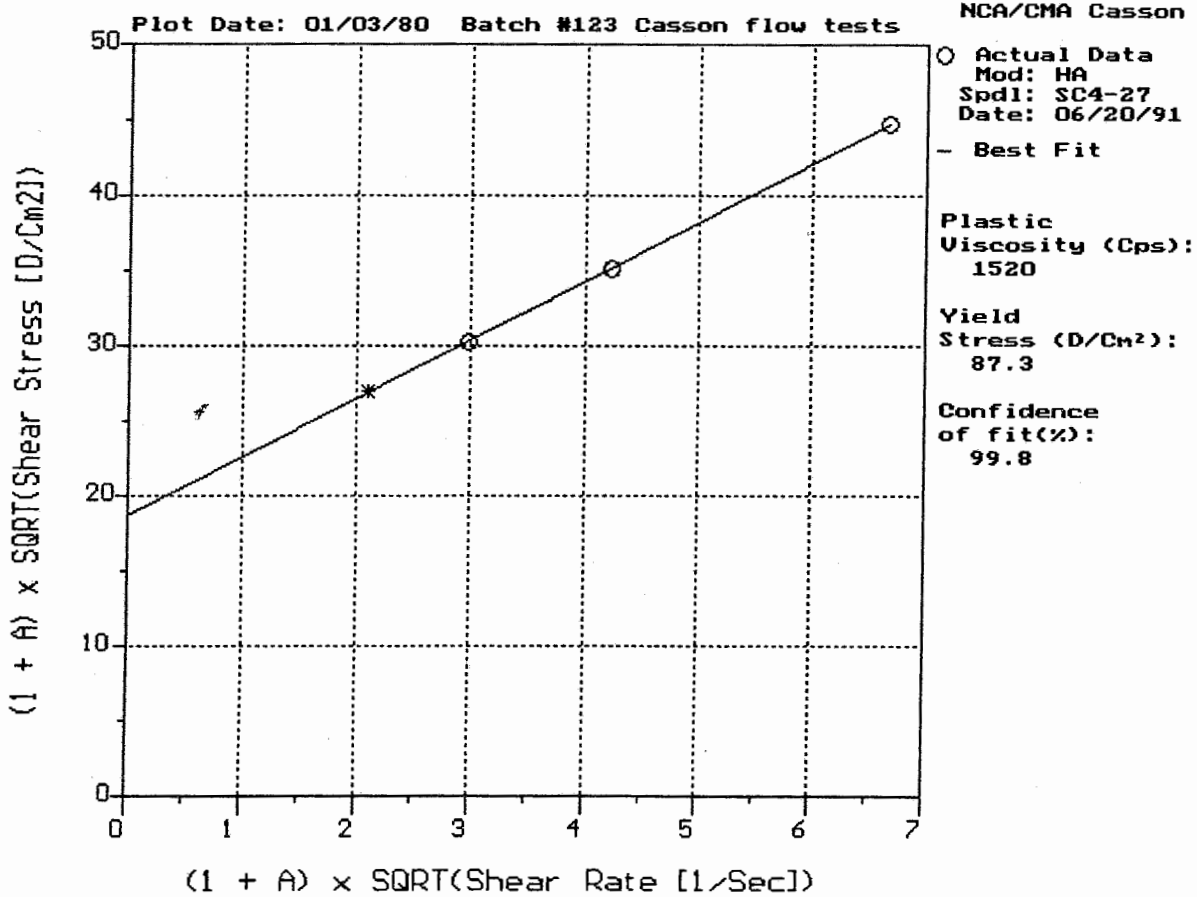
The calculated parameters for this model are:

- Plastic Viscosity (cP or mPas)
- Yield Stress (Dynes/Cm<sup>2</sup> or N/m<sup>2</sup>)
- Confidence of fit (%)

A plot of (1 + a) times the *square root* of shear stress versus (1 + a) times the *square root* of shear rate is displayed for this model when the F2 key is pressed.

a = spindle (or bob) radius / inner cup radius

Brookfield Engineering Labs RHEOCALC



Chocolate Casson Plot

e. Power Law

The Power Law equation is  $\tau = k D^n$  where

- $\tau$  = shear stress
- $D$  = shear rate
- $k$  = consistency index (cP)
- $n$  = flow index

The calculated parameters for this model are:

- Flow Index** (no units)
- Consistency Index** (cP or mPas)
- Confidence of fit** (%)

A plot of the LOG of shear stress versus the LOG of shear rate is displayed for this model when the F2 key is pressed.

Power Law $\tau = kD^n$		
$\tau$ = Shear Stress	$D$ = Shear Rate	
Flow Index (n)	0.423	
Consistency Index (k)	1113	(cP)
Confidence of fit	99.1	(%)

#### f. Shear Thinning Index

After selecting this option, a window opens which requires the user to enter the % Torque and RPM for a pair of data points. Using these entered values, the *Shear Thinning Index* and the *Brookfield Thix Index* are calculated. Indexes less than 1 indicate that the entered data points show a *dilatant* tendency; indexes equal to 1 show a *Newtonian* tendency; indexes greater than 1 show a *pseudoplastic* tendency.

**NOTE:** See More Solutions to Sticky Problems for more information on the terms *shear thinning index*, *dilatant*, *Newtonian*, and *pseudoplastic*.

Shear Thinning Index	
% Torque 1	25
RPM 1	50
% Torque 2	35
RPM 2	75
ST Index	1.21
Thix Index	1.07
Index < 1: Dilatant	
Index = 1: Newtonian	
Index > 1: Pseudoplastic	

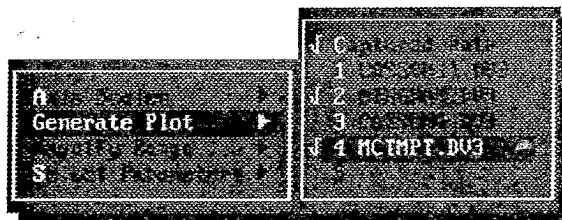
## 6. Plot

### a. Axis Scales

Allows the choice of either linear or logarithmic plots on either the X axis, Y axis, or both axis.

### b. Generate Plot

Executes the generation of a plot. After choosing this option, you are asked to choose which data set to print. From a list containing the Capture Buffer and any of the five allowable loaded data sets, five data sets may be plotted at one time on EGA and VGA monitors. Computers using CGA monitors may only plot four data sets at once. Data sets are selected by pressing the key corresponding to the highlighted letter or number, or by using the **cursor** keys in conjunction with the **Return/Enter** key. If the plot uses more than one data set, an entry window appears allowing the entry of a plot title that appears at the top of the plot. If only one data set is to be plotted, the data set's Sample name is used by default.



When the desired data sets are chosen, press the F1 key to display a menu containing the allowable plot types for the chosen data sets. The allowable plot types are:

- Torque vs. RPM
- Torque vs. Shear Rate
- Torque vs. Time
- Torque vs. Temperature
- Shear Stress vs. RPM
- Shear Stress vs. Shear Rate
- Shear Stress vs. Time
- Shear Stress vs. Temperature
- Viscosity vs. RPM
- Viscosity vs. Shear Rate
- Viscosity vs. Time
- Viscosity vs. Temperature

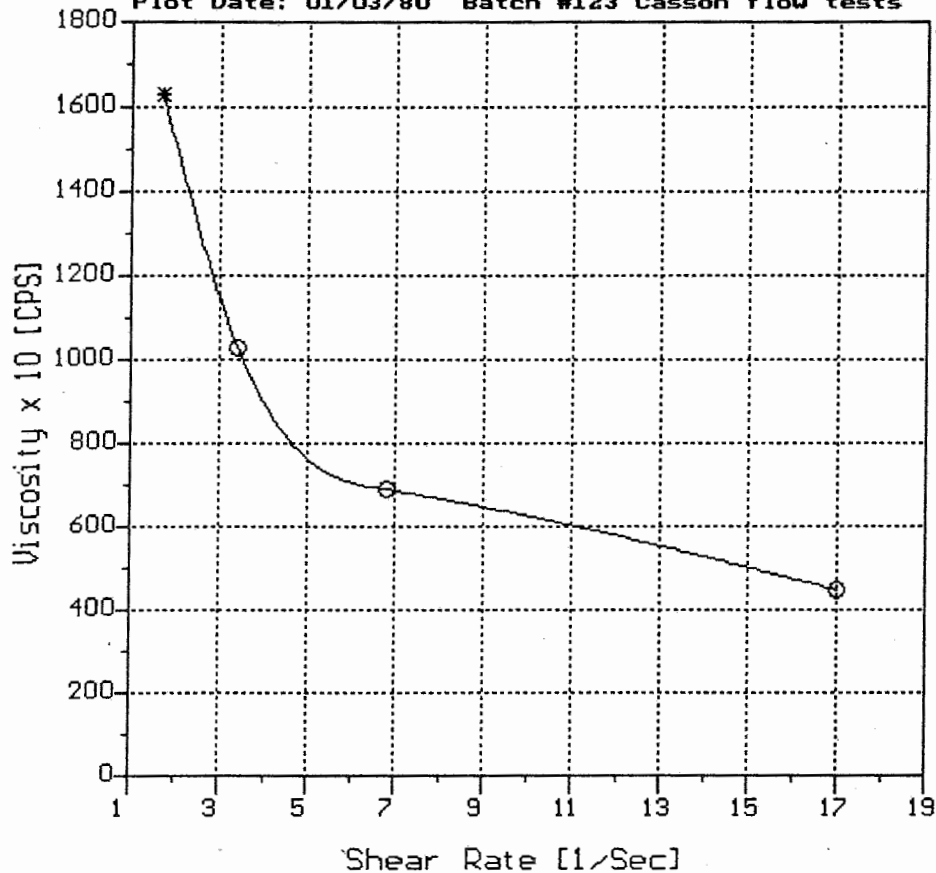
c. Printing a Plot

Once a plot appears on your computer screen, it may be printed by pressing the P key.

- NOTES:** 1) The plot is sent to the printer designated as LPT1 (also known as PRN1) by your computer. This is normally the printer connected to the parallel port of your computer.  
2) Ensure your printer is turned ON and is ON-LINE.

Brookfield Engineering Labs RHEOCALC

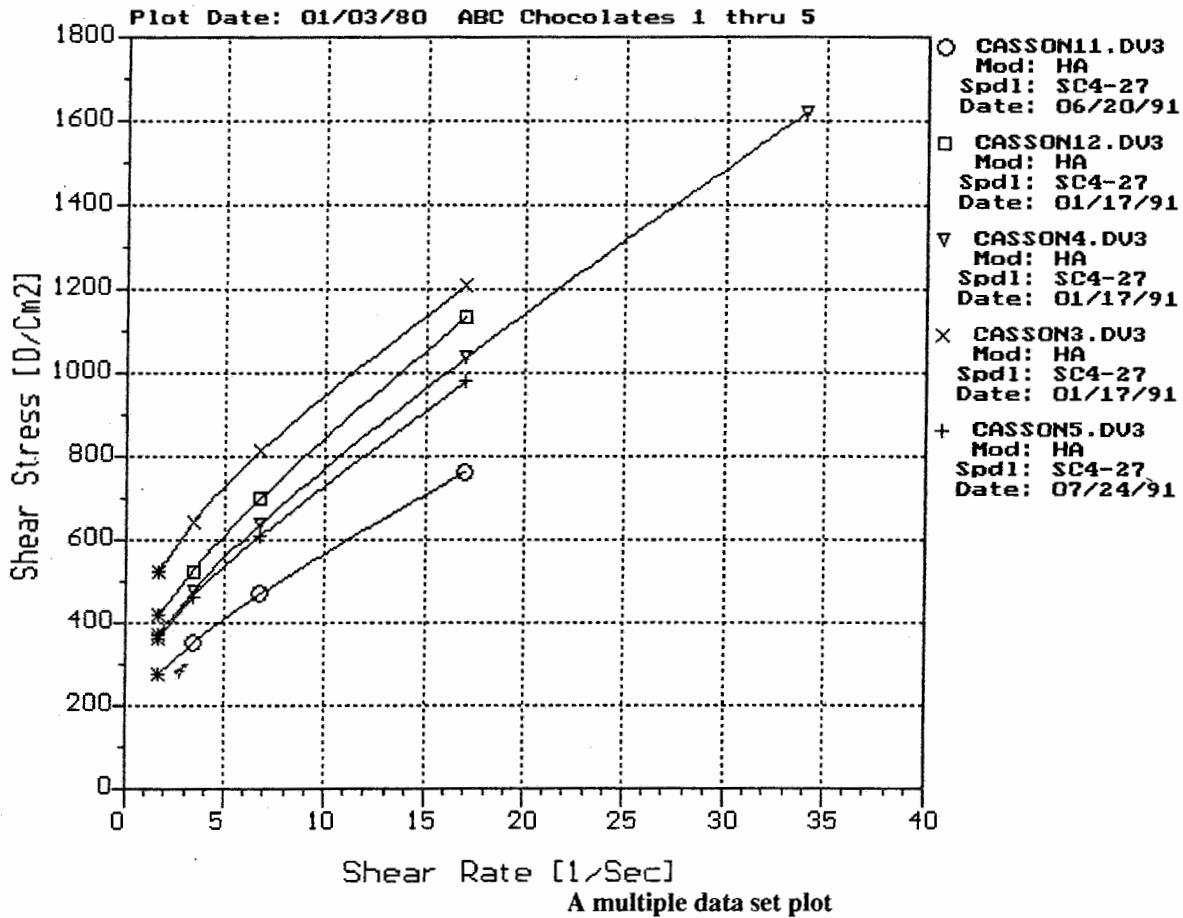
Plot Date: 01/03/80 Batch #123 Casson flow tests



○ CASSON11.DU3  
Mod: HA  
Spd1: SC4-27  
Date: 06/20/91

A single data set plot

Brookfield Engineering Labs RHEOCALC



Under certain conditions, some of these plot types may appear gray in color and are not accessible to the user. If any of the data sets chosen for a plot contains any data that renders a particular plot type unusable, the corresponding plot option is disabled. Conditions that cause plot types to be disabled are as follows:

- 1) A data set taken with a spindle that does not allow for the calculation of shear rate renders all plot types using shear rate unusable.
- 2) A data set taken with a spindle that does not allow for the calculation of shear stress renders all plot types using shear stress unusable.
- 3) A data set taken in the Spring Relax mode (i.e. at 0 RPM) renders all plot types using RPM, shear rate, and viscosity unusable.
- 4) A data set taken with no temperature probe connected or DVGather data sets (with the DVD file extension) renders all plot types using temperature unusable.

**NOTE:** If any data sets being plotted contain under range (< 0.0) or over range (> 100.0) torque values, the plot is cancelled.

It may take several seconds for the plot to appear on your computer screen depending on the plot options selected and the speed of your computer. If a spline plot has been selected or if either axis is logarithmic (LOG), it will take longer for the plot to appear. *Once the plot does appear, if you wish to print the plot, press the "P" key on your keyboard.* To remove the plot from the screen, press any other key.

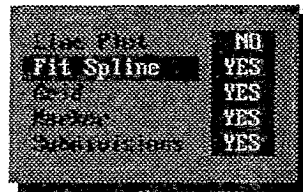
#### d. Magnify Range

Allows you to expand a section of the original plot. An entry window opens requiring you to input a *start* and *end* point chosen from the **X** axis. The entry window also displays the limits of the X axis range of the plot. You may not choose values outside these limits. If you wish to expand the whole plot, simply press the **Return/Enter** key without entering any values. When the plot is displayed, notice the tag of "*Sub-range Plot*" in the lower left hand corner of the plot. A sub-range plot may be performed regardless of the number of data sets plotted in the original plot. As with all plots, *you may press the "P" key to print the plot* or any other key to remove the plot from the screen.

**NOTE:** This option is disabled if an initial plot has not yet been performed. If after performing a plot you elect to return to the main menu and then return to the Plot menu, you must redo the original plot before a sub-range plot can be done.

#### e. Select Parameters

The following five plot parameters may be selected by the user (Setting an option to **YES** enables that option; setting it to **NO** disables the option):



- Line Plot - The plot is drawn using straight line segments.
- Fit Spline - A *cubic spline* is fit to the data points instead of using straight line segments. These first two options are mutually exclusive. If one is set to **YES**, the other is set to **NO**.
- Grid - Draws division lines at each major increment of the plot.
- Marker - Draws a marker at each data point of the plot.
- Subdivisions - Draws subdivision lines (tick marks) between major increment lines.

### 7. Setup

#### a. About RHEOCALC

Selecting this option displays an information window about the RHEOCALC program.

#### b. Change Spindle

This option allows the you to select or change the current spindle. After selecting this option, the User Spindles window opens. This window displays the list used to store frequently used spindles. Initially, only the **#99 SPECIAL** spindle appears on this list. To add a spindle to this list, press the **F1** key, and the Standard Spindles window opens above the User Spindles window. The Standard Spindles window contains all Brookfield Engineering Labs standard spindles. Use the cursor keys to scroll to the spindle you wish to add, and press the **Return/Enter** key. If the selected spindle is not already in the User Spindles list, it is automatically be added to this list. Press the **Esc** key when you wish to exit the Standard Spindles window.



Code	Name	SMC	SRC
00	HE1	0.24	1.279
01	HE1	1.0	0.0
02	HE2	4.0	0.0
03	HE3	10.0	0.0

Code	Name	SMC	SRC
99	HE1	0.24	1.279
99	HE2	1.0	0.0
37	SC4-37	25.000	0.360
99	HE3	10.0	0.0

To add a user defined Special spindle, proceed to the end of the User Spindles list and select **#99 SPECIAL**. An entry window opens allowing you to enter the **name**, **SMC**, and **SRC** of your new spindle. Enter the appropriate data and press the **Return/Enter** key to add your spindle to the User Spindles list. You may also select any spindle with a code of **99** from the User Spindles list to alter the parameters of that spindle.

To remove a spindle from the User Spindles list, scroll to the unwanted spindle in the User Spindles window, and press the **F2** key. After **RHEOCALC** verifies your intent, the spindle is removed from the list. The **#99 SPECIAL** spindle may not be removed from the User Spindles list, but all other **#99** coded spindles are removable.

The User Spindle list is stored in a disk file (**USERSPDL.BEL**) and is re-loaded with each run of the **RHEOCALC** program.

#### c. Date Format

This option allows you to change date formatting between **USA** and **Non-USA** formats.

#### d. Model Name

This option allows you to choose the type of rheometer model you are using if the **RHEOCALC** program is being used with a **BEL Rheoset**. When a model is selected, it appears in the model field of the green General Information Panel.

**NOTE:** This option is disabled unless a **BEL Rheoset** is connected to the host computer.

#### e. Printer Type

This option provides for the selection of a printer type. The type of printer selected is important to the manner in which plots are printed. The supported printer types are:

- |                           |  |
|---------------------------|--|
| Epson FX series           | - 9 pin printers                             |
| Epson LQ series           | - 24 pin printers                            |
| Epson MX series           | - older 9 pin printers                       |
| HP LaserJet               | - any of the Hewlett Packard LaserJet series |
| HP ThinkJet               | - any of the Hewlett Packard inkjet printers |
| IBM Graphics              | - IBM 9 pin printers; IBM Laser printers     |
| IBM Proprinter            | - IBM 9 pin printers; IBM Laser printers     |
| Okidata 9 pin printers    | - 9 pin printers                             |
| Panasonic 24 pin printers | - 24 pin printers                            |
| Star 9 pin printers       | - 9 pin printers                             |
| Star 24 pin printers      | - 24 pin printers                            |

If your printer is not listed, check your printer manual for a type that your printer can emulate.

**f. RS232 Setup**

Choosing this option causes **RHEOCALC** to scan **COM1** and **COM2** (if present) for connected **Brookfield Engineering Labs** instruments. At present, **RHEOCALC** recognizes the **DV-III**, the **HT-104**, the **HT-105**, and the **Rheoset**. If a **DV-III** or a **Rheoset** is not found, the data fields in the *red* Current Data Panel are all blank. If a rheometer is found, all these fields are blank except for the Temperature field which displays the temperature sensed by the rheometer probe. The other fields remain blank until the rheometer has been *auto-zeroed*. If an **HT-104** or an **HT-105** is found, the Temperature field in the Current Data Panel displays the temperature sensed by its probe instead of that of the rheometer. It may take a few seconds for this scan to finish so be patient.

**NOTES:** 1) This option is disabled if **RHEOCALC** finds no communications (serial) ports on the host computer.  
 2) If the **RHEOCALC** program was started with the **COM1** or **COM2** command line option, only the corresponding port (1 or 2) is scanned when **RS232 Setup** is selected. The other communications port is ignored as it is upon program startup.

**g. Sample Name**

This option allows you to enter or edit the current sample name. An entry window opens with the cursor positioned at the current entry point. A sample name may contain 26 alpha-numeric characters.

**h. Units**

This option allows for the selection of various units of measurement and control throughout the program.

**NOTE:** The Units option is disabled during all data gathers. Units of any type cannot be changed while gathering data.

**1. Measurement**

- i. **CGS** - All data is displayed in units of the CGS measurement system.
- ii. **SI** - All data is displayed in units of the SI measurement system.

Measurement Units					
	Speed	Torque	Viscosity	Shear Stress	Shear Rate
<b>CGS</b>	RPM	% of scale	cP (centipoise)	Dynes/cm <sup>2</sup>	1/sec
<b>SI</b>	RPM	% of scale	mPas (milliPascal seconds)	Newton/m <sup>2</sup>	1/sec

**2. Rotation**

- i. **Ang. Velocity (RPM)** - Choosing this option results in all rheometer speeds, both direct entries and those in program modes, being entered in units of RPM (rotations per minute). The maximum allowable speed entry in this mode is 250 RPM. The minimum allowable speed entry in this mode is 0.1 RPM. The minimum allowable speed increment in this mode is 0.1 RPM.
- ii. **Shear Rate (1/Sec)** - Choosing this option results in all rheometer speeds, both direct entries and those in program modes, being entered in units of 1/Sec (reciprocal seconds). The maximum entry, minimum entry, and minimum increment in this mode are dependent upon the current spindle.

**NOTE:** The Rotation option is disabled if there is no current spindle entered or the current spindle does not support shear rate calculations (i.e. the **SRC** parameter for the spindle is 0).

### 3. Temperature

i. Centigrade - Chooses the Centigrade scale for temperature display throughout the program.

ii. Fahrenheit - Chooses the Fahrenheit scale for temperature display throughout the program.

### i. Zero Rheometer

This option automatically "Zeros" the connected rheometer. The program asks that the spindle first be removed, then a key to be pressed to start the *autozero* process. When the zero process is complete, the spindle should be replaced. This same process occurs if a data gather mode was started, and the connected rheometer had not yet been zeroed. Once the rheometer has been zeroed, the red Current Data Panel now displays all incoming data.

### 8. Quit

This option exits the RHEOCALC program. If there is unsaved data in the Capture Buffer, you are asked if you wish to save this data before exiting. If you elect to save the data, the File System windows open, and you can save the data as you normally would. All user configurable parameters are saved in a file (DV3PARMS.PAR). This file is loaded and become the user's default parameters when the program is next run.

## VIII. Hot Key Functions

The RHEOCALC *hot* keys may be displayed on the Active Key Line at the bottom of the computer screen at any time by holding down the **Alt** or the **Ctrl** keys. While holding down the **Alt** or the **Ctrl** key, press any of the keys shown to invoke the key's corresponding function. If a "Beep" is heard when a *hot* key is pressed, it indicates that the *hot* key's function is disabled due to prevailing program conditions. Releasing the **Alt** or **Ctrl** key re-displays the valid keys for the active window.

### 1. View Menu (Alt-F7)

Pressing **Alt-F7** opens the View Menu. The View Menu allows you to choose what is displayed in the screen area to the right of the main menu. The choices are:

#### a. Buffer Data

This option displays the Data Set menu which contains a list of all data sets currently being used within RHEOCALC (see Appendix B). Choosing any of the available data sets causes it to be displayed in the Review Data window to the right of the Main Menu.

**NOTES:** 1) This option is disabled if the Capture Buffer is empty and there are no disk files loaded.  
2) Remember that whenever the Review Data window is open, it is the active window, and all keystrokes pertain to this window until it is closed using the **F1** key.

#### b. Directory Tree

This option displays the File System windows (the Directory panel and the Files panel) behind any menus, entry window, status window, or message windows that are currently open. It essentially uses the File System windows as a backdrop in the area to the right of the Main Menu. The Directory panel does *NOT* become the active window at this point. The active window remains unchanged when this option is selected. The only ways to enter the File System are:

- pressing the **Tab** key while in the Main Menu
- pressing the **F2** key while viewing Capture Buffer data in the Review Data window
- selecting Load/Save Program from the **Program** options menu.

#### c. Gather Mode

This option opens the Gather Status (if applicable) and Gather Data windows in the area to the right of the Main Menu. When these windows are open, all keystrokes pertain to the data gather operation until it is ended or placed in the background. After beginning a gather mode, you may close the Gather windows by opening the View Menu and selecting an option other than Gather Mode. The data gather continues in the background while you are free to perform other *non-data gathering* operations in the foreground.

**NOTE:** This option is disabled if no data gather is in progress.

#### d. None

This option clears the area to the right of the Main Menu of all Review Data, Gather, and File System windows providing a plain white backdrop for all menus, entry windows, and message windows.. The active window does not change when this option is selected.

## 2. Stop Motor (Alt-F8)

If a rheometer is connected to the host computer, pressing the **Alt-F8** key combination *stops the rheometer immediately* (i.e. sets the rheometer speed to 0 RPM).

## 3. Configuration Window (Alt-F9)

Pressing the **Alt-F9** key combination opens the **RHEOCALC** Configuration window. This window contains the current settings of pertinent program parameters. These parameters are broken up into two categories: **Plot** and **General**.

### Plot

- Scale Type - Plot axis (X and Y) scales (Linear or Logarithmic).
- Line/Spline - Fit a straight line or a cubic spline to the data.
- Grid - Show major division grid marks on the plot.
- Marker - Plot a marker at each data point.
- Subdivisions - Show subdivision marks in between each major division.
- Type - Shows which data was plotted on each axis for the last plot (i.e. Torque vs. RPM).

### General

- Port 1 (COM1) & Port 2 (COM2) - Displays what BEL instruments, if any, are connected to the corresponding communications ports. If no BEL instrument is connected to a port, the text *No BEL Instr.* appears.
- Load File Format - The type of data files displayed in the File System.
- Save File Format - The format in which **RHEOCALC** data is saved (DV3 or Lotus).
- Date Format - Current date format (USA or non-USA).
- Rotation Units - Speed input method (RPM or Shear Rate).
- Measurement Units - Measurement units in use (CGS or SI).
- Printer Type - The printer type selected to print graphs.
- Microprocessor - The type of microprocessor used in the host computer (Example: 80486).

## 4. Direct Speed Entry (Alt-F10)

Pressing the **Alt-F10** key combination opens the Speed Entry window. This window allows you to enter rheometer speeds at any time. If rotation units are set to RPM, you may enter speeds between 0 and 250 RPM in 0.1 RPM increments. If rotation units are set to 1/Sec, the range of usable shear rates depends upon the spindle selected. This window always displays the minimum and maximum usable RPM or Shear Rate.

**NOTE:** This option is disabled (causes a beep to sound if selected) if a data gather other than the Manual Gather is in progress. The Manual Gather mode allows rheometer speed changes to be entered at any time.

## 5. Stop Temperature Control (Ctrl-F8)

If an HT-104 or HT-105 is in use and currently maintaining a set point temperature (notice the *RUN* light on the HT-104/HT-105 front panel is ON), pressing the **Ctrl-F8** key combination causes the HT-104/HT-105 to stop maintaining the set point temperature (the *RUN* light extinguishes).

**NOTE:** If this option is exercised while running a Temperature program, the remainder of the program is cancelled, and the data gathered thus far is displayed.

**6. Set Temperature (Ctrl-F10)**

If an **HT-104** or **HT-105** is in use, pressing the **Ctrl-F10** key combination displays the Temperature Entry window. This window allows you to enter a single setpoint temperature and causes the **HT-104/HT-105** to maintain that temperature (notice the *RUN* light on the **HT-104/HT-105** front panel is ON).

**NOTE:** This option is disabled (causes a beep to sound if selected) if a temperature program is currently executing.

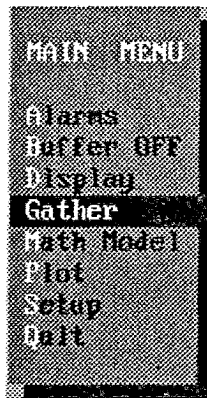
**Appendix A - RHEOCALC Windows**

All screen display in the **RHEOCALC** program is done through the use of windows. These include menus, message boxes, entry boxes, the directory tree, list boxes, review data boxes, gather data boxes, and the edit data box. **RHEOCALC** allows multiple windows to be open at one time but only one window may be the active window at any one time. The active window is the window that is currently accepting keyboard input (i.e. the only window that the user may directly affect).

*The keystrokes that are permitted for the active window are always displayed on the bottom line of the computer screen. This line changes as the active window is changed.*

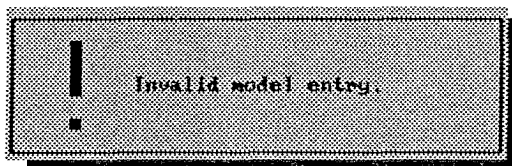
**Menus**

Menus are red in color with black text. The first letter of each menu item is white in color. To select a menu option, you may press the key corresponding to any of these white first letters, or you may use the cursor keys to position the highlight bar (yellow on black in color) on the desired option, then press the *Return/Enter* key to activate that option. At certain times, a menu option may appear gray on red instead of black on red. You will also notice that you are not able to choose these gray options. These options have been disabled due to certain prevailing program conditions. These conditions are explained throughout the course of this manual.



**Message Boxes**

Message boxes are white on blue windows with a flashing yellow icon in the left of the window. The type of icon indicates which of the 3 types of message boxes the window is.

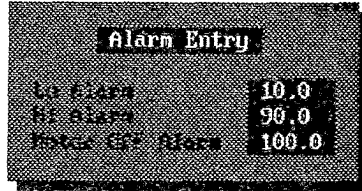


**Exclamation type window**

- ? - A question mark indicates that the window is asking a question that must be answered with a **YES** (Y or y keys) or a **NO** (N or n keys).
- ! - An exclamation mark indicates that the message in the window is some type of warning that requires the user to press a key to acknowledge.
- \* - An asterisk indicates that the message in the window is useful information. No keypress is required. The window closes automatically after a few seconds.

## Entry Boxes

Entry boxes are white on purple with blue entry fields. Entry boxes allow the user to enter all required text and numeric program parameters. A cursor will always be flashing in one of the entry fields indicating the current data entry position. In general, the **TAB** key is used to jump between entry fields and the **ESC** key is used to cancel entries made. The keystroke to accept changes made in the entry box is normally the **RETURN/ENTER** key, but this does differ in some cases. *Again, all valid keys for the active window are always shown at the bottom of the screen.*

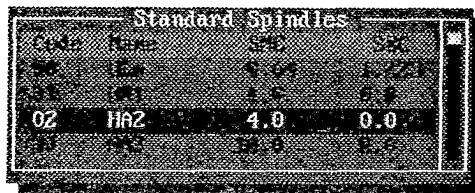


## Directory Tree

The Directory Tree displays a graphical representation of the currently selected disk drive. The Directory Tree is explained in detail in section VI.

## List Boxes

List boxes may appear in various colors. List boxes are windows that contain more choices than will fit within the confines of the window. For this reason, as the user reaches the bottom of the window, all choices in the window are shifted up one line within the window and, new choices appear at the bottom. The reverse is true as the user again reaches the top of the window. All list boxes also have a depth indicator at the right of the window that gives an indication how far into the total list the currently highlighted choice is.



## Review Data Window

The review data window displays buffer data to the user. Model, spindle, sample, date, and time information is displayed in the upper portion of the window while the data points are displayed in the lower portion. The cursor keys are used to scroll up and down through the data points in this lower window portion. This window always opens to the right of the main menu and is cyan in color. *When the review data window is open, it is always the active window. The only way to deactivate the review data window is to close it by pressing the F1 function key.* When the review data window is closed, it disappears from the screen. The data, however, has not been erased and may easily be re-displayed. When the review data window contains unsaved data, the data may be saved by pressing the F2 function key. This opens the File System windows over the review data window. Operation of the File System is explained in section VI.

0.5RV		SC1-27		01/03/80		10:03	
Oil Grade Test Batch #1				UNSAVED DATA			
010	100.0	20.5	256.3	87.1	34.0	69.9	00:10
011	100.0	20.4	255.0	86.7	34.0	69.9	00:10
012	100.0	19.7	246.3	83.7	34.0	69.9	00:10
013	100.0	19.8	247.5	84.2	34.0	69.9	00:10
014	100.0	19.7	246.3	83.7	34.0	69.9	00:10
015	100.0	19.0	237.5	80.8	34.0	69.9	00:10



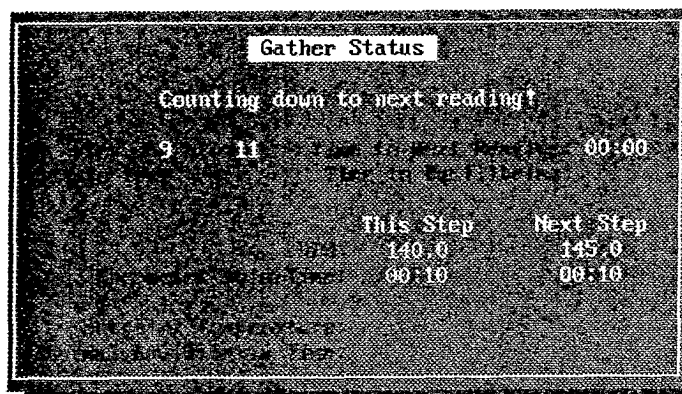
## Gather Data Window

Whenever a data gather has been initiated, the gather data window opens to the right of the main menu. The gather window displays the data as it is placed in the capture buffer in the same way a List Box displays its contents.

**NOTE:** Although the rheometer speed is set to 0 RPM when the Motor Off alarm is tripped, the programmed speed is shown (surrounded by *asterisks (\*)*) in the review and gather data windows so that the cause of the alarm is readily apparent. All other values displayed in the gather and view data windows are based on the actual speed of 0 RPM.

## Gather Status Window

The gather status window opens on top of the gather data window and displays the following pertinent information regarding the current gather operation:



- Current program step number
- Number of total steps in the program
- Current motor speed or shear rate
- Motor speed or shear rate of the next step
- Current step time
- Step time of the next step
- Current temperature setpoint (if the HT-104 or the HT-105 is being used)
- Next temperature setpoint (if the HT-104 or the HT-105 is being used)
- Current temperature reading (if the HT-104 or the HT-105 is being used)

The gather status window may be toggled ON and OFF by pressing the F3 key. Turning this window off allows the data being gathered to be viewed.

**Edit Data Box**

The Edit Data Box is cyan in color and looks similar to the review data window. The difference is that there will always be an entry field highlighted (yellow on blue in color) somewhere in the window. The upper portion allows for alteration of the model, spindle, sample, date, and time. The lower portion allows for the alteration of RPM, % Torque, Temperature, and Time Interval values. The function of the Edit Data window is explained in detail in section VII.

0.5HR		SC4-27		01/03/80		10:03	
Oil Grade Test Batch #1				UNSAVED DATA			
001	100.0	16.2	202.5	68.9	34.0	69.9	00:07
002	100.0	21.7	271.3	92.2	34.0	69.9	00:07
003	100.0	21.9	273.8	93.1	34.0	69.9	00:07
004	100.0	17.2	215.0	73.1	34.0	69.9	00:07
005	100.0	15.6	195.0	66.3	34.0	69.9	00:07
006	100.0	17.3	216.3	73.5	34.0	69.9	00:07

**Edit Data Window**

---

## Appendix B - Data Buffers

---

RHEOCALC allows the use of six separate sets of data at any one time. These data sets are stored in one of the following two buffers:

### Capture Buffer

This buffer holds any data that has been gathered, created, or edited and has not yet been saved to disk. When reviewing data in this buffer, the color of the data is always *yellow*. Keep in mind that if there is already data in this buffer and an attempt is made to gather new data or edit existing data, RHEOCALC asks if you wish to save the data that is still unsaved in the Capture buffer. If you elect not to save it and continue with the gather or edit operation, the previous data in the buffer is lost.

### Load Buffer

This buffer holds one of five possible disk files that may be utilized in the program at any one time. The files may be loaded in one of five slots that are provided when a file load is attempted. When reviewing data in this buffer, the color of the data is always *red*. Because only one buffer exists to work with five possible data files, the data not immediately in use is swapped to a temporary disk file.

Any time you are required to choose a data set to perform some operation on (i.e. display, print, plot) the Data Set menu appears displaying the data sets currently being used within the RHEOCALC program. The data stored in the Capture Buffer is always at the top of this list followed by five possible data sets loaded from disk files (numbered 1 through 5). Use the **cursor** and **Return/Enter** keys to select a data set or simply press the key corresponding to the highlighted number or letter before each data set on the Data Set menu (these are "C", "1", "2", "3", "4", or "5").

---

## Appendix C - File Formats

---

With the exception of the Lotus-123 save format option, all data and program files used by RHEOCALC are in ASCII form.

### Data

The following definitions apply to all data files:

- Sample - A description of the data set given by the user (up to 26 characters).
- Model - The rheometer model type used to collect the data.
- Spindle - The spindle used to collect the data.
- Date - The date on which the data was collected.
- Time - The time of day the data was collected.
- #Points - The number of data point in the data set.
- Speed - Spindle speed in RPM.
- % Torque - The scale reading in percentage of full scale.
- Temperature - The sample temperature in degrees C.
- Time Interval - The time elapsed since the last data point was taken.

### 1. RHEOCALC (DV3)

Line 1 : Sample

Line 2 : Date, Time

Line 3 : Model, Spindle, #Points, SMC(optional), SRC(optional)

**NOTE:** The SMC and SRC are present only if the Spindle is a Special (code 99).

The remaining lines contain one data point per line. The format for each of these lines is as follows (Time Interval is in MM:SS):

Speed, % Torque, Temperature, Time Interval

Example (with a standard spindle):

```
Batch #123 Casson flow tests
11/16/90,10:14
HA, SC4-27, 4
50.0,44.9,20.0,00:05
20.0,35.0,20.0,00:05
10.0,25.0,20.0,00:05
5.0,16.3,20.0,00:05
```

Example (with a special spindle):

```
Batch #123 Casson flow tests
11/16/90,10:14
HA, MYSPIND, 4, 32.23, 1.56
50.0,44.9,20.0,00:05
20.0,35.0,20.0,00:05
10.0,25.0,20.0,00:05
5.0,16.3,20.0,00:05
```

**NOTE:** Data lines beginning with an asterisk (\*) indicate that alarms were enabled during the data gather, and the motor off alarm was tripped when speed of the line was executed.

Line 1 : Rate Mode, Start Speed, Corner Speed, End Speed, Time, Up/Down  
Line 2 : Spindle, SMC, SRC

Example:

1, 25, 250, 25, 5, 01:00, 2  
LV4

## 2) Non-Geometric (NGO)

Line 1 : Rate Mode

Line 2 : Spindle, SMC, SRC (SMC and SRC are only present if the spindle is a SPECIAL.)

The remaining lines contain each step of the program and are formatted as follows:

Speed, Time Interval

Example:

1  
LV4  
10, 00:10  
12, 00:07  
20, 00:10  
22, 00:07  
30, 00:10  
35, 01:00

## 3) Temperature (NGT)

Line 1 : Rate Mode

Line 2 : Spindle, SMC, SRC (SMC and SRC are only present if the spindle is a SPECIAL.)

The remaining lines contain each step of the program and are formatted as follows:

Speed, Time Interval, Temperature, Hold Time

Example:

1  
SC4-31  
20, 00:30, 125, 2  
20, 00:30, 130, 2  
20, 00:30, 135, 2  
20, 00:30, 140, 2

**NOTE:** All temperatures are stored to disk in °Centigrade.

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## Appendix D - Problem Solver

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The following is a guide to some of the more common warnings and/or problems that may occur during your use of RHEOCALC.

- 1) **Indication:** There is an insufficient amount of memory available to run RHEOCALC.  
**Meaning:** There is not enough memory available to run RHEOCALC.  
**Solution:** If there were any TSRs (Terminate and Stay Resident), device drivers, or shell programs loaded before RHEOCALC, there is less memory available to RHEOCALC. Remove any unnecessary programs of the types previously mentioned before running RHEOCALC. TSRs and device drivers are usually loaded in the *config.sys* or *autoexec.bat* files. Consult your DOS manual on the proper procedures for altering these files.

**NOTE:** The minimum amount of memory required to start RHEOCALC is approximately 570 Kbytes. It is recommended that there be at least 590 Kbytes free memory before starting RHEOCALC in order fully utilize all its features.

- 2) **Indication:** Insufficient memory to perform this operation.  
**Meaning:** You attempted to perform some operation that requires more memory than is currently available.  
**Solutions:** a) When plotting, memory is required for each data set plotted. Spline plots require more memory than straight line plots. Plots containing UP/DOWN data and sub-range plots use extra memory.  
b) Running a data gather takes memory. If a data gather is running in the background while attempting to perform another operation, there is less memory available to that operation.  
c) If there were any TSRs (Terminate and Stay Resident), device drivers, or shell programs loaded before RHEOCALC, there is less memory available to RHEOCALC. Remove any unnecessary programs of the types previously mentioned before running RHEOCALC. TSRs and device drivers are usually loaded in the *config.sys* or *autoexec.bat* files. Consult your DOS manual on the proper procedures for altering these files.
- 3) **Indication:** Insufficient disk space to perform this operation.  
**Meaning:** There is insufficient disk space to accept the data that RHEOCALC is attempting to write to it. RHEOCALC writes to disk in three situations:  
a) When data or a rheometric program is saved to disk.  
b) Swapping data sets from the Load Buffer to temporary disk buffers as different data sets are used.  
c) When RHEOCALC is exited, the program's pertinent parameters are saved to the parameter file (*DV3PARMS.PAR*).  
**Solution:** Clear off space on the default disk.
- 4) **Indication:** Communications Error. Unable to communicate with the DV3 (or HT-104/105).  
**Meaning:** RHEOCALC is not getting any response from the referenced instrument.  
**Solution:** This warning occurs when a line of communication with an instrument is broken.  
a) Ensure the appropriate cable is properly connected to the instrument in question and to a valid communications port on the host computer (COM1 or COM2).  
b) Ensure the instrument in question is turned ON.
- 5) **Indication:** Error #xxx occurred while accessing file {filename}.  
**Meaning:** RHEOCALC attempted to open the file called *filename* (which can be a data, program, parameter or swap file) but could not gain access due to the condition of number xxx.  
**Solution:** Attempt the operation again. If the error persists, restart RHEOCALC and perform the operation again. If the error still persists, check the named file (*filename*) for any corruption. Use of a disk diagnostic program is helpful in this respect. If the file appears intact, contact Brookfield Engineering Labs and report the occurrence along with the error number xxx.

6) **Indication:** The screen stating Checking RS-232 ports for Brookfield instruments... appears, but the **RHEOCALC** main screen never appears.

**Meaning:** The **RHEOCALC** program is *locked up (hung up)*.

**Solution:** There are several known causes for this condition.

- a) In some cases, an external non-Brookfield device operating while connected to either COM1 or COM2 can cause such a *hang up*. Disconnect or power down the device. **RHEOCALC** can be also forced to ignore the communications port the device is using by starting the program with the COM1 or COM2 command line option (use the option corresponding to the port that the rheometer will use).
- b) An internal device, such as an internal modem, may be configured to use COM1 or COM2. As stated above, disable the device or use the COM1/COM2 command line option to start the **RHEOCALC** program.
- c) In some cases, the host computer contains the hardware for two communications ports, but one or both of the ports may be disabled through the use of the computers's system setup (also referred to as CMOS setup). Consult the computer operator's manual for instructions on enabling communication ports. **RHEOCALC**'s COM1/COM2 command line option may also be used to avoid the disabled communication port.
- d) COM1 or COM2 may be damaged. **RHEOCALC** determines the number of communication ports and, by default, scans both. **RHEOCALC** cannot determine whether or not a port is damaged and attempts to scan it anyway. Use the COM1/COM2 command line option to avoid a damaged communications port.

**NOTE: COM1/COM2 command line option:** By default, **RHEOCALC** checks all serial ports up to and including **COM2** for the aforementioned Brookfield instruments. **RHEOCALC** can be forced to check only one specific serial port by placing either a *COM1* or a *COM2* on the DOS command line after the *rheocalc* command. For example, typing the command *rheocalc COM1* at the DOS prompt causes **RHEOCALC** to scan only communications port one for Brookfield instruments. If a second communications port exists, it is ignored.

7) **Indication:** An error #913 is displayed while attempting to start the **RHEOCALC** software.

**Meaning:** **RHEOCALC** will only run on computers using a color monitor (CGA, EGA, or VGA). An attempt was made to start **RHEOCALC** on a computer with an incompatible monitor (i.e. monochrome).

**Solution:** Run the software on a computer with an appropriate monitor.

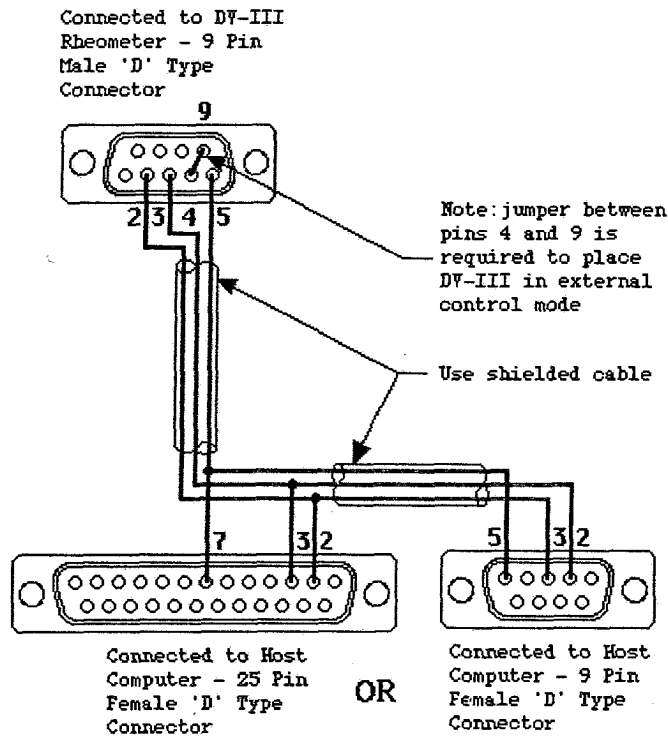
8) **Indication:** If the program will still not run after all other troubleshooting methods have been exhausted, run the software from a *clean* system.

**Meaning:** In other words, start the computer without loading any TSR's (terminate and stay resident programs) or device drivers. One way to do this is to *boot* the computer from a floppy disk containing the current version of DOS in use on the computer.

Appendix E - Communications

Cable

To connect your computer to a Brookfield Engineering Labs DV-III, use the supplied Brookfield Engineering Labs DV-III Computer Cable Assembly (BEL part #DVP-80). If you wish to make your own cable, use the following pin assignments:



View from the rear (solder side) of the connectors

The DV-III uses a standard 9-pin male 'D' Type connector. Your computer's serial port may use either a standard 9-pin or 25-pin female 'D' Type connector (some computers use a male 'D' type instead). Use whichever is appropriate for your computer.





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## SAMPLE CUP CP-44PY

TEL 508-946-6200 or 800-628-8139 (USA excluding Massachusetts)  
 FAX 508-946-6262 INTERNET <http://www.brookfieldengineering.com>

Sample cup CP-44PY with embedded RTD temperature probe is a new option for Brookfield Cone/Plate Viscometers and Rheometers. The cup may be used with any DV-II+ or DV-III Cone/Plate instrument to display sample cup temperature. CP-44PY may also be used with dial reading, DV-I and DV-II series instruments when combined with the Brookfield Digital Temperature Indicator (DTI).

The cup has an RTD probe embedded in the plate and is connected to the viscometer using cable SC4-61Y (included with the CP-44PY). The connector for the cable is shown in Figure 1. Figure 2 shows the CP-44PY installed on a DV-II+ C/P Viscometer. Figure 3 shows the DTI. The accuracy of the temperature measurement is shown in Table 1.

Sample cup CP-44PY may be ordered as a replacement for CP-44Y (sample cup without RTD probe) in which case, the cone spindle(s) must be returned to Brookfield for calibration to the new sample cup or as original equipment with a new Cone/Plate Viscometer.

**Note** Early model DV-IIIC/P Rheometers with a Limo connector for the temperature probe (serial numbers from R22764 to R20400) will require the Switchcraft to Limo adapter; please order Brookfield Part No. DVP-98Y.

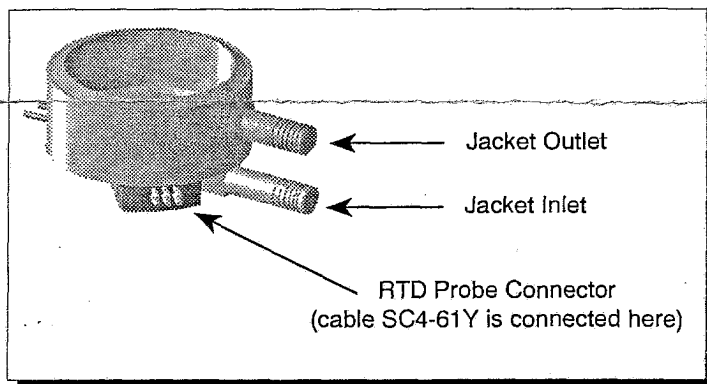


Figure 1: CP-44PY Sample Cup

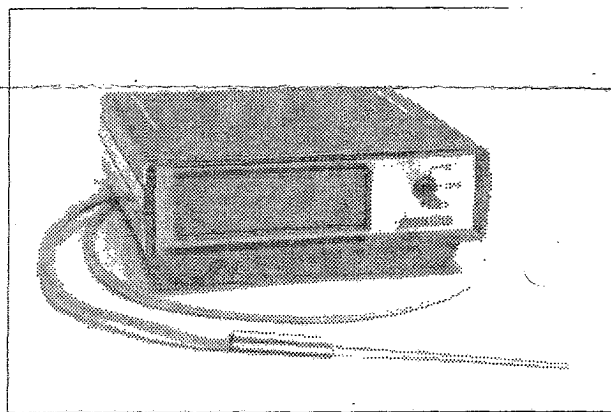


Figure 3: Digital Temperature Indicator (DTI)

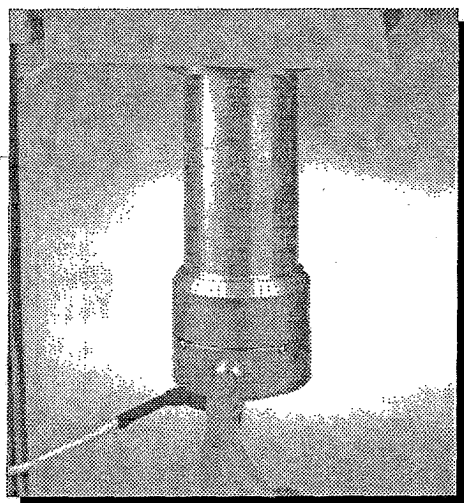


Figure 2: DV-II+CP with Sample Cup CP-44PY

Temperature Range	Temperature Accuracy
-100°C — +100°C	±0.5°C
+100°C — +200°C	±1.0°C
+200°C — +300°C	± 2.0°C

Table 1: Temperature Accuracy with DV-II+, DV-III and DTI

**CAUTION:** The maximum upper temperature limit for the Brookfield Cone/Plate Viscometer/Rheometer is 100°C. The operator must use caution when the temperature exceeds 80°C for personal safety reasons.