BROOKFIELD CT3

TEXTURE ANALYZER

Operating Instructions

Manual No. **M08-372-E0315**

BROOKFIELD SPECIALISTS IN THE MEASUREMENT AND CONTROL OF VISCOSITY

with offices in: Boston • Chicago • London • Stuttgart • Guangzhou

BROOKFIELD ENGINEERING LABORATORIES, INC.
11 Commerce Boulevard, Middleboro, MA 02346 USA
TEL 508-946-6200 or **800-628-8139** (USA excluding MA)
FAX 508-946-6262 INTERNET http://www.brookfieldengineering.com

Table of Contents

I. INTRODUCTION

The CT3 Texture Analyzer is the most recent development of the original Boucher Jelly Tester. The original product was created as the Stevens Texturemeter and evolved into the CNS Farnell LFRA TA (Leatherhead Food Research Association Texture Analyzer). Brookfield Engineering first enhanced the design of the LFRA, maintaining the characteristics of the original equipment, while expanding its measurement capabilities and ease of use by incorporating modern digital technology.

The new Brookfield CT3 Texture Analyzer is the third generation of this venerable product, adding tension testing capability, increased load cell options, space for large samples, two options for base tables and a wider range of accessories for more flexibility. The main objective is to characterize your samples in a way that best represents their perception by human senses. This is the essence of texture analysis.

The principle of operation of the CT3 Texture Analyzer is to subject a sample to controlled forces in compression using a probe, or in tension using grips. The resistance of the material to these forces is measured by a calibrated load cell and shown in either grams or Newtons. These forces are a function of the properties of the sample and the parameters of the test method.

There are seven load cell ranges available for the CT3 Texture Analyzer offered by Brookfield:

Model	Load Cell Range
CT3-100	0.1kg or 100g
CT3-1000	1.0kg or 1000g
CT3-1500	1.5kg or 1500g
CT3-4500	4.5kg or 4500g
CT3-10KG	10.0kg
CT3-25KG	25kg
CT3-50KG	50kg

I.1 Components

Please check to be sure that you have received all components, and that there is no damage. If you are missing any parts, please notify Brookfield Engineering or your local Brookfield agent immediately. Any shipping damage must be reported to the carrier.

Component	Part Number	Quantity
CT3 Texture Analyzer	varies	1
Operating Manual	M08-372	1
USB Cable	DVP-202	1
Power Cord		1
115 Volt *or*	DVP-65	1
230 Volt	DVP-66	
TextureLoader CD	CD-ProgA	1
Probe Adapter M6 to M3 Threads	TA51	1
Optional		
Probe	varies	per order
Temperature Probe	DVP-94Y	1
Rotary Base Table	TA-RT-KIT	1
Fixture Base Table	TA-BT-KIT	1
Bloom Strip	CT3-CS-100 *or* CT3-CS-1000	1
Calibration Weight Set	varies by load cell	1
Standard Probe Kit	TA-P-KIT2	1
TexturePro CT Software	TA-CT-PRO	1

NOTE: Optional components may include probes or fixtures. See Appendix A for details.

I.2 Utilities

Input Voltage:	90-265 VAC
Input Frequency:	50/60 Hz
Power Consumption:	150 VA
Fuse:	Two 4 amp, 5 x 20mm, Time-lag

Power Cord Color Code:

	United States	Outside United States
Hot (live)	Black	Brown
Neutral	White	Blue
Ground (earth)	Green	Green/Yellow

Main supply voltage fluctuations are not to exceed ±10% of the nominal supply voltage.

I.3 Units

The CT3 Texture Analyzer uses the SI system of units for all parameters.

Parameter	**Unit**	**Abbreviation**
Load	Grams or Newtons	g or N
Deformation	Millimeter	mm
Time	Seconds	s
Speed	Millimeter per second	mm/s
Work	MilliJoules	mJ

I.4 Specifications

Load:

Model	Range Grams	Resolution Grams	Accuracy*
CT3-100	0-100	0.01	±0.5%FSR
CT3-1000	0-1000	0.10	±0.5%FSR
CT3-1500	0-1500	0.20	±0.5%FSR
CT3-4500	0-4500	0.50	±0.5%FSR
CT3-10KG	1-10000	1.0	±0.5%FSR
CT3-25KG	2-25000	2.0	±0.5%FSR
CT3-50KG	5-50000	5.0	±0.5%FSR

FSR = Full Scale Range

*This value applies to the full range of operating temperatures as defined later in this section under Environmental Conditions. Accuracy is 0.2%FSR, when the instrument is operated in a stable ambient temperature (20°C - 25°C).

Trigger Point:

Model	Range Grams	Resolution Grams
CT3-100	0.1-10	0.01
CT3-1000	0.2-100	0.10
CT3-1500	0.2-150	0.2
CT3-4500	0.5-500	0.5
CT3-10KG	1-1000	1.0
CT3-25KG	2-2500	2.0
CT3-50KG	5-5000	5.0

Recommended trigger value settings are given in Table II.1.

NOTE: Setting a trigger value of zero disables trigger function so test will immediately start from current position.

Speed: 0.01 to 0.1 mm/s in increments of 0.01 mm/s
0.1 to 10 mm/s in increments of 0.1 mm/s
Accuracy: ±0.1% of set speed

Position: Range: 0-101.6 mm
Resolution: 0.1mm
Accuracy: 0.1mm

Increments for changing test speed using the Select/Scroll knob can be switched between 0.1mm/s and 1.0mm/s by depressing Reset/Stop button.

Temperature: -20°C to 120°C (Requires optional probe, DVP-94Y)

Output: RS232 Compatible Serial Port, USB Port

Environmental Conditions: 0°C to 40°C temperature range (41°F to 104°F)
20% - 80% relative humidity, non-condensing atmosphere

Use: Intended for indoor use only
Altitude: up to 2000m

Dimensions: 10.5” x 10.5” x 24”

Weight: 37 lbs. (16.8 kg)

I.5 Installation

1) Prepare a clean, level surface.

***NOTE*:** This instrument is a sensitive force measuring device. It should be installed on a clean, solid, level bench surface which is free from external vibrations.

2) Unpack and remove the CT3 Texture Analyzer from the shipping container.

⚠ The CT3 Texture Analyzer weighs 16.8 kg (37 pounds). Use caution when lifting the unit out of the packaging.

3) Place the CT3 Texture Analyzer on a sturdy, level surface. Adjust the four feet to ensure that the instrument is stable.

4) Remove any additional components from the shipping package. Save the shipping container and packaging for future use.

5) Install base table using the supplied pair of T-bolts and thumbscrews. Position the base table so that it is approximately centered under the probe. More accurate alignment may be required for certain fixtures.

6) Make sure that the AC power switch at the rear of the CT3 Texture Analyzer is in the OFF position. Connect the power cord to the socket on the back panel of the instrument and plug it into the appropriate AC line. Position instrument so that the power cord can be removed easily.

⚠ The AC input voltage and frequency must be within the appropriate range as shown on the model and serial tag of the instrument (located on the back of the CT3).

⚠ The CT3 Texture Analyzer must be earth grounded to ensure against electronic failure!

7) If appropriate, connect communication cable which is supplied with Texture Loader software to the appropriate port for connection to a computer.

8) Turn the power switch to the ON position. The startup screen will indicate the firmware version and load range of the CT3 (Figure I.1).

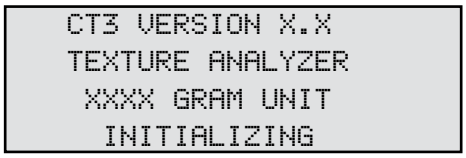


Figure I.1

9) Allow the instrument to warm up for 10 minutes.

10) If desired, check calibration according to Section III.9.

I.6 Safety Symbols and Precautions

Safety Symbols

The following explains safety symbols which may be found in this operating manual, or on the instrument itself.

⚠ Indicates hazardous voltages may be present.

⚠ Refer to the manual in all cases where this symbol is evident. Used for specific warning or caution information to avoid personal injury or damage to the instrument.

Keep hands, fingers and other body parts clear of moving parts when operating instrument.

Functional Earth Terminal - Main power entry module must have an earth conductor.

Precautions

If this instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

This instrument is not intended for use in a potentially hazardous environment.

In case of emergency, turn off the instrument and then disconnect the electrical cord from the wall outlet.

The user should ensure that the substances placed under test do not release poisonous, toxic or flammable gases or liquids at the temperatures which they are subjected to during the testing.

I.7 Key Functions

The CT3 Texture Analyzer is operated through two keys and a knob located on the keypad. Additionally, there is an emergency stop button located above the base and to the right of the probe rod.

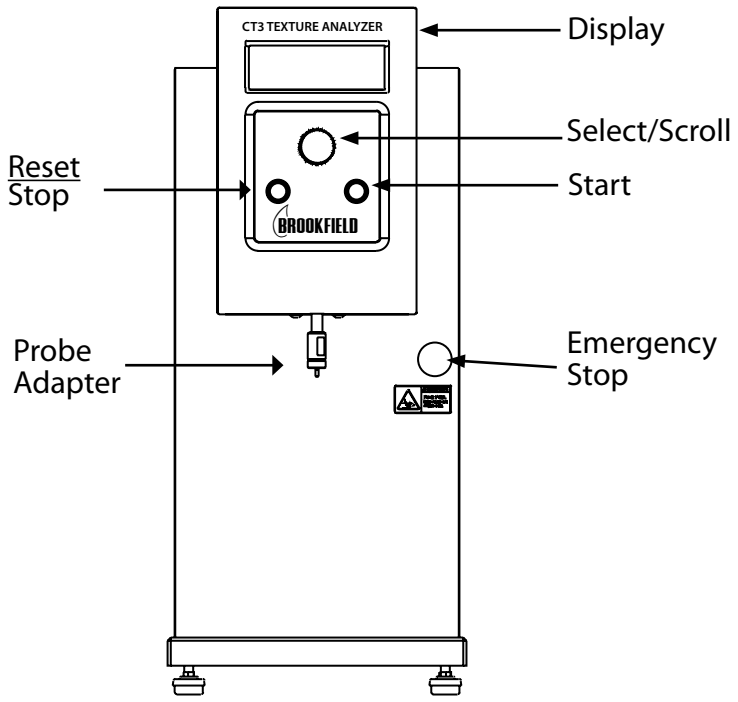


Figure I.2

RESET / STOP

This key is used to stop a test in progress and return to starting position. This button will also toggle test speed selections between 0.1mm/ss and 1.0mm/s as the Select/Scroll knob is rotated.

START

This key is used to start the test. During the descent of the probe, prior to the trigger point, this key can be used to accelerate the rate of descent.

SELECT / SCROLL (see section III.6)

This knob has multiple functions:

1. The knob is pressed to select the option currently highlighted.
2. The knob is rotated to change the value of the parameter being selected.
3. During a test, pressing this knob will display test parameters.
4. Holding knob depressed while turning on power will switch the load display units between grams and Newtons.

EMERGENCY STOP

This button is used to abort a test in case of an emergency condition.

BACK PANEL

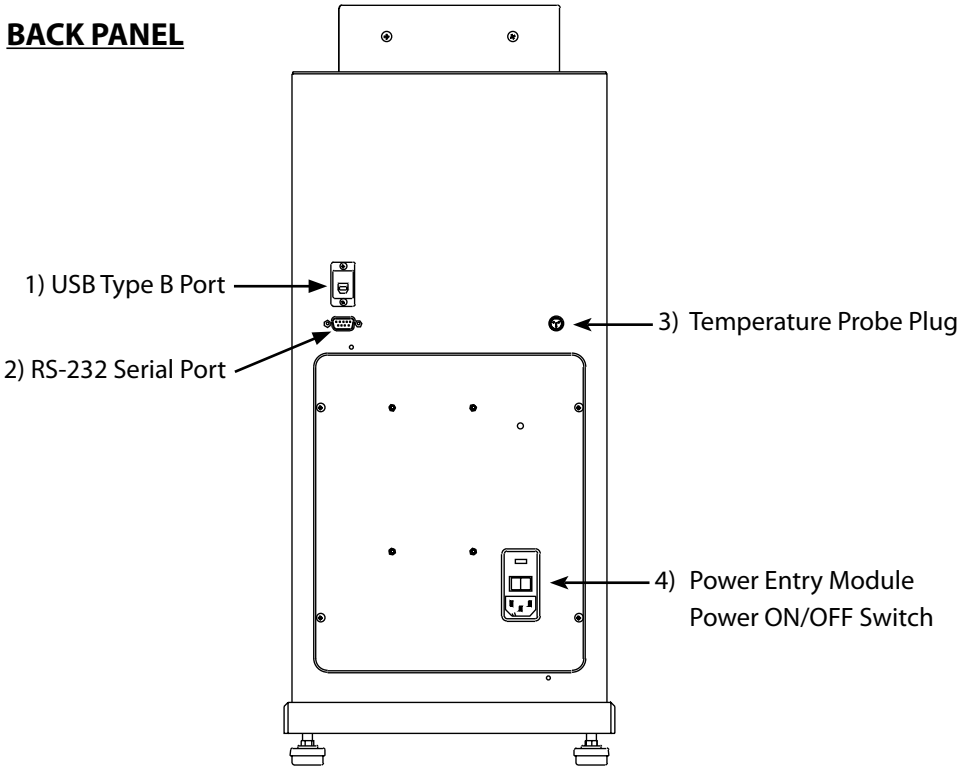


Figure I.3

1) USB TYPE B PORT

Use with USB Cable P/N DVP-202 to connect instrument to a computer. Cable USB 2.0 A Male to B Male. See Appendix D, (CT3 to Computer Command Set)

2) RS-232 Serial Port

Use with RS-232 Cable P/N DVP-80 to connect instrument to a computer.
See Appendix D, (CT3 to Computer Command Set).

3) Temperature Probe Plug - 4 pin plug. Use with Temperature Probe P/N DVP-94Y

4) Power Entry Module: ON/OFF switch-fused (see I.2 Utilities). Voltage: 90-265 VAC

I.8 Cleaning

Instrument and Keypad:	Clean with a dry, nonabrasive cloth. Do not use solvents or cleaners.
Probes and Fixtures:	Probes and fixtures are made from a variety of materials from metals (stainless steel, aluminum) to plastics (acrylic, Black Delrin, Nylon). Clean with a nonabrasive cloth using solvents that are appropriate for both the sample material and the material of the probe and/or fixture.

⚠ Do not apply excessive upward, downward or sideways force to probe while fixed to CT3. Damage may occur to the load cell.

II. QUICK START

1. Unpack the instrument according to Section I.5.

2. Install base table in accordance with the instruction sheet that is enclosed with the base table. Place the sample on the base table. Adjust the table height so that the surface of the sample is within 5 mm of the probe.

3. Attach the selected probe. See Section IV.2 for more information.

4. Set the test mode to Normal. Please review Section III.6 for detailed explanation of operation of Select/Scroll knob.

5. Set the trigger value as recommended below.

Load Cell	Recommended Minimum Trigger Value
100g	0.5g
1000g	2g
1500g	3g
4500g	4.5g
10kg	10g
25kg	25g
50kg	50g

Table II.1

6. Set the test speed and distance. See Section IV.3 for more information.

7. Press the START button. The weight of the probe will autozero and then the test will start.

8. Record all test results.

9. Remove sample and clean the probe.

III. OPERATION

III.1 Principle

The Brookfield CT3 Texture Analyzer can be operated in either compression or tension modes.

In compression mode, a probe moves down slowly at pretest speed until a threshold value (the trigger) is reached. The probe then moves a set distance at a set speed into the sample material that is placed (or fixed) on the base table. The load is continuously monitored as a function of both time and distance until the probe again returns to its starting position.

In tension mode, the sample is typically held between a pair of grips. The test starts when the trigger load is reached as the grips move apart. The load resistance as the sample is stretched or pulled apart is recorded as a function of both time and distance.

III.2 Emergency Stop

The CT3 Texture Analyzer can operate with up to 50,000g (50kg) of force dependent on load cell. Be sure to place only the sample for test under the probe.

Keep body parts and clothing away from the probe during the test.

The CT3 Texture Analyzer uses controlled forces to evaluate a material. The user must take care not to place any body part or clothing in the testing zone while the machine is moving. The CT3 Texture Analyzer is provided with an Emergency Stop Button (see Figure I.2) for use in case of an operational problem.

Pressing the Emergency Stop Button will cause different immediate actions depending upon the type of test in use.

Compression: Pressing Emergency Stop Button during a compression test will:

1) Stop the test in progress and display emergency stop screen.

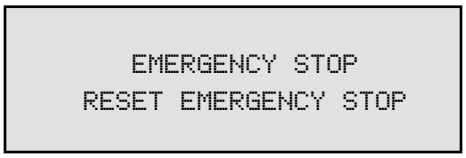


Figure III.1

2) The probe immediately returns to the home position.
3) The Emergency Stop condition can be canceled by rotating the Emergency Stop Button clockwise. This will reset the CT3 firmware to the power up condition.

Tension: Pressing Emergency Stop Button during a tension test will:

1) Immediately stop probe movement and display the emergency stop screen.
2) Probe returns to test start position, after resetting the emergency stop.
3) A sequence of menus then leads user back to the home position.

III.3 Base Table

The CT3 Texture Analyzer offers two options for Base Tables on which the test sample is placed. Both tables should be secured to the slotted base of the CT3 with thumbscrews and T-bolts. This design provides ample adjustment side-to-side and front-to-back to correctly align fixtures and position a wide range of samples for testing.

NOTE: Always be sure all position and height adjustments are securely locked before starting every test.

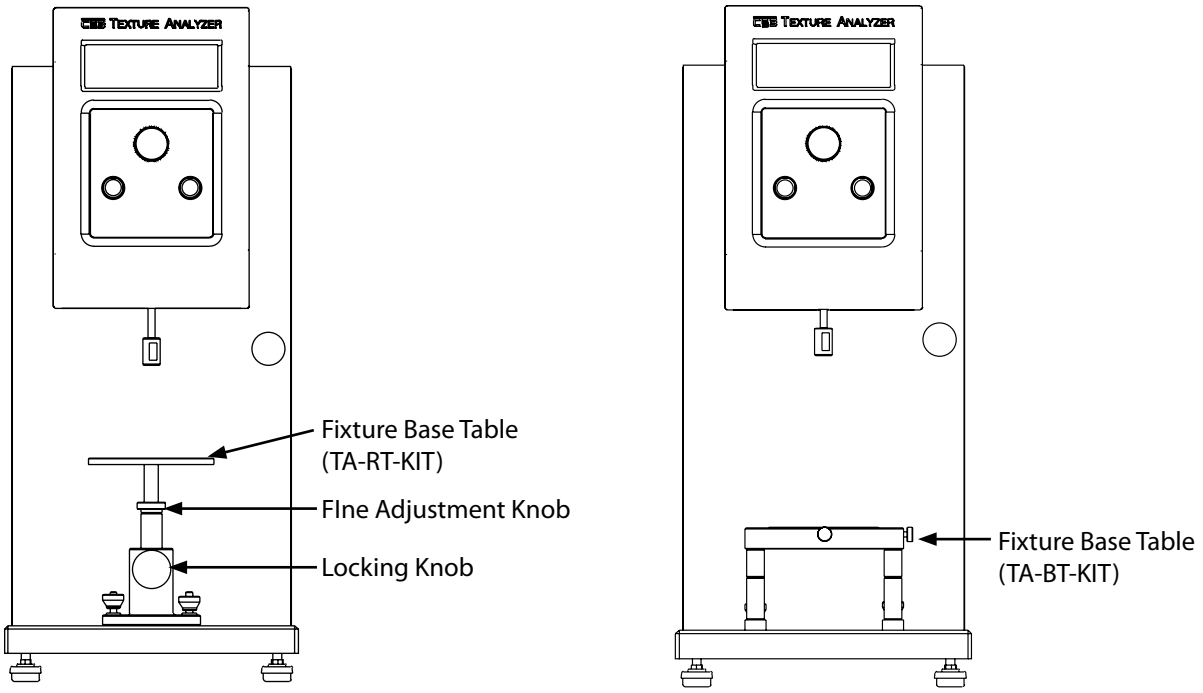


Figure III.2

See Appendix A for fixtures which can be used with each Base Table.

Rotary Base Table

The Rotary Base Table (P/N TA-RT-KIT) is a disc shaped surface and should always be centered under the probe when conducting compression tests. There are two methods of adjusting the height in order to place the sample close to the probe for testing. The locking knob on the base of the Rotary Table allows quick height adjustment; just unlock the knob, raise or lower the table, then lock it into position. The table is also mounted on a threaded shaft held securely with a fine adjustment nut. Unlocking the fine adjustment nut and rotating the table will raise or lower the test surface to give even more range to the height adjustment.

Always hold the Rotary Base Table with one hand while loosening the Locking Knob. This will prevent the Rotary Base Table from falling abruptly to the CT3 housing.

Keep fingers away from the Fine Adjust Nut when lowering the Rotary Base Table to prevent a pinch injury.

Fixture Base Table

The Fixture Base Table (P/N TA-BT-KIT) is a rectangular test surface with a removable center. Many of the test fixtures fit into this center area so this table becomes the mounting base for these

sample test fixtures. The Fixture Base Table is supplied with a variety of extension legs to set the test surface at the correct height for all accessory fixtures. Some disassembly is required to add or remove extension legs by loosening the Phillips head bolts in the underside of the base table.

III.4 Probes

There are a wide range of probes available for use with the CT3 Texture Analyzer as described in Appendix A. One should always be aware that the probe chosen will have an impact upon the test result. Choice of a probe must be made with consideration toward the purpose of the test and the nature of the sample.

The probes may be cleaned while attached to the CT3. Follow recommendations in Section I.8.

⚠ Always attach probes only finger tight to prevent thread damage. Do not apply excessive upward, downward or sideways force. Damage may occur to the load cell.

Inspect a probe before use for any damage and always handle them carefully as some have sharp points or edges. Most probes require the TA51 thread adapter to attach to the CT3. This adapter is installed at the factory before your instrument was shipped. A few probes and most accessory fixtures require removal of the probe adapter. Keep it in a safe place as it is needed for most probes.

III.5 Fixtures

There are a range of fixtures available for use with the CT3 Texture Analyzer as described in Appendix A. These devices are designed to hold a sample in place during measurement. Each fixture is designed to attach to either the Rotary Base or Fixture Base Table. Refer to the instructions provided with the fixture for proper installation.

NOTE: Brookfield can design custom fixtures to meet your application. Contact Brookfield Engineering or your local authorized dealer for details.

III.6 Operating Menu

The CT3 Texture Analyzer offers seven test modes, one calibration mode and one parameter selection table.

Normal – single compression cycle.
Hold Time – compress and hold.
Cycle Count – compress sample several times.
Bloom – compression test measures gelatin bloom strength.
TPA – two cycle Texture Profile Analysis compression test.
Tension – pulls apart a sample using tensile force.
Surimi – single compression cycle, stops automatically after gel breaks.
Static Load – monitors load while hanging weights for calibration.
Global Parameter – allows setting pretest speed, post test speed and temperature units.

Each test mode requires parameters to be set. All test mode selection and parameter setting is done using the Select/Scroll knob (see figure 1.2). This knob is both rotated and depressed during operation.

NOTE: When setting the test speed, pressing the RESET button will toggle the increments from 0.1mm/s to 1mm/s.

The specific parameters required will depend upon the type of test chosen:

Normal Test Requires:	trigger, deformation, speed
Hold Time Test Requires:	hold time, trigger, deformation, speed
Cycle Count Test Requires:	cycle count, trigger, deformation, speed
Bloom Test Requires:	All parameters are fixed according to industry standard
TPA Test Requires:	trigger, deformation, speed
Tension Test Requires:	trigger, deformation, speed
Surimi Test Requires:	trigger, correction, speed
Static Load Test Requires:	none
Global Parameters:	pretest speed, post test speed, temperature units

These parameters, once set, will be maintained by the CT3 even after power down to facilitate repetitive testing. The test mode used prior to powering down will be presented on the screen at the next power up. A test is started by depressing the start button.

The test parameters are defined as follows:

Trigger: The load, in grams, measured by the CT3 to indicate that the probe is in contact with the sample. Once the trigger value is reached, the test will begin at the defined speed. Brookfield recommends trigger values as specified in Table II.1 **Setting trigger value to zero disables trigger function so test will immediately start from current position.**

Deformation: The total downward distance the probe will travel once the trigger value is reached.

Speed: The speed at which the probe will travel the specified distance.

Time: The number of seconds that the probe will be held at the defined distance during a Hold Time test.

Count: The number of cycles (Speed and Distance) that will be applied to the sample during a Cycle Count test.

Correction: Specifies the size of the load drop, in grams, that is required to recognize a gel rupture.

All parameters can be set within the ranges shown in Table III.1.

	Load Cell Range						
Parameter	**100g**	**1000g**	**1500g**	**4500g**	**10kg**	**25kg**	**50kg**
Trigger*	0.1 – 10g	0.1 – 100g	0.2 – 150g	0.5 – 500g	1-1000g	2-2500g	5-5000g
Deformation (mm)	0.1 – 101.6	0.1 – 101.6	0.1 – 101.6	0.1 – 101.6	0.1 – 101.6	0.1 – 101.6	0.1 – 101.6
Speed (mm/s)	0.01 – 10	0.01 – 10	0.01 – 10	0.01 – 10	0.01 – 10	0.01 – 10	0.01 – 10
Hold Time	0 – 9999 s	0 – 9999 s	0 – 9999 s	0 – 9999 s	0 – 9999 s	0 – 9999 s	0 – 9999 s
Cycle Count	0 – 99	0 – 99	0 – 99	0 – 99	0 – 99	0 – 99	0 – 99
Correction	5 – 99	5 – 99	5 – 99	5 – 99	N/A	N/A	N/A

* Minimum recommended values for trigger are shown in Table II.1.

Table III.1

Define a test by first selecting a test mode. Rotate the Select/Scroll knob until the required test mode is displayed, then press the Select/Scroll knob to confirm your choice. As the test modes are displayed, the parameters specific to that mode will be shown with the previously selected parameters.

Once a test mode is selected, the cursor will move to the first parameter. You may either select that parameter to enter new values by pressing the Select / Scroll knob or you may scroll to the next parameter by rotating the Select / Scroll knob.

Data entry is accomplished by setting each digit individually. For example: to set a value of 57.0 as the target distance, rotate the Select / Scroll Knob until the "D" in "Distance" is blinking. Depress the Select / Scroll knob to get to the tens digit, then rotate the knob to the value 5. Depress the Select / Scroll knob again to get to the ones digit, then rotate the knob to the value 7. Depress the Select / Scroll knob to get to the tenths digit, and depress it again to leave the value at 0.

A data entry of zero in all columns for any parameter will result in that parameter being reset to the previous value. Pressing the Select / Scroll knob without first rotating it during the data entry process will result in a zero being placed in that column. This can expedite the entry of Trigger values since in most cases the first one or two columns will be zero (004.0 grams).

When the operator is actively editing TRIGGER, DEFORMATION, TIME or LOAD, pressing the STOP button erases the digit over which the cursor is positioned to the left. The erased digit is replaced with an underscore and normal data field editing resumes (i.e. rotary action of the know changes the digit value; pressing SELECT accepts the data entry and advances the cursor to the right). The STOP button performs no action when the cursor is positioned to the left most digit. Edited values are not changed in memory until the last digit is entered. When not editing TRIGGER, DEFORMATION, TIME or LOAD, the STOP button can toggle the speed selection increment between 0.1 mm/sec and 1.0 mm/sec.

Display Conventions

The CT3 display contains four lines, but some result screens contain additional lines of information. In order to show more than four lines of information, screens are allowed to scroll using the Scroll knob. Scrollable screens are identified by the ↑↓ symbols in the upper right corner of the display. Whenever these symbols appear, the display can be scrolled up or down as indicated to show the lines above or below those presently displayed. In the following section describing test modes, all possible displays are shown. For those having more than four lines, the additional lines are shown in grey text as seen in Figure III.3.

Force shown in grams Force shown in Newtons

Figure III.3

III.7 Running A Test

A test is initiated by depressing the start button. The operator is reminded to attach a probe, then press start again to zero the weight of the probe and begin the test.

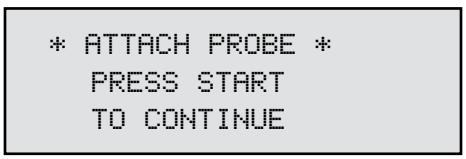


Figure III.4

Depressing the Select/Scroll knob at any time during the test, or even while test results are displayed, will show the current test parameters. At the completion of the test, the final results will be displayed until the start button or reset button is pressed. The reset button will return the instrument to the default display where the test mode may be selected. The start button will begin the same test again.

A test may be repeated simply by depressing the start button while viewing test results.

The test may be stopped at any time by using the stop/reset button or by pressing the emergency stop button. We recommend that the stop/reset button be used for normal operation. The emergency top is intended for emergency use only.

It may happen that the instrument overloads during a test. This will happen if the load exceeds 120% of the load cell capacity. When an overload condition occurs the display will show the following:

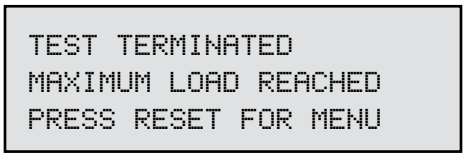


Figure III.5

Depressing the reset button will return to the test mode menu. Correct the reason for the overload and retest.

<u>NORMAL TEST</u> – performs a single compression of the sample then immediately returns to HOME starting position.

The operator sets the trigger value, target deformation (travel distance into the sample) and the test speed using the Normal menu screen:

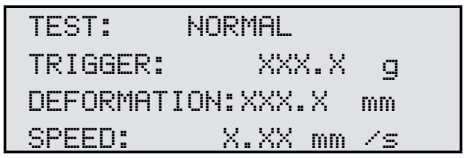


Figure III.6

A normal test performs a single compression cycle when the operator depresses the start button. Beginning at the position where the trigger load is measured, the probe descends at the programmed test speed to the target deformation, then returns immediately to home/starting position. Return travel speed is 4.5mm/s. During the test the running screen is seen as shown below:

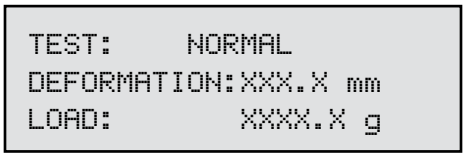


Figure III.7

Deformation and Load will remain live displays during the test.

Test results are shown on the reporting screen:

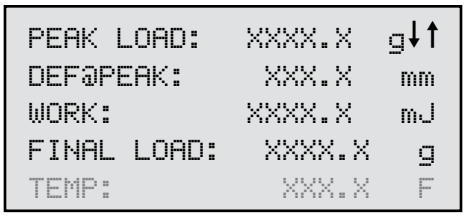


Figure III.8

Peak load is reported as the maximum measured load during the test.

Deformation at peak is the distance to which the sample was compressed when the peak load occurred.

Work is defined as the energy required to deform a sample. It is calculated by measuring the force vs. distance to compress or pull apart the sample. Work done is reported in milli-Joules.

Final load is the load at maximum deformation. Often the peak load and final load will be the same value.

A new feature is the display of adhesive force and adhesiveness in the NORMAL mode. The POST SPEED of the probe will be the GLOBAL post speed value.

Adhesiveness and Adhesive Force - These values are measured as the energy and force required to separate a probe from the sample on the return stroke.

NORMAL mode Final screen - After the probe has returned to the START position, the display will show the test results for ADHESIVE FORCE and ADHESION (ADHESIVENESS). Since only four lines are available on the display, rotate the Select Knob to scroll down to observe the added parameters as shown in the following figure.

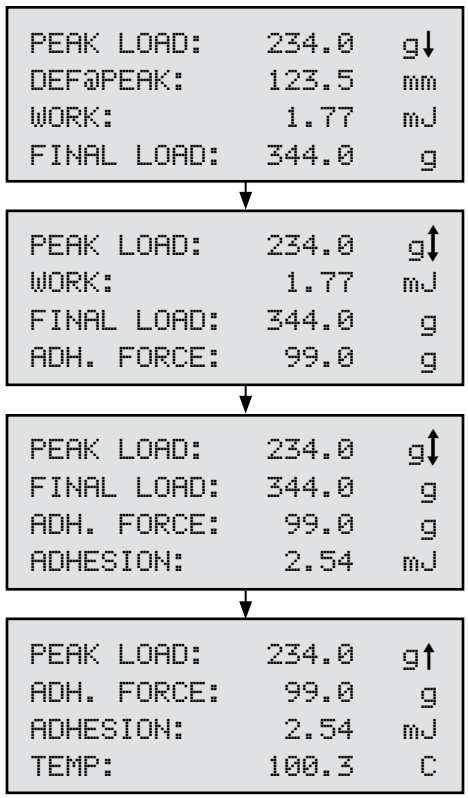


Figure III.9

<u>HOLD TIME TEST</u> - performs a single compression of the sample. The sample remains compressed for programmed hold time before the probe returns to starting position.

The operator sets the hold time, trigger value, target deformation and test speed using the Hold Time menu screen:

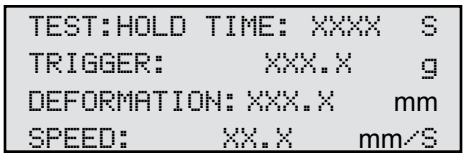


Figure III.10

A hold time test performs a single compression cycle when the operator depresses the start button. The test runs at the programmed test speed to the target deformation, then holds at this position while monitoring sample load for the programmed hold time. The countdown clock shows remaining hold time. During the test, the running screen is seen as shown below:

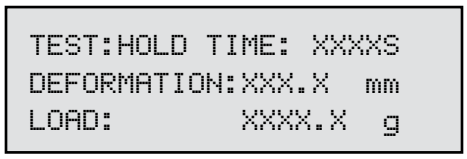


Figure III.11

Deformation and Load will remain live displays during the test. When the countdown clock reaches zero, the probe returns to home/starting position at 4.5mm/s.

Test results are shown on the reporting screen:

Figure III.12

Peak load usually occurs at the target deformation, but may occur before the target is reached.

Final load is the load recorded at the end of the hold time and is usually lower than the peak due to sample relaxation.

<u>CYCLE COUNT TEST</u> – performs a programmed number of compression cycles upon a sample.

The operator sets the number of cycles, trigger value, target deformation and test speed using the Cycle Count menu screen:

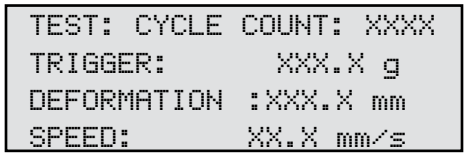


Figure III.13

When the operator depresses the start button, the cycle count test performs multiple compressions on a sample at the programmed test speed to the target deformation, then returns immediately to home/starting position. Return travel speed for each cycle is the same as compression speed.

During the test the running screen is seen as shown below:

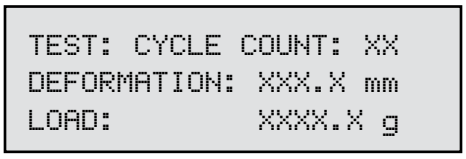


Figure III.14

Cycle count will show a count down of the number of cycles remaining. Deformation and Load will remain live displays during the test.

Test results are shown on the reporting screen:

Figure III.15

Mean and standard deviation of all peaks is reported.
Peak load is the highest peak and final load is the peak load of the last cycle.
Temp shows temperature at time of last cycle peak, only if probe is connected.

<u>BLOOM TEST</u> – performs a single compression cycle using industry established test parameters and reports gelatin bloom strength.

Deformation and test speed are fixed in the Bloom Test specification.

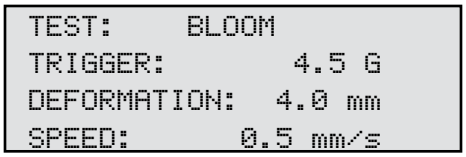


Figure III.16

When the operator depresses the start button the Bloom test performs a single compression cycle at 0.5mm/s to the target deformation of 4mm. During the test the running screen is seen as shown below:

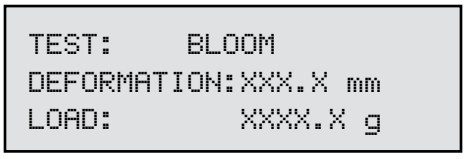


Figure III.17

Both Deformation and Load displays are live during the test. The probe then returns immediately to home/starting position at 4.5mm/s.

Test results are shown on the reporting screen:

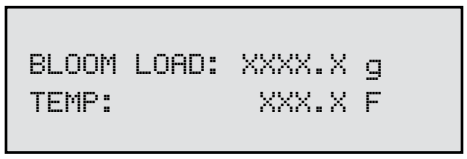


Figure III.18

Bloom load in grams is generally reported as "grams bloom".

***NOTE*:** It is not recommended to conduct bloom testing with load cells greater than 1500g. On instruments with load cells 10kg or higher, the bloom test will not appear on the menu.

<u>TPA TEST</u> – performs two compression cycles on the sample and reports five established Texture Profile Analysis results.

The operator sets the trigger value, target deformation (travel distance into the sample) and the test speed using the TPA menu screen:

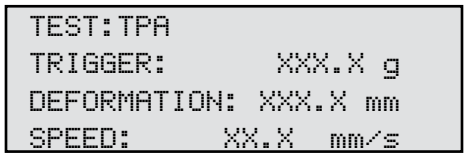


Figure III.19

The operator depresses the start button to begin the test. In a TPA test the compression and return strokes of both cycles occur at the programmed test speed. Target deformation for both cycles begins at the trigger position of the first cycle.

During the test the running screen is seen as shown below:

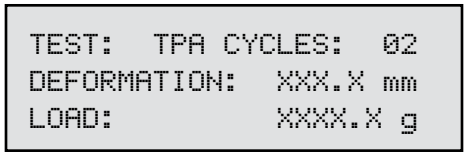


Figure III.20

TPA cycles will count down to show the number of cycles remaining. Deformation and Load will remain live displays during the test.

Test results are shown on the reporting screen:

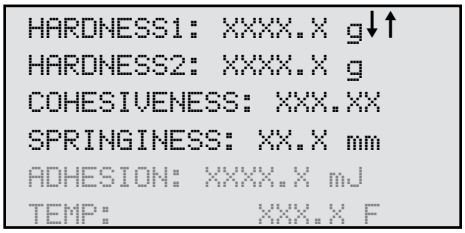


Figure III.21

Hardness1 is the peak load of the first compression cycle.
Hardness2 is the peak load of the second compression cycle.

Cohesiveness is the ratio of A2/A1. A2 is the area under the compression stoke of the second cycle and A1 is the area under the compression stoke of the first cycle. If the structure of the sample is completely destroyed on the first compression, this ratio is zero. If the sample is perfectly elastic and not damaged at all by the first compression this ratio is 1.0 Most food products will fall somewhere in between 0 and 1.

Springiness is a measure of how far the sample returns after being compressed to the target deformation.

Adhesiveness is a measure of stickiness and is calculated as the area under the negative peak as probe withdraws after the first compression.

<u>TENSION TEST</u> – this test can be used to pull apart a sample, usually using grip fixtures to apply tension load on the sample.

The operator sets the trigger value, target deformation and the test speed using the Tension menu screen:

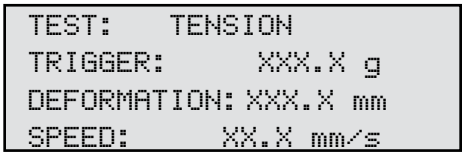


Figure III.22

After pressing Start the operator is presented with this reminder screen:

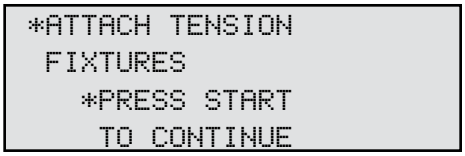


Figure III.23

Be sure grips or other sample fixtures are secure and aligned then press START. The Scroll/Select knob now becomes a tool for adjusting the position of the grips so that the sample can be clamped. Rotate knob to move 1mm/click or hold knob down to descend at 4.5mm/s:

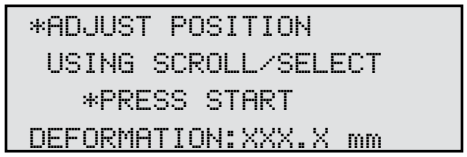


Figure III.24

The deformation value shown in this screen is the current distance from the top Home position and as such shows how much travel is possible once the test begins. Be sure this value is greater than the sum of the distance necessary to reach the trigger plus the programmed target deformation.

When clamping the sample try to exert only minimal lateral loads on the probe shaft. Pressing Start as shown below will start the test:

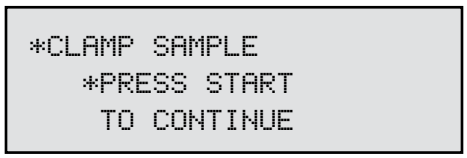


Figure III.25

During the test the running screen is seen as shown below:

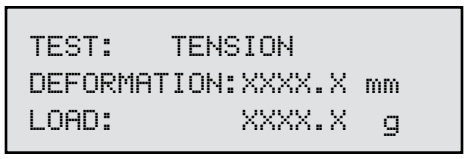


Figure III.26

Deformation and Load will remain live displays during the test. When deformation reaches the target value, the test stops.

Test results are shown on the reporting screen:

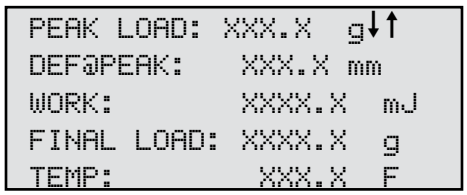


Figure III.27

Peak load is the maximum load measured during the test. Temperature at peak load is only shown if temperature probe is used.

Def@Peak is the sample deformation at the peak load. The trigger position is the zero deformation reference point.

Work is the area under the load curve and is measured in milli joules.

Final load is the load at the target deformation.

NOTE: It is not possible to perform tension tests with the 100g load cell.

<u>TARGET HOLD-TO-LOAD</u> – this test applies a constant force to the sample material for a user-defined time interval.

The target hold setup screen allows the operator to assign four variables: Hold Time, Trigger Load, Target Load, and Run Speed.

The first line allows the operator to input a Hold Time. The time is entered as whole seconds; the HOLD TIME field length is four digits long. Trigger force and Target Load entries conform to the load cell type of the instrument as shown in Figure III.28:

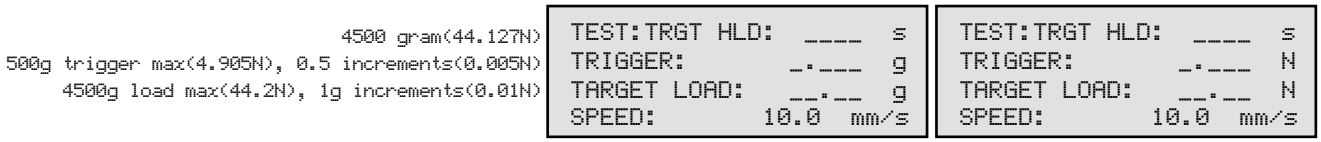


Figure III.28

Note that the information to the left of the screenshot details the instrument type, the maximum allowable trigger value with its associated resolution, and the proposed target load maximums and resolution. Also listed is the targeted hold accuracy of 0.5% full scale.

The target load value is in whole grams and corresponds to approximately 0.01 Newtons for most load cells. However, the same resolution restrictions as used in Trigger Value entry will apply. For example, with 50000g load cell, the least significant digit in Newton mode will be 0.05N.

Pressing the Select Knob, when the cursor is positioned over the HOLD (time) text, will start the Hold Time data entry. The cursor will be repositioned over the left most digit of the time field, which will be four digits wide. At this time, the entire field will be cleared so that all digits are displayed as underscore lines. Rotating the Select Knob will scroll through digits 0 to 9; clockwise rotation scrolls up, counter clockwise rotation scrolls down. Pressing the Select Knob locks in the digit and advances the cursor to the right. Pressing the Select Knob over a cleared (underscore) displayed digit will replace the underscore with "0". Pressing the Select Knob over the last (right-most) digit will lock in the value and advance the cursor to the TRIGGER data line.

Pressing the STOP button during data entry will clear the existing digit back to an underscore, and reposition the cursor one digit to the left where possible. Multiple presses of the STOP button will continue to move the cursor backwards, ending at the left most position.

Pressing the Select Knob when the cursor is positioned over the TRIGGER text will start the Trigger Load data entry. This is accomplished in the same manner as described above. The width of the trigger field will vary depending on the load cell type used. Exiting the Trigger Load data entry will advance the cursor to the TARGET LOAD data line.

Pressing the Select Knob when the cursor is positioned over the TARGET LOAD text will start the Target Load data entry. This will be accomplished in the same manner as described above. The width of the target load field will vary depending on the load cell type used. Exiting the Target Load data entry will advance the cursor to the SPEED data line. Attempting to enter a load that exceeds the maximum allowable load as defined by the cell type will default to the maximum allowable load.

Pressing the Select Knob when the cursor is positioned over the SPEED text will start the SPEED data entry. The cursor will reposition over the right-most digit of the speed data field. The speed field will retain its previous value (unlike Hold Time, Trigger Load, and Target Load). Rotating the Select Knob will increment or decrement the displayed value through all available speeds from 0.01 mm/sec to 10.0 mm/sec. Pressing the Select Knob will lock in the displayed speed and advance the cursor to TEST.

Pressing the START button will begin a test run. If the START button is pressed in the middle of a data entry (before the final value has been locked in), the test run will start, but the value of the aborted data entry field will revert to its previous setting. The first screen when starting a new TARGET HOLD test reminds the operator to attach a probe.

Pressing the STOP button will go back to the previous Setup Screen with the cursor over the first character of the test type. This indicates that the mode is no longer selected and rotating the Select Knob will scroll through the other test modes. Any parameter entries that were completed will be saved, even if the test is not run.

Pressing the START button will advance to the Pre-positioning screen, which allows the operator to reposition the probe prior to beginning the test. The probe can be moved downwards or upwards by rotating the Select Knob. Pressing the Select Knob causes the probe to continuously descend. The display shows the position of the probe as a deviation from the HOME (0.0 mm) position.

Pressing the STOP button will go back to the previous Setup Screen with the cursor over the first character of the test type. This indicates that the mode is no longer selected and rotating the Select Knob will scroll through the other test modes. The probe will retract to the HOME position.

Pressing the START button will advance the AUTOZEROING screen. Once the standard AUTOZEROING function is performed, the CT3 automatically advances to running the test. Pressing the Stop during AUTOZERO will revert to the Setup Screen and retract the probe to the HOME position.

The following sequence of display screens summarizes the Target Hold setup procedure:

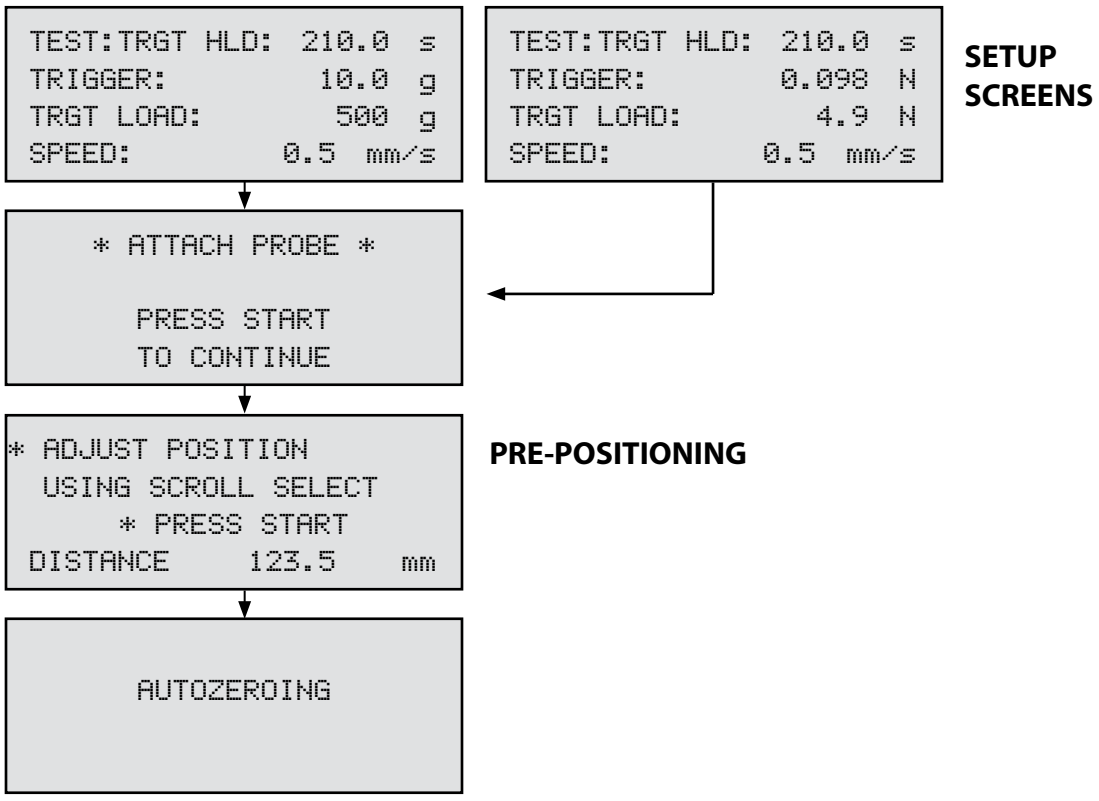


Figure III.29

The CT3 displays the following information while the Target Hold test is being run.: TIME AT TARGET, DEFORMATION, and the current measured LOAD. The sequence of events, and the corresponding display fields, is as follows.

The display begins with the TIME at 0 while the probe descends at the selected PRE-SPEED (assigned by the user in the GLOBAL PARAMETERS screen described elsewhere). Pressing and holding the START button prior to reaching the TRIGGER load will override the PRE-SPEED setting for the probe with a default speed of 4.5 mm/sec (known as jogging). The DISTANCE remains at 0.0 until the TRIGGER load value is reached when the probe makes contact with the sample. The LOAD field then starts to display the actual force measured by the CT3.

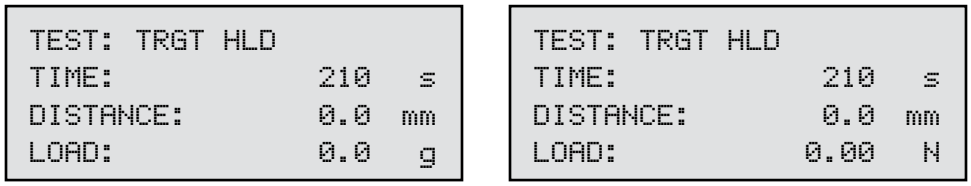


Figure III.30

When the measured LOAD reaches the assigned TRIGGER value, the probe speed is changed to the assigned SPEED from the Target Hold setup screen. As the probe approaches the target load at the pre-assigned speed, there will be a fixed deceleration algorithm that reduces the speed of the probe until it reaches the target load, based on a percentage of the load cell full scale. Therefore, the pre-assigned probe speed only represents the maximum allowable speed. For example, if the applied load, when the TRIGGER point is reached, is sufficiently close to the target hold load, then the probe will run at a speed slower than what was entered in the setup screen.

When the measure LOAD equals the TARGET LOAD assigned in the setup screen (the CT3 must detect two readings at the target load for valid detection), the CT3 begins the HOLD portion of the test. At this time, the DISTANCE value is saved, and the TIME field is replaced with the hold time value which starts the count down to zero. The CT3 repositions the probe, as necessary, to maintain the measured LOAD within 0.5% of the full scale load cell capacity. The LOAD and DISTANCE fields remain active.

When the TIME field counts to zero, the test is stopped. The probe is retracted to the pre-positioned start position using the post test speed. The display TIME remains at zero. DISTANCE and LOAD fields remain active. The CT3 continues to internally record LOAD measurements and logs negative values of LOAD as the probe moves upward. When the probe reaches the start position, the display advances to the FINAL screen.

During the running of the test, pressing and holding the Select Knob causes the display to revert to the setup screen, but the actual test will continue to run uninterrupted. Releasing the Select Knob returns the display to the RUN screen. Activating the EMERGENCY STOP knob will terminate the test and return the probe to the HOME position. Pressing the STOP button will also abort the test, retract the probe to the HOME position, and return the display to the TARGET HOLD SETUP screen.

After the probe has been returned to the start position, the display will show the test results: DISTANCE AT START of hold period, DISTANCE AT END of hold period, DEFORMATION, ADHESIVE FORCE, ADHESION, and TEMPERATURE. Since only four lines are available on the display, rotating the Select Knob will scroll down for the added parameters. Figure III.31 shows examples of a hypothetical test.

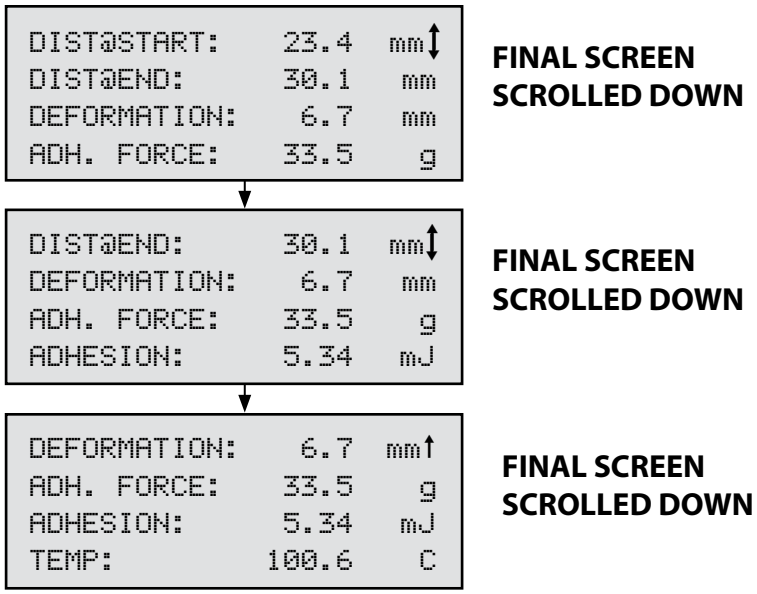


Figure III.31

DEFORMATION is the difference in distance between DIST@START and the DIST@END. ADHESION (ADHESIVENESS) is the area under the force vs. distance curve for ALL negative values of load detected at the end of the test as the probe returns to the HOME position. (The current standalone TPA test has a calculated final screen value called ADHESION, reported in mJoules. The Target Hold calculation is performed in the same way.) ADHESIVE FORCE is the peak negative value. This will be reported as a positive value, rather than a negative value.

Pressing and holding the Select Knob while displaying the FINAL screen will show the SETUP screen for reference. Releasing the Select Knob will revert back to the FINAL screen.

Re-starting the test can be performed in two ways.

1) **Quick Start**. When the FINAL test screen is displayed, the operator can do a quick restart of the test by pressing the START button. The CT3 will begin the AUTOZEROING process and execute the same test again.

2) **Full Start**. When the FINAL test screen is displayed, the operator can do a full restart of the test. Pressing the STOP button at this time will display the SETUP screen. The various setup parameters can then be modified as needed before pressing the START button to begin the full test.

The following test is not included in the CT3 unless requested by the customer at the time when the instrument is first ordered. It replaces the TARGET HOLD test.

SURIMI TEST - performs a single compression of a surimi sample until the gel ruptures. The test result will be the distance the sample deformed before it ruptured and the peak load just prior to the rupture. As soon as the rupture occurs the probe retracts to the HOME starting position.

NOTE: This test is only available in CT3 instruments with load cells up to 4500g and firmware version 2.0 or higher.

The operator may set the trigger value, correction value and test speed.

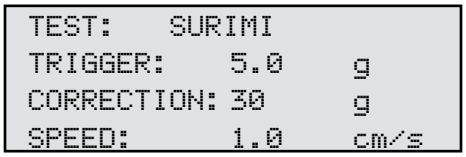


Figure III.32

The trigger value is a small load, in grams, measured by the CT3 that indicates the probe is in contact with the sample. Once the probe contacts the sample the test will begin at the defined speed. The range of acceptable trigger values depends upon the load cell in use and is shown in Table III.1. In general, the trigger value should be large enough to prevent a false trigger from starting the test before the probe comes in contact with the sample. A false trigger is usually the result of excessive vibrations passing through the lab bench. A 5g trigger is typical.

When the surimi sample ruptures, the load measured by the CT3 will drop. The Correction value specifies the size of the load drop, in grams, that is required to recognize a gel rupture. The correction value may be set from 5g to 99g. The two most common correction values used are 30g or 50g. The default setting is 30g and should be good for most surimi applications.

The test speed for all surimi testing has historically been 1 cm/s, so this is the default value. The test speed can be set from 0.1 mm/s to 10 mm/s, which is equivalent to 1 cm/s.

⚠ Changing the test speed is likely to change the gel result.

During the test, the display will show live deformation and load.

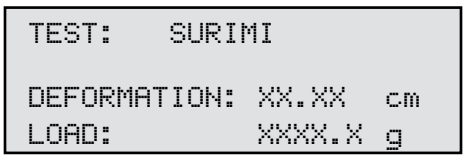


Figure III.33

As soon as the surimi gel ruptures, the result screen will appear.

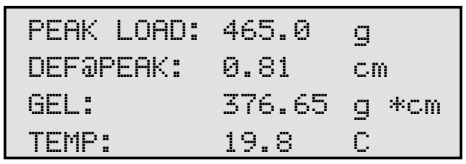


Figure III.34

The GEL result is the multiplication of Peak Load times Def@Peak in units of g-cm.

If a temperature probe is used with the CT3, the temperature at the time of the test is also shown. The TEMP line will not be seen in the display if a temperature probe is not used. DO NOT insert the temperature probe into the surimi sample being tested.

III.8 Global Parameters

The CT3 has a GLOBAL PARAMS screen which allows the pre-setting of: PRE SPEED, POST SPEED, TEMP. C/F (temperature in C or F), and load measurement unit in "g" (grams) or "N" (newtons). After Autozero during startup, rotate the Select Knob to reach the GLOBAL PARAMS screen, then press the Select Knob to access the data entry function.

There are some parameters that affect every test screen. The speed of the probe prior to triggering is the pretest speed, which is called Pre-Speed on the display screen. This may be set over the range of 0.1mm/s to 2.0mm/s.

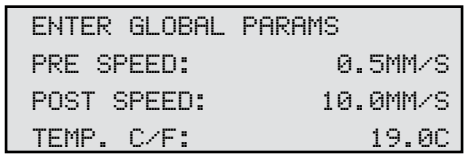


Figure III.35

The return speed after the target is reached is the post test speed which is called Post Speed on this screen. It may be set from 0.1mm/s to 10.0mm/s. For some tests, Such as TPA, the post test speed is irrelevant because it will always be the same as the test speed. The two tests for which this is the case are TPA and the Cycle test.

Rotate the Select Knob to LOAD UNITS. When the cursor is over the "L" in LOAD, pressing the Select Knob will reposition the cursor to the "g" or "N" at the far right of the field. Rotating the knob will alternate between the "g" and "N" (grams and Newtons).
Temperature units may be set to either degrees Celsius or Fahrenheit. Once set on the Global Params screen these parameters will remain in effect until changed again on this screen.

If a temperature probe is not mounted on power up, then access to temperature unit selection is disabled. Live temperature, however, can still be displayed by plugging in the temperature probe at any time.

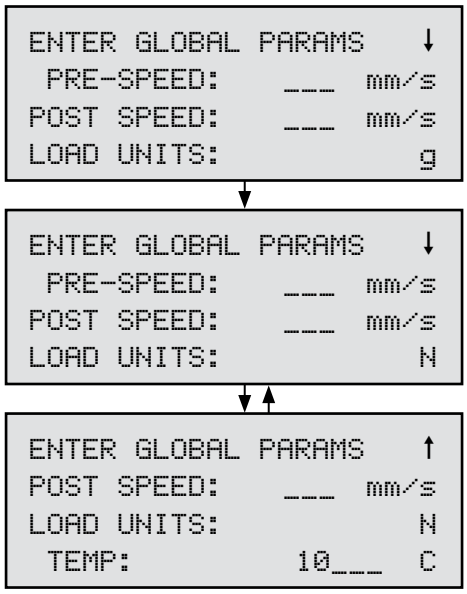


Figure III.36

This selection table is global in nature and applies to all tests with the following exception. Newtons are not available as a selection in the BLOOM mode.

III.9 Probe Pre-positioning

This section describes how to pre-position the probe prior to all standalone tests.

III.9.1 NORMAL mode pre-positioning

The pre-positioning screen is displayed after the ATTACH PROBE screen. The probe can be moved downwards or upwards by rotating the Select Knob. Pressing the Select Knob causes the probe to continuously descend. The display shows theposition of the probe as a deviation from the HOME (0.0 mm) position.

The pre-position of the probe will be considered the START position and will now be assigned as distance 0.0 mm. The displayed distance value will remain at 0.0 mm until the instrument senses a valid TRIGGER force after the test starts. All distance and deformation measurements will then be referenced to the TRIGGER point.

At the end of a NORMAL test, the probe will return to the START position rather than the HOME position. The probe will return to the HOME position only if a full restart of the NORMAL test is done. The following diagram shows, from left to right, The HOME position corresponding to the probe at power up, the START position which is determined by the pre-position operation, the TRIGGER position where the sensed load equals the trigger value, and the DEFORMATION position which generally corresponds to the completion of a compression type test. In the case of the TARGET HOLD mode, the DEFORMATION value is the downward distance that the probe has moved relative to its position upon reaching the TRIGGER point. This DEFORMATION value will vary as the sample material relaxes under a constant load. DEFORMATION, in that case, will be reported as the change in distance while at constant load.

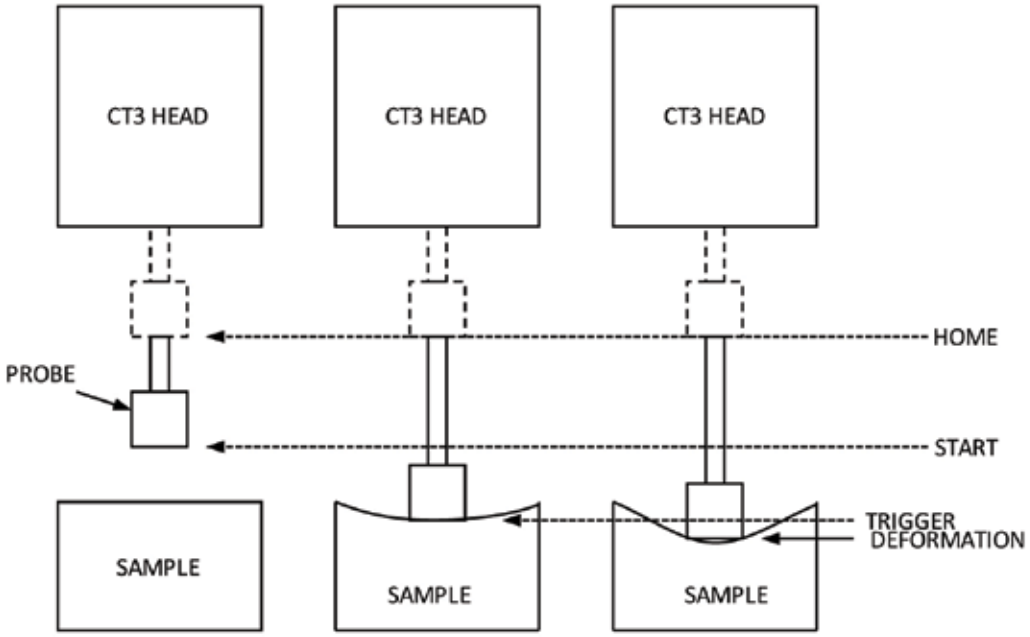


Figure III.37

NORMAL mode Quick re-start
After a NORMAL test is complete, pressing the START button will re-run the test starting at the AUTZERO screen and function. The test will proceed from the pre-positioned START.

NORMAL mode Full re-start
After a NORMAL test is complete, the operator can do a full restart of the test. Pressing the STOP button at this time will display the setup screen. This places the CT3 back at the NORMAL setup mode. The probe will return to the HOME position. The various setup parameters can be modified and pressing START will begin the full test run complete with pre-positioning.

III.9.2 HOLD TIME mode pre-positioning

The pre-positioning screen is displayed after the ATTACH PROBE screen. Move the probe from the HOME position to the desired START position. The displayed value for deformation will be set to 0.0 mm. All deformation measurements will then be referenced to the position at which the probe makes contact with the sample and reaches the trigger point.

At the end of a HOLD TIME test, the probe will return to the START position rather than the HOME position. The probe will return tho the HOME position only if a full restart of the HOLD TIME test is done.

HOLD TIME mode Quick re-start
After a HOLD TIME test is complete, pressing the START button will re-run the test starting at the AUTZERO screen.

HOLD TIME Full re-start
After a HOLD TIME test is complete, the operator can do a full restart of the test. Pressing the STOP button at this time will display the setup screen. This places the CT3 back at the HOLD TIME setup mode. The probe will return to the HOME position. The various setup parameters can be modified. Pressing START will begin the full test run complete with pre-positioning.

III.9.3 CYCLE COUNT mode pre-positioning

The pre-positioning screen is displayed after the ATTACH PROBE screen. Move the probe to the desired START position. The displayed value for deformation will be set to 0.0 mm. All deformation measurements will then be referenced to the trigger point after the probe makes contact with the sample.

When the probe is retracted upwards between cycles, it will stop at the START position before descending for the next cycle. At the end of a CYCLE COUNT test, the probe will return to the START position. The probe will return to the HOME position only if a full restart of the CYCLE COUNT test is done.

CYCLE COUNT mode Quick re-start
After a CYCLE COUNT test is complete, pressing the START button will re-run the test starting at the AUTZERO screen.

CYCLE COUNT Full re-start
After a CYCLE COUNT test is complete, the operator can do a full restart of the test. Pressing the STOP button at this time will display the setup screen. This places the CT3 back at the CYCLE COUNT setup mode. The probe will return to the HOME position. The various setup parameters can be modified. Pressing START will begin the full test run complete with pre-positioning.

III.9.4 BLOOM mode pre-positioning

The pre-positioning screen is displayed after the ATTACH PROBE screen. Move the probe to the desired START position. The displayed value for deformation will be set to 0.0 mm. All deformation measurements will then be referenced to the position when the probe makes contact with the sample and the trigger point is reached.

At the end of a BLOOM test, the probe will return to the START position. The probe will return to the HOME position only if the full restart of the BLOOM test is done.

BLOOM mode Quick re-start
After a BLOOM test is complete, pressing the START button will re-run the test starting at the AUTZERO screen.

BLOOM Full re-start
After a BLOOM test is complete, the operator can do a full restart of the test. Pressing the STOP button at this time will display the setup screen. This places the CT3 back at the BLOOM setup mode. The probe returns to the HOME position. The various setup parameters can be modified. Pressing START will begin the full test run complete with pre-positioning.

III.9.5 TPA mode pre-positioning

The pre-positioning screen is displayed after the ATTACH PROBE screen. Move the probe to the desired START position. The displayed value for deformation will be set to 0.0 mm. All deformation measurements will then be referenced to the position when the probe makes contact with the sample and the trigger point is reached.

The probe will retract to the START position between cycles. At the end of a TPA test, the probe will return to the START position. The probe will return to the HOME position only if a full restart of the TPA test is done.

TPA mode Quick re-start
After a TPA test is complete, pressing the START button will re-run the test starting at the AUTOZERO screen.

TPA Full re-start
After a TPA test is complete, the operator can do a full restart of the test. Pressing the STOP button at this time will display the setup screen. This places the CT3 back at the TPA setup mode. The probe will return to the HOME position. The various setup parameters can be modified. Pressing START will begin the full test run complete with pre-positioning.

III.9.6 TENSION mode pre-positioning

The TENSION mode already incorporates pre-positioning in the manner described for the other modes above. It has other screens, however, that address clamp and probe operations.

III.10 Texture Loader Software (See Appendix C for details)

Texture Loader software was supplied with your CT3 on the bundled software CD. After installing this software into a computer you can add up to 10 additional test programs to the CT3 menu based upon any one of the test methods described above. For example, suppose you routinely test rye bread using a TPA test with a trigger value of 5g, deformation of 18mm and a test speed of 3mm/s. You can create a test called RYE with these test parameters. After downloading this test to the CT3, you will see the RYE test appear in the display as you scroll through the test methods. The Texture Loader program is supplied as a convenience for our customers who routinely run tests with established parameters.

III.11 Checking Calibration

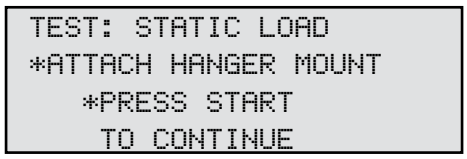
The load calibration of the CT3 Texture Analyzer can be verified using the Static Load mode. We recommend that you use the Brookfield weight set appropriate for your CT3 load range:

BEL Part No.	Load Range
•TA-CW-100C	100 gram
•TA-CW-1000C	1000 gram
•TA-CW-1500C	1500 gram
•TA-CW-4500C	4500 gram
•TA-CW-10KGC	10kg
•TA-CW-2550KGC	25kg and 50kg

The frequency of the calibration verification should be set in accordance to your company procedures.

1. Start the calibration verification process using the select/scroll knob to set the test mode to Static Load and press the start button. The display will request that you attach the hanger mount to the probe shaft.

   Note: TA-CW-100C does not include a hanger mount or hanger. A black, TA5 probe is included and is used as the hanger. Each of the three weights are stacked on top of the probe during step 4.



III.38

2. The weight of the hanger mount itself will be zeroed by pressing the start button.

III.39

The display will change to show static load active parameters once the autozero process is complete.

```
TEST:   STATIC LOAD
ADD HANGER AND MASS
LOAD        XXXX.X g
```

III.40

The Hanger is the first weight to be fixed to the Hanger Mount.

***NOTE*:** The Hanger is part of the calibrated weight set, and it has a calibrated weight value. This weight must be included as part of the total weight applied to the load cell.

Attach the desired weight to the Hanger and record the load value from the display. Multiple weights may be attached to the Hanger to achieve a range of test points.

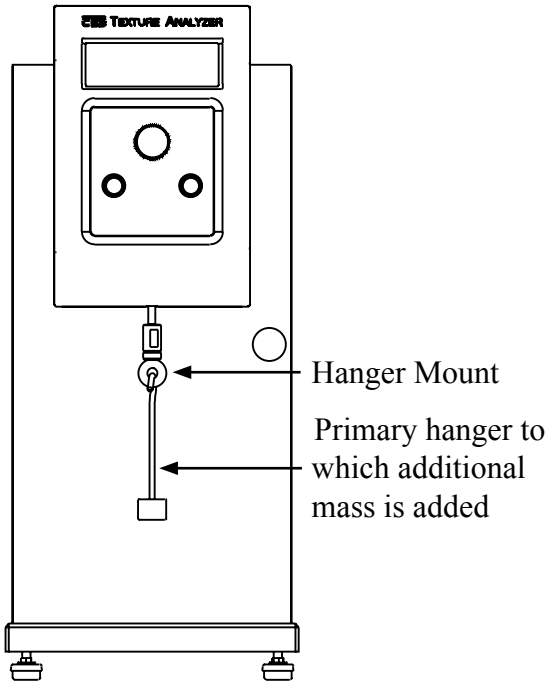


Figure III.41

⚠ Do not apply excessive upward, downward or sideways force to the Hanger Mount or Hanger while adding or removing weight. This may damage the sensing mechanism of the CT3.

As successive weights are added, the CT3 will show the total weight, which should be within the specified instrument tolerance shown in Table III.2. The accuracy of the CT3 is defined by the rating of the load cell as detailed in Table III.2. If the CT3 Texture Analyzer produces data outside of the acceptable range, contact Brookfield or our authorized representative for information on repair/calibration services (see Appendix D for Brookfield locations).

Model	Load Range	Load Accuracy Grams
CT3-100g	0 – 100g	0.5
CT3-1000g	0 – 1,000g	5.0
CT3-1500g	0 – 1,500g	7.5
CT3-4500g	0 – 4,500g	22.5
CT310kg	0-10kg	50
CT325kg	0-25kg	125g
CT350kg	0-50kg	250g

Table III.2

Example of Calibration Verification

A 4500 gram CT3 Texture Analyzer, according to Table III.2, has an accuracy of ±22.5 grams. The spreadsheet shown below can be used to easily evaluate a calibration check using the appropriate Brookfield calibration weight set.

Calibration Spreadsheet

CT3 TEXTURE ANALYZER serial # 6514047 ①

	Load Cell Capacity 4500 ②				
#	1	2	3	4	5
③ Mass	999.84	994.04	993.96	994.05	497.12
Serial #	59	87	92	106	153

⑤ Load Cell Accuracy 22.5g

	Weight
1	999.84
1 & 2	1993.88
1, 2 & 3	2987.84
1, 2, 3 & 4	3981.89
1 - 5	4479.00

Low Limit	④ **Reading**	High Limit	**Difference**
977.34	**999.5**	1022.34	**-0.3**
1971.38	**1993.5**	2016.38	**-0.4**
2965.34	**2987.5**	3010.34	**-0.3**
3959.39	**3981.5**	4004.39	**-0.4**
4456.51	**4479.5**	4501.51	**0.5**

INSTRUCTIONS FOR USE

The CT3 Calibration template can be downloaded from our website, www.brookfieldengineering.com/products/texture-analysis/cts.asp

① Enter the serial number of your CT3.

② Enter the load cell in your CT3. The load cell accuracy is automatically calculated from this value.

③ Enter the mass and serial numbers of the weights in the same order that you add them to the hanger.

④ Enter the load value shown in the CT3 display as each weight is added.

⑤ Calibration is satisfactory if all values in the "Difference" column are smaller than the "Load Cell Accuracy" value.

IV. TEST METHOD DEVELOPMENT

The measurement results provided by the CT3 Texture Analyzer will be dependent on several factors relating to the sample, the test probe, and the test parameters. A variation on any of these elements may result in a change in measurement results. For good test repeatability, it is suggested that a clear and complete test method be developed. The following sections describe these elements. Brookfield suggests that your method development include some trial and error testing to determine the best test method for your sample material. Brookfield offers a texture day training course for anyone wishing assistance with texture analysis methods.

IV.1 Sample Preparation

The measurement of texture using the CT3 Texture Analyzer requires contact between the test probe and the sample. The shape and surface of the sample may affect the measurement results. Consider for example an orange: the test of a peeled orange will likely give a different result from the test of a single wedge from the same fruit. This is likely the same for any bulk material when compared to a neatly prepared cube of material. Consideration should be given to the preparation of the sample to facilitate repeatability of the test. For example a material that has a flat surface offers a consistent interface with the probe even if the material is not centered in the test fixture. If your test sample is uneven, part of the test method could be to cut / shape / modify the sample such that the sample is flat; consider, for example, the difference between a loaf of bread versus a slice of bread.

IV.2 Test Probe / Fixture

The CT3 Texture Analyzer may be used with a wide variety of probes and fixtures. Brookfield offers a set of standard items while also providing special design services. Each type of probe offers benefits for certain sample types. The following table provides some basic guidelines. Although this table represents our general experience, it is important to note that there are few established standard tests for physical measurements of texture. The main objective is to characterize your material in a way that best represents its perception by human senses. This is the essence of texture analysis.

Probe Type	Typical Application
Cylinder	well defined samples with uniform surfaces, general purpose, TPA (texture profile analysis)
Sphere	samples with small scale variations on surface, general purpose
Cone	samples with rigid outer layer. Also used for penetrometry and spreadability
Wire	used for cutting or slicing samples such as cheese
Magness Taylor	used for puncturing, often used for determining ripeness of fruit/vegetables
Extrusion Cell	samples that can be made to flow, general purpose
Shear blades	meat tenderness

Table IV.1

Within a probe category, variations of geometry can be significant. It may require a larger force to drive a cone of shallow angle as compared to a cone of steep angle. Similarly, a cylinder of large diameter may require a larger force than a cylinder of small diameter. The selection of the probe (type and size) will affect the test result.

Keep hands, fingers and other body parts clear of moving test probes when operating instrument.

IV.3 Test Parameters

The CT3 Texture Analyzer will require the setting of several parameters depending upon the test method selected (see Table III.1). In general, the following relationships will hold true for Speed and Distance.

1) The measured load tends to increase as the test speed increases.

2) The measured load tends to increase as the compression distance increases. An exception to this could be a material with an outer layer such as an apple, or one that fractures.

The Trigger Point establishes the minimum load required to begin the test. This is how the CT3 knows when the probe is touching the sample. This parameter should be set to a low value for a material with a very delicate outer layer. Trigger value depends upon you load cell. Minimum recommendations are shown in Table II.2.

The Hold Time allows for monitoring the response of a material as it is held compressed. Normally, an increase in the Hold Time will result in a lower measured value, as the sample relaxes.

The Cycle Count provides a way of working a sample by compressing it repeatedly and monitoring its response.

IV.4 Recommendations

The test results of a texture measurement are very dependent on both sample preparation and the test method. When developing a method, Brookfield recommends that each parameter be varied in turn to determine its effect on the results. (***Note***: vary only one parameter at a time.) Once this information is considered and a method is established, the method should be documented in significant detail. This will ensure good repeatability of results and good comparison with others who attempt to duplicate your method.

V. APPLICATIONS

This applications section should be used as a guide to the development of techniques specific to your own application and requirements. These notes are empirical in nature. Deviation from the described test configurations (parameter settings, sample size, shape, formulation, etc.) will result in deviations from the observations discussed in each application.

V.1 Comparison of Low Fat and Virtually Fat Free Yogurt Consistencies

PRODUCT: Low-fat (1%) and virtually fat-free (0.05%) natural yogurt

OBJECTIVE: Comparison of textural properties in order to identify differences between protein networks formed as an indication of product creaminess.

BACKGROUND: The textural properties of yogurts are critical in determining consumer preference where variation in fat content of formulation has a direct influence on the sensory characteristics of the product. The elevated Solids Not Fat (SNF) content of low-fat yogurts forms strong casein-casein bonds uncharacteristic in a full-fat yogurt, where homogenized fat globules are partly covered with casein, facilitating protein-protein interactions. Fat becomes trapped within this protein network where it imparts a smooth creamy mouthfeel and spoonable glossy consistency characteristic of full-fat yogurts.

Back Extrusion is an ideal method for the assessment of yogurts and other gelled, semi-solid foods. This compression extrusion test consists of applying a force to the product until it flows through the space between the probe perimeter and the container. A wide range of complex forces are generated. However, the test gives good measures of peak force and area of work during compression indicative of the strength of the gel and product consistency. These forces may also be recorded in reverse on the negative portion of the force-time curve where they are indicative of sample viscosity.

CT3 SETTINGS:

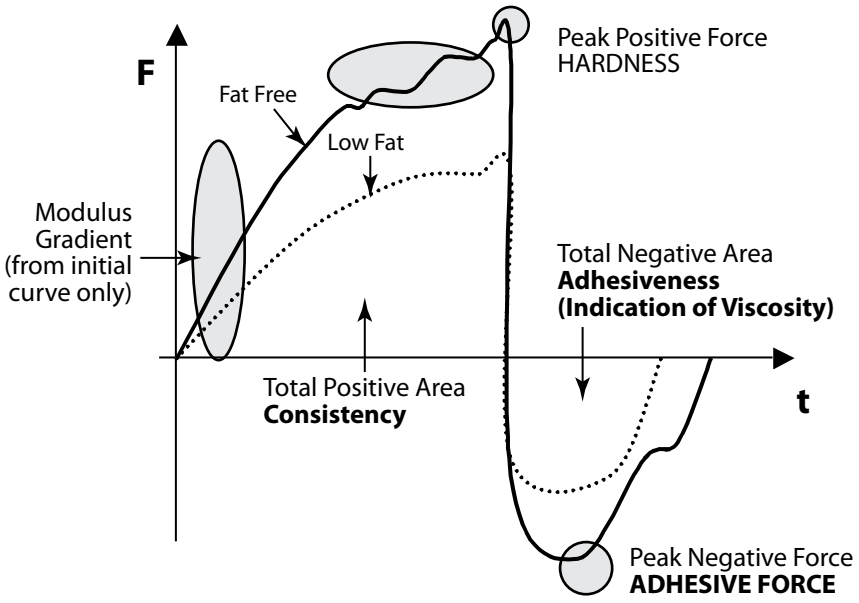
MODE:	Normal
TRIGGER:	see table II.2
DISTANCE:	30mm, or appropriate for your container
SPEED:	1mm/s

PROBE REF: TA4 38.1mm Ø Perspex Cylinder, or larger if your container allows.

METHOD: Samples were removed from refrigerated conditions of 5°C and centrally positioned beneath the probe within the container in which they were packed. Tests were conducted at ambient conditions of 18.2°C while the test temperature of the low-fat yogurt was 8.7°C and the virtually fat- free was 7.9°C. It was essential that a sufficient distance (circa 20mm) was left between the sample surface and the base of the probe. This was left to ensure that a complete break between probe/sample interface was made during probe retraction so that adhesiveness characteristics could be evaluated.

NOTE: Samples were tested with original containers as supplied. Use of different dimension holding vessels will change results obtained, therefore, operators must be consistent with the test setup used.

READING:



DISCUSSION:

Once the trigger is attained, the force continues to increase until a surface fracture occurs. The modulus changes at this point to a less steep gradient, and the force nearly reaches a plateau.

The low-fat sample appears much softer than the fat-free, having increased flow over the plunger with a visually less grainy and more glossy fluid appearance. The softer set is characterized by the lower forces and areas of work measured, as well as the shallower slope. The softer set is also characterized by the failure to form sample fracture and the absence of peaks within the curve.

The fat-free sample has a much steeper initial gradient and subsequently higher values for all measured parameters. Its grainy set structure is characterized by the large number of peaks attained within the curve, while the increased viscosity or spoonability is shown within the negative portion of the curve.

PARAMETER COLLECTION:

Peak force and work (area under load curve) will show on CT3 display when used as stand alone. With an attached computer and TexturePro CT software modulus and many other parameters are available.

PARAMETERS:

HARDNESS	Force necessary to attain a given deformation
WORK (Total Positive Area)	Internal strength of bonds within a product
ADHESIVENESS (Total Negative Area)	Work necessary to overcome attractive forces between surface of the food and the materials with which it comes into contact.

ADHESIVE FORCE	Force required to "pull" probe from sample (suction).
MODULUS	Ratio of stress divided by strain during the first compression cycle (e.g., the slope of the force:deformation curve). It is representative of sample rigidity.

RESULTS:

	LOW-FAT	FAT-FREE
HARDNESS (g)	122	227
WORK (mJ)	1592.7	3199.9
ADHESION (mJ)	-246.4	-522.6
ADHESIVE FORCE (g)	-58	-112

CONCLUSIONS:

Creaminess of samples was evaluated as a comparison between low-fat and fat-free samples. This is a comparative measure between two samples, but does give good indication of the effect of formulation on the protein:protein network and resulting gel set. Such a test would be excellent both within the Quality and Development environments, where product matching as well as process control could be facilitated.

The modulus values are also considerably different where the higher values for the fat-free fat product denote the firmer, more bound consistency of the product.

EMPIRICAL FACTORS:

Test conditions which will affect results generated:

1. Sample size
2. Sample age
3. Sample temperature
4. Base and edge effects
5. Sample container and/or test probe employed

Sample conditions which will effect results generated:

1. Fat content
2. Protein content
3. pH
4. Set/Stirred product
5. Syneresis and surface characteristics
6. Presence of inclusions e.g. fruit
7. Temperature and uniformity

RELATED TESTS:

45° cone penetrometer test utilizing hold until time function to determine relaxation.

BIBLIOGRAPHY AND REFERENCES:

Anon. 1988. Facts About Yogurt. National Dairy Council, London.
Anon. 1996. Yogurt: A Technical Profile. National Dairy Council, Education Department.
Bylund, G. 1995. Diary Processing Handbook. Tetra Pak Processing Systems AB, Sweden.
Prentice, J. 1992. Dairy Rheology A Concise Guide. VCH Publishers, USA.
Tamime, A. and Robinson R. 1985. Yogurt Science and Technology. Pergamon Press Ltd., Oxford.
Varnam. A. and Sutherland, J. 1994. Milk and Milk Products - Technology, Chemistry and Microbioogy. Chapman and Hall, Great Britain.

V.2 A Comparison of the Textural Characterstics of Biscuits (Cookies)

PRODUCT: Biscuits

OBJECTIVE: To compare the textural characteristics of the two different types of biscuit while utilizing parameters generated using penetration test.

BACKGROUND: The textural characteristics of hygroscopic foods (those which take up water from the atmosphere) such as biscuits is of critical importance in the assessment of their quality. The hardness of a sample is indicative of its freshness, while the crispiness parameter evaluated within this investigation, characterizes its inner crumb structure and bake characteristics.

The test may be employed as part of any quality control procedure, whether that is to evaluate staling of product life, bake characteristics through quantification of hardness at different points within the biscuits circumference or any other application specific to your organization.

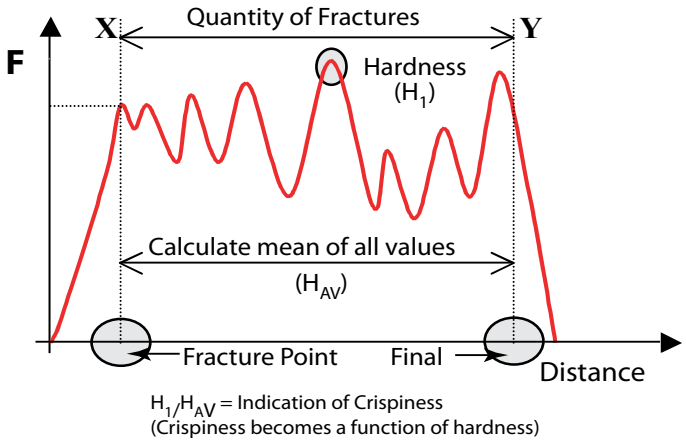
CT3 SETTINGS:

MODE:	Normal
TRIGGER:	See table II.1
DISTANCE:	3mm
SPEED:	0.5mm/s

PROBE REF: 2 mm stainless steel cylinder probe (REF: TA39)

METHOD: Biscuits approximately 6 mm thick were located beneath the probe and clamped to the analyzer bed using low pressure clips. The probe then penetrated sample to target distance and the profile of characteristics was recorded through the interface package.

READING:



H_1/H_{AV} = Indication of Crispiness
(Crispiness becomes a function of hardness)

Relate the mean value of peaks obtained to the original hardness value. Empirically our investigations highlighted that higher values of the ratio were indicative of increased crispiness.

DISCUSSION:

As the probe travels through the sample an initial fracture of the surface is recorded. This fracture is greater in relation to other peaks within the chocolate coated sample due to surface characteristics. A range of internal fractures are then recorded as the probe progresses to the target deformation of 3 mm. The level of peaks within the sample are indicative of crispiness e.g. harder samples showed greater fracture force and were thus considered as being more crispy. The overall force:deformation curve highlights various peaks and troughs as the aerated structure of the sample is penetrated, peaks may be caused through the presence of sugar crystals or where the probe makes contact with air pockets within the dough structure. The overall positive area of the curve is indicative of sample hardness (as is peak force) and may be taken as a direct indication of bake conditions imposed e.g. hotter oven or longer residence time produces a harder biscuit within a sample batch. As two different varieties of biscuit were evaluated, the overall hardness characteristics were considered to be the result of variations in formulation, composition and process conditions imposed. Please note that if inclusions such as chocolate chips or oats are in the biscuit, they will contribute directly to result fluctuations.

PARAMETER COLLECTION:

Use with TexturePro CT software is necessary to obtain fracture calculations.

PARAMETERS:

HARDNESS — Load detected at highest peak during compression

WORK — Integrated area under the compression cycle. Total energy required to penetrate the sample

QUANTITY AND NUMBER OF FRACTURES
Internal ruptures and fracture of sample as structure is broken. Indicative of sample brittleness and internal bond strength.

CONCLUSIONS: Crispiness is an extremely complex parameter to quantify being a function of many artifact attributes. This investigation has excluded the inclusion of number of peaks in order to simplify the equation employed, however, it should be noted that the number of internal factors is an important consideration when evaluating the force:deformation profiles formed. More comprehensive equations should include the calculation of peaks per mm penetration as well as the internal strength or bake characteristics of the product.

EMPIRICAL FACTORS: Results will be affected by a large number of factors including:

1. Biscuit composition
2. Sample age
3. Atmospheric exposure
4. Positioning beneath probe (closeness to sample edges)
5. Surface characteristics

V.3 Review of Solid Chocolate at Ambient Temperature

PRODUCT: Milk Chocolate (single chunk 27.25mm x 7.92mm)

OBJECTIVE: To determine the optimum penetration distance to detect hardness of solid chocolate tablet through the employment of penetration forces.

BACKGROUND: The CT3 is restricted to maximum force generation in the region of 1kg thus the relatively solid consistency of chocolate determined that a very small Ø probe was utilized at minimal test speed. This permitted a flow of molecules within the sample and minimized the forces generated while maximizing the force:deformation profile of the product.

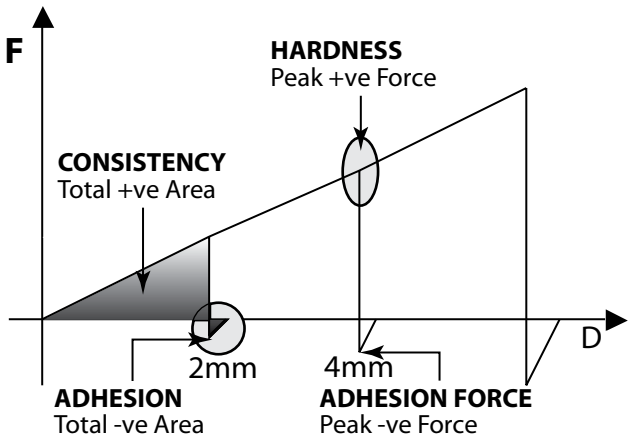
LFRA SETTINGS:

MODE:	NORMAL
TRIGGER:	See table II.1
SPEED:	0.1 mm/s
DISTANCE:	2, 4, or 6 mm

PROBE REF: Stainless steel needle probe, 10° Taper (Ref: TA9)
Confectionery holding rig TA-CJ

METHOD: Samples were removed from wrappers and broken into individual chunks. The individual chocolate piece was then held within jaws of confectionery holder clamped to adjustable bed of CT3 approximately 2mm below surface probe.

READING:



Note: Graph shows continuation of penetration at 2mm, 4mm and 6mm parameter values recorded at set points for each penetration depth.

DISCUSSION: Force: deformation curves generated indicate a linear relationship between forces generated and depth of penetration. It was therefore recommended that the 4mm mid penetration value is utilized to permit evaluation of a range of chocolate types thus enabling comparison of a range of results.

PARAMETER COLLECTION All parameters are automatically calculated within the a test report once they are selected on the test results tab. Thus calculate parameters for each curve individually and record results.

PARAMETERS:

HARDNESS	Force necessary to attain a given deformation
WORK	Internal strength of bonds within a product
ADHESIVENESS	Work necessary to overcome attractive forces between surface of the food and materials as the probe retracts.
ADHESION	Maximum negative load (stickiness)

RESULTS:

PARAMETER	UNIT	2mm	4mm	6mm
HARDNESS	(g)	334	722	1159
WORK	(m^J)	3192.3	1278.6	23878.9
ADHESIVENESS	(m^J)	-0.4	-4.1	-180
ADHESION	(g)	-18	-60	-15.1

NOTE: Adhesion forces give greatest differentiation.

CONCLUSIONS: This empirical procedure generates key information related to chocolate hardness and consistency, while additional information relating to adhesion is also acquired. Adhesion forces were not considered paramount to the investigation due to difficulties in imitating oral mastication properties.

A penetration depth of 4mm (approx. 50% deformation or strain) was considered optimum in generating key profile data and is recommended for future investigation using the 1500g CT3 where prevention of upload forces is critical.

EMPIRICAL FACTORS:

Test conditions will be affected by:

1. Sample temperature
2. Proximity of test holes within sample
3. Ambient temperatures
4. Base effects where probe compresses against analyzer test bed

Rheology of chocolate is influenced by:

1. Cocoa solids content
2. Cocoa butter content
3. Solid fat content
4. Crystal modification (acting as an indication of temperature abuse).

Appendix A - Probes, Fixtures, Calibration Accessories and Gelatin Accessories

This section provides part numbers and detailed descriptions for the test probes and fixtures that can be used with your CT3 Texture Analyzer. Also included is information on calibration accessories and the equipment used to perform gelatin Bloom tests.

A-1 Probes

SELECTED PROBE KITS

TA-P-KIT2 **RECOMMENDED GENERAL PROBE KIT**
Includes the following probes: 60 degree cone TA2/1000; 12.7mm cylindrical (BS std) TA5; 60mm wide knife edge TA7; 1.0mm dia needle TA9; 12.7mm cylindrical (AACC std) TA10; 25.4mm cylindrical (AOAC std) TA11/1000; 45 degree cone TA15/1000; 30 degree cone TA17; 12.7mm ball TA18; 50.8mm cylinder TA25/1000; 0.33mm cutting wire TA53; 2mm rod TA39; 38.1mm cylinder TA4/1000; 6mm cylindrical TA41; 25.4mm ball TA43; 4mm cylinder TA44 and TA-PCC

TA-P-KIT3 **CURD PROBE KIT**
Includes the following probes: 5mm disc TA46; 8mm disc TA-47; 10mm disc TA48 and storage case.

CYLINDER / ROD PROBES

* *included in TA-P-KIT2*

TA3/100 **25.4mm DIAMETER CYLINDER PROBE**
Clear Acrylic. 35mm Long. Rad .35 - .43mm (Low mass for CT3100)

TA3/1000 **25.4mm DIAMETER CYLINDER PROBE**
Clear Acrylic. 35mm Long. Rad .35 - .43mm.

TA4/100 **38.1mm DIAMETER CYLINDER PROBE**
Clear Acrylic. 20mm Long. Rad .35 - .43mm. (Low mass for CT3100)

TA4/1000 *** 38.1mm DIAMETER CYLINDER PROBE**
Clear Acrylic 26g. 20mm Long. Rad .35 - .43mm.

TA5 *** 12.7mm DIAMETER CYLINDER PROBE**
Black Delrin 5g. 35mm Long. Rad .35 - .43mm.

TA6 **6.35mm DIAMETER CYLINDER PROBE**
Black Delrin. 20mm Long. Rad .35 - .43mm. . (Low mass for CT3100)

TA10 *** 12.7mm CYLINDER PROBE**
Clear Acrylic 5g. 35mm length with sharp edge. Gelatin Bloom Probe

TA11/100 **25.4mm AOAC STANDARD CYLINDER PROBE**
Clear Acrylic. 35mm Long. (Low mass for CT3100)

TA11/1000 *** 25.4mm AOAC STANDARD CYLINDER PROBE**
Clear Acrylic 21g. 35mm Long.

TA19 **1cm² KOBE TEST PROBE**
Stainless Steel. 11.3mm Diameter. 25mm Long.

TA24 **4mm DIAMETER ROD PROBE**
Black Delrin. 20mm Long, Flat End

TA25/1000 *** 50.8mm DIAMETER CYLINDER PROBE**
Clear Acrylic 23g. 20mm Long. Rad .35 - .43mm.

TA35 **5mm DIAMETER CYLINDER PROBE**
Black Delrin. 20mm Long.

TA36 **7mm DIAMETER CYLINDER PROBE**
Stainless Steel. 35mm Long.

TA39 *** 2mm DIAMETER ROD PROBE**
Stainless Steel 5g. 20mm Long. Flat End (Margarine).

TA40 **4.5mm DIAMETER ROD PROBE**
Stainless Steel. 20.5mm Long. Flat End (Margarine).

TA41 *** 6mm DIAMETER CYLINDER PROBE**
Stainless Steel 7g. 35mm Long.

TA42 **3mm DIAMETER CYLINDER PROBE**
Stainless Steel. 35.8mm Long.

TA44 *** 4mm DIAMETER CYLINDER PROBE**
Stainless Steel 10g.

TA45 **1mm DIAMETER CYLINDER PROBE**
Stainless Steel.

TA54 **38.1mm DIAMETER 170° SHALLOW ANGLE CYLINDER PROBE**
Clear Acrylic. 20mm Long.

CONICAL PROBES

**** included in TA-P-KIT2***

TA2/100 **60º CONE PROBE**
Clear Acrylic. 30mm Diameter. (Low mass for CT3100)

TA2/1000 *** 60º CONE PROBE**
Clear Acrylic 15g. 30mm Diameter, 36mm L

TA15/100 **45º CONE PROBE**
Clear Acrylic. 30mm Diameter. (Low mass for CT3100)

TA15/1000 * **45º CONE PROBE**
Clear Acrylic 13g. 30mm Diameter, 40mm L

TA16 **40º CONE PROBE**
Clear Acrylic. 29mm Diameter 41mm L

TA17 * **30º CONE PROBE**
Clear Acrylic 8g. 24mm Diameter, 46mm L

TA27 **20º CONE PROBE**
Clear Acrylic. 12.4mm Diameter.

TA29 **15º CONE PROBE**
Stainless Steel. 8mm Diameter.

TA32/100 **90º CONE PROBE**
Clear Acrylic. 30mm Diameter. (Low mass for CT3100)

TA32/1000 **90º CONE PROBE**
Clear Acrylic. 30mm Diameter.

TA-PCC **PROBE CARRYING CASE**
For Texture Analyzer Probes And/Or Calibration Weights. (Foam Insert Cut To Order). Black Polypropylene - 225mm(L)X 200mm(W) X 70mm(H).

SPHERICAL PROBES

* ***included in TA-P-KIT2***

TA8 **6.35mm DIAMETER BALL PROBE**
Stainless Steel.

TA18 * **12.7mm BALL PROBE**
Stainless Steel 30g

TA28 **2mm DIAMETER BALL PROBE**
Stainless Steel.

TA31 **1mm DIAMETER BALL PROBE**
Stainless Steel.

TA33 **3mm DIAMETER BALL PROBE**
Stainless Steel.

TA38 **10mm DIAMETER BALL PROBE**
Stainless Steel.

TA43 *** 25.4mm DIAMETER BALL PROBE**
Nylon 14g

TA49 **25.4mm DIAMETER ROUND END**
Clear Acrylic.

TA50 **5mm DIAMETER BALL PROBE**
Surimi application

MISCELLANEOUS PROBES

**** included in TA-P-KIT2***
***** included in TA-P-KIT3***

TA-DGF001 **DUAL GRIP FIXTURE**
These are multipurpose general grips for tensile type testing. The 25mm wide grips are fitted with rubber inserts to maximise contact adhesion with sample and are capable of holding rectangular samples up to 5mm thick. Each grip clamps from both sides of sample with two opposing thumbscrews for precise alignment. Includes one pair of T-Bolts for mounting to base. Base table kits are NOT USED with this fixture.

TA7 *** KNIFE EDGE**
Clear Acrylic 8g. 60mm Wide.

TA9 *** NEEDLE PROBE**
Stainless Steel. 1.0mm Diameter. 43mm Long.
10º Maximum Taper.

TA22 **18SWG BAR FRAME PROBE**
Aluminium Frame. 39mm Wide.1.2mm Dia

TA23 **12.7mm DIAMETER ROUND END PROBE**
Black Delrin. 35mm Long.

TA46 **** TA CURD PROBE 5mm**
Stainless Steel, 5mm dia disc (0.2 sq cm)

TA47 **** TA CURD PROBE 8mm**
Stainless Steel, 8mm dia disc (0.5 sq cm)

TA48 **** TA CURD PROBE 10mm**
Stainless Steel, 10mm dia disc (0.8 sq cm)

TA37 **2.36mm DIAMETER CUTTING WIRE PROBE**
Aluminium Frame. 40mm Wide.

TA52 **Small Scale MOHRS Shear Blade**
Includes one blade holder and five blades. Blades are 9mm Wide x 35mm Length x .5mm Thick

TA53 ***** 33mm D Cutting Wire Probe, 40 mm L, Connects to M6 Female Thread

A-2 Fixtures

ACCESSORIES FOR ROTARY BASE TABLE

TA-RT-KIT **ROTARY BASE TABLE**
Round base table provides quick and easy height adjustment to accommodate various samples. Accessories listed below are mounted onto this table to facilitate special sample holding requirements. Includes pair of T-bolts for securing table.

ALL ACCESSORY FIXTURES BELOW MOUNT ONTO ROTARY BASE TABLE

TA-ATT **ADHESIVE TACK TESTER**
This tester is used for measuring stickiness of pressure sensitive adhesive materials such as tape. Requires Rotary Base Table TA-RT-KIT.

TA-AVJ **ADJUSTABLE VICE JIG**
This fixture is used for holding smal samples for a puncture test. Good for Jelly beans, gum drops, etc. Requires Rotary Base Table TA-RT-KIT.

TA-BEC **BACK EXTRUSION CELL**
The Back Extrusion Cell is used for measuring the consistency of applesauce, pudding, yogury and similar products. It consists of 3 containers with internal dimensions of 38.1mm diameter, 24mm deep; includes one 25.4mm diameter probe. Requires Rotary Base Table TA-RT-KIT.

TA-JTPB **JUNIOR THREE POINT BEND FIXTURE**
Small scale three point bend fixture for fracture test of brittle materials. Probe used with this fixture, TA7 Knife Edge Blade, is included in General Probe Kit TA-P-KIT2. Otherwise, please order TA7 separately. Requires Rotary Base Table TA-RT-KIT.

TA-JPA **JUNIOR PUNCH ASSEMBLY**
This accessory is used for punching through flat samples. Probe used with this assemblyy, TA10, is included in General Probe Kit TA-P-KIT2. Otherwise, order TA10 separately. Requires Rotary Base Table TA-RT-KIT.

TA-TBLT Pair of T-bolts with nuts and washers.

ACCESSORIES FOR FIXTURE BASE TABLE

TA-BT-KIT **FIXTURE BASE TABLE**
Rectangular base table with removable insert, which is used as a test surface. All accessories listed below mount into this table when the insert is removed. Pair of T-Bolts for securing the table are included. Four sets of extension legs (1, 1.5, 2 & 4 Inches) are supplied. Extra extension legs may be purchased separately.

TA-BT-3KY **Set of four 1 inch table leg extensions**

TA-BT-2KY **Set of four 1.5 inch table leg extensions**

TA-BT-7KY **Set of four 2 inch table leg extensions**

TA-BT-8KY **Set of four 4 inch table leg extensions**

TA-BT-6KY **Set of two thumbscrews for base table insert**

ALL ACCESSORY FIXTURES BELOW MOUNT ONTO FIXTURE BASE TABLE

TA-AACC21 **AACC RECOMMENDED 21mm DIAMETER PROBE**
Aluminum Cylinder, 21mm D and 40mm L. Requires Fixture Table Base TA-BT-KIT.

TA-AACC36 **AACC SPEC PROBE (36mm)**
This probe is used for measuring bread firmness and performing texture profile analysis (TPA). Requires Fixture Table Base TA-BT-KIT.

TA-BLS **BILAYER SHEAR TEST FIXTURE**
This fixture uses a guillotine blade to separate a bilayer tablet while measuring shear strength. Requires Fixture Base Table TA-BT-KIT.

TA-BPS **BLISTER PACK SUPPORT TEST FIXTURE**
This fixture is used to measure the force required to remove the tablet from its blister pack. Requires Fixture Base Table TA-BT-KIT.

TA-CEF **CHEESE EXTENSIBILITY FIXTURE**
This fixture measures the extensibility of a smaple, such as molten cheese, to break point.

TA-CJ **CONFECTIONERY JIG**
This fixture is used for holding candies and similar products for penetration testing. Requires Fixture Base Table TA-BT-KIT. Consists of bases and top plates with holes 4mm, 8mm and 12mm in diameter to allow through penetration of samples with probes slightly smaller than holes. One blank plate (no hole) is also included to serve as a test surface when needed.

TA-CKA **CRAFT KNIFE ADAPTER**
This adapter cuts cleanly into and through material with minimum deformation of the sample. Requires Fixture Base Table TA-BT-KIT.

TA-CLT001 **CAPSULE LOOP TENSILE TEST FIXTURE**
This fixture is used to measure the force required to split on half of a hard gel capsule. Requires Fixture Base Table TA-BT-KIT.

TA-CSF **CIRCULAR SUPPORT FIXTURE**
This fixture provides support for round samples and retains any potential fluid expressed during the test. Requires Fixture Table Base TA-BT-KIT.

TA-CTP **COMPRESSION TOP PLATE**

Rectangular plate 150mm X 100mm, used for compressing large samples. Fixture Base Table TA-BT-KIT is normally used to support sample while testing with this large compression plate.

TA-DE **DOUGH EXTENSIBILITY JIG**

This fixture is used for holding a sheet of raw dough or flat bread to measure the breaking point of the stretched sample. Consisting of 2 aluminum plates, one plate with 25.4mm hole and the other with 38.1mm hole complete with upper fixing plates to hold disc of flat sample. Used with TA18* and TA43* probes respectively. Requires Fixture Table Base TA-BT-KIT.

TA-DEC **DUAL EXTRUSION CELL**

The Dual Extrusion Cell is used for either forward or back extrusion of fruit puree, pudding, yogurt or similar products. Test cell is cylinder 40mm in diameter and 50mm depth. Forward extrusion forces a semi-solid sample through an outlet of known geometry. Complete with 4 plungers of 34mm, 36mm, 38mm and 40mm in diameter and interchangeable base plates with apertures of 8mm, 6mm, 4mm, 2mm and one blank. Requires Fixture Base Table TA-BT-KIT.

TA-DGF **DUAL GRIP FIXTURE**

These are multipurpose general jigs for tensile type testing. The fixtures utilize a universal fitting enabling 360º rotation for comprehensive test configuration. The 25mm wide grips are fitted with rubber inserts to maximise contact adhesion with sample and are capable of holding rectangular samples up to 5mm thick. Each grip clamps from both sides of sample with two opposing thumbscrews. Attaches to slot in CT3 base. Does not require any base table.

TA-DSJ **DOUGH STICKINESS JIG**

This fixture is used for measuring dough stickiness as a standard test; important for processing raw dough. Requires Fixture Base Table TA-BT-KIT and TA3/1000 or TA11/1000* probe.

TA-EP **EYE PENCIL TEST FIXTURE**

This fixture measures the hardness of cosmetic pencil tips for eye- or lip-ling products and can also be used for artistic type pencil tips. Requires Fixture Base Table TA-BT-KIT.

TA-FMBRA **FMBRA STANDARD DOUGH POT SET**

This set is used for preparing dough samples and measuring dough firmness. The set comprises of two test cells and two plungers: An aeration plunger and a compacting plunger. A known weight of sample is placed in the pot and the aeration plunger is used to remove air pockets through gentle rotation. The dough is then assessed for firmness using a TA41 6mm Ø stainless steel probe. Includes Dough Aerator, Dough Compactor & 2 Containers.

TA-FSF **FILM SUPPORT FIXTURE**

This fixture is used for puncture tests to measure the strength of fine films. Requires Fixture Base Table TA-BT-KIT.

TA-GPJ **GENERAL PEELING JIG**

This fixture measures the adhesive strength needed to remove the lid froma sealed container at 0˚, 45˚, and 90˚ angles. Requires Fixture Base Table TA-BT-KIT.

TA-HCF **HAIR COMBABILITY TEST FIXTURE**

This fixture measures the effect of products, such as shampoo and conditioners, on the combability of hair.

TA-JMPA **JUNIOR MULTIPLE PROBE ASSEMBLY**

This multiple probe assembly, consisting of nine 3mm probes and corresponding base plate, is specifically designed to hold nine small samples of irregular geometry, such as peas, corn, nuts or dried fruit. Requires Fixture Base Table TA-BT-KIT.

TA-KF **KEIFFER DOUGH AND GLUTEN EXTENSIBILITY FIXTURE**

This fixture quantifies maximum force and distance needed to break the sample. Requires Fixture Base Table TA-BT-KIT.

TA-KSC **KRAMER SHEAR CELL**

The Kramer Shear Cell follows principles of the Allo-Kramer Shear Press. Test cell (53mm X 57mm X 56mm) has clear Perspex front for viewing test progress. Ten shear cutting blades alternating (65mmL) are loosely suspended from blade holder. Blade holder has quick-release mounting mechanism allowing removal fro cleaning withour distrubing the alighnment. Requires Fixture Base Table TA-BT-KIT.

TA-LC **LIPSTICK CANTILEVER TEST FIXTURE**

This fixture allows imitative tests on lipstick and similar products to quantify the strength of a product. Requires Fixture Base Table TA-BT-KIT.

TA-LTT **LOOP TACK TESTER**

This tester measures the adhesive strength of pressure sensitive tape and stickers according to ASTM D6195. Requires Fixture Base Table TA-BT-KIT.

TA-MA **MUCO ADHESION TEST FIXTURE**

This fixture quantifies tablet adhesiveness to a mucosal surface by simulating body and temp conditions and force needed to pull tablet away from surface.

TA-MDI **METER DOSE INHALER TEST FIXTURE**

This fixture measuresthe push-button force to actuate the inhaler. Requires Fixture Base Table TA-BT-KIT.

TA-MCF **MULTIPLE CHIP FIXTURE**

This fixture is used for testing the penetration or firmness of multiple chips/ french fries. Requires Fixture Base Table TA-BT-KIT.

TA-MP **MESH PROBE**

This fixture quantifies the consistency of products such as mayonnaise and yogurt. Requires Fixture Base Table TA-BT-KIT.

TA-MTP **MAGNUS TAYLOR PROBE KIT**

This probe kit is used for puncture tests to measure the hardness of fresh fruit and vegetables. This kit includes the following probes: Flat End Probe, 3mm TA-MTP-3F; Round End Probe, 3mm TA-MTP-3R; Flat End Probe, 4mm TA-MTP-4F; Round End Probe, 4mm TA-MTP-4R; Flat End Probe, 5mm TA-MTP-5F; Radius End Probe, 5mm TA-MTP-5R; Flat End Probe, 6mm TA-MTP-6F; Radius End Probe, 6mm TA-MTP-6R; Flat End Probe, 7mm TA-MTP-7F; Radius End Probe, 7mm TA-MTP-7R. Requires Fixture Base Table TA-BT-KIT. Requires Fixture Base Table TA-BT-KIT.

TA-NTF **NOODLE TEST FIXTURE**

This fixture is used to evaluate noodle quality. Requires Fixture Base Table TA-BT-KIT.

TA-OC **OTTAWA CELL**

The Ottawa cell follows principles of the Ottawa Test Measurement System (OTMS). Test cell (45mm X 45mm X 55mm) has clear Perspex front for viewing test progress. Corresponding plungers (43mm sq. and 40mm sq.) are used to compress and extrude samples. Complete With 3 Plates (one with pattern of holes 44mm diameter and the other with bars) and 2 Plungers for forward and back extrusion. Requires Fixture Base Table TA-BT-KIT.

TA-PF90 **90˚ PEEL FIXTURE**

This fixture measures the adhesive strength to pull tape of of a rigid surface using force at a 90˚ angle. Requires Fixture Base Table TA-BT-KIT.

TA-PFS **PASTA FIRMNESS AND STICKINESS JIG**

This fixture measures the firmness and stickiness of uncooked pasta. Requires Fixture Base Table TA-BT-KIT.

TA-PFS-C **COOKED PASTA FIRMNESS AND STICKINESS JIG**

This fixture measures the firmness and stickiness of cooked pasta and like products. Requires Fixture Base Table TA-BT-KIT.

TA-PTF **PIZZA TENSILE FIXTURE**

This fixture quantifies cooked pizza firmness by measuring the tensile force and deformation distance to break the sample.

TA-RCA **ROLLER CAM ACCESSORY**

This accessory's grips measure the tensile strength and tear characteristics of material such as polymer films.

TA-RT **RAFT TESTER**

The Raft Tester looks like a L-hook. It is used in the assessment of the Strength of Alginate Rafts, used in the treatment of gastro-oesophagael reflux. The force required to pull the raft tester up through the raft is recorded as the raft strength (peak Load). Requires Fixture Base Table TA-BT-KIT.

TA-SBA **SET OF 4 SHEAR BLADES**

Including Warner Bratzler test jig complete with slotted base. The blade set includes four shear blades, firmly held within a specially designed blade holder. The jig is utilized in the measurement of shearing and cutting forces, as the blades pass through a sample. Requires Fixture Base Table TA-BT-KIT.

TA-SFF **SPAGHETTI FLEXURE FIXTURE**

This fixture is used to quantify flexure characteristics of uncooked spaghetti and other dry pastas.

TA-SFJ **SLIDING FRICTION JIG**

This fixture measures the coefficient of friction for packaging materials according to ASTM D1894. Requires Fixture Base Table TA-BT-KIT.

TA-STF **SPREAD TEST FIXTURE**

This fixture quantifies the force to spread a material on a surface. The Fixture includes one male cone, five female cones and one female cone holder. Requires Fixture Base Table TA-BT-KIT.

TA-STJ **SYRINGE TESTING JIG**

This fixture is used for measuring the force required to push or pull a syringe plunger. Important to pre-filled syringe market or manufacturers of custom syringe products. Fixture designed to hold syringe barrel while pushing or pulling syringe plunger. A clamping mechanism to hold syringe barrel adjusts to accommodate barrel up to 40mm in diameter. Requires Fixture Base Table TA-BT-KIT.

TA-TCA **TABLET COATING ADHESION FIXTURE**

This fixture measures the adhesion force of a tablet coating to a tablet. Requires Fixture Base Table TA-BT-KIT.

TA-TEF **TUBE EXTRUSION FIXTURE**

This fixture measures the force needed to squeeze cream or paste out of a tube. Requires Fixture Base Table TA-BT-KIT.

TA-TPB **THREE POINT BEND TEST FIXTURE**

Three point bend test fixture is used for fracture tests of brittle materials. Sample supports can be adjusted to provide spacing from 10mm-70mm. Sample supports and identical test blade are 80mm in length with a 1.5mm radius rounded edge. Requires Fixture Base Table TA-BT-KIT.

TA-TRF **TORTILLA ROLL FIXTURE**

This fixture is used to evaluate changes in corn tortilla texture per AACC technical paper by measuring the force to roll up a tortilla. Requires Fixture Base Table TA-BT-KIT.

TA-TSF **TAPE STICKINESS FIXTURE**

This fixture measures the adhesive force to pull tape off of a surface. Multiple tape samples can be tested simultaneously for average values. Requires Fixture Base Table TA-BT-KIT.

TA-VBJ **VOLODKEVITCH BITE JAWS**
Compression test used to simulate the shearing action of the front incisors as they bite through a food item, generating an indication of sample toughness or fibrousness. Consisting of both upper and lower jaws, the compressive movement of the travelling beam imitates the human "biting action". Requires Fixture Base Table TA-BT-KIT.

TA-WSP **WIRE SHEAR PLATE**
This fixture is an aluminium plate with aperture to pass wire cutting blade through a sample for shear type testing. Good for products with significant stickiness like cheese or butter. Includes TA53* cutting wire. Requires Fixture Base Table TA-BT-KIT.

TA-WB-PY **WATER JACKET SAMPLE CUP FOR TEMP CONTROL**
Water jacketed cup assembly with RTD temperature probe and CABLE for temperature control on semi solid samples.

QTS-AVJ Adjustable vice Jigs left over from QTS inventory.

Miscellaneous

TA-RT-5	T-Bolt (2)
TA-RT-3	Thumbnut (2)
TA-TBLT	Table Bolt Nut
TA-BT-5	Base Table Insert for TA-BT-KIT
TA51	M6 to M3 Probe Adapter
TA52-4	Packet of 5 Blades for TA52
TA-LVL	Bubble Level

A-3 Calibration Accessories

TA-CW-100C **CALIBRATION WEIGHT SET, 100g WITH CASE & CERTIFICATE**
Set of weights (total mass 100g) to be used to check calibration of the 100g LFRA Texture Analyzer. Includes verification certificate traceable to NIST standards.

TA-CW-1000C **CALIBRATION WEIGHT SET, 1000g WITH CASE & CERTIFICATE**
Set of weights (total mass 1000g) to be used to check calibration of the 1000g LFRA Texture Analyzer. Includes verification certificate traceable to NIST standards.

TA-CW-1500C **CALIBRATION WEIGHT SET, 1500g WITH CASE & CERTIFICATE**
Set of weights (total mass 1500g) to be used to check calibration of the 1500g CT3 Texture Analyzer. Includes verification certificate traceable to NIST standards.

TA-CW-4500C **CALIBRATION WEIGHT SET, 4500g WITH CASE & CERTIFICATE**
Set of weights (total mass 4500g) to be used to check calibration of the 4500g CT3 Texture Analyzer. Includes verification certificate traceable to NIST standards.

TA-CW-10KGC CALIBRATION WEIGHT SET, 10kg WITH CASE & CERTIFICATE
Set of weights (total mass 10kg) to be used to check calibration of the 10kg CT3 Texture Analyzer. Includes verification certificate traceable to NIST standards.

TIA-8013 HANGER MOUNTING RING
Used to hang calibration weights. Included with each weight set. Replacements may be ordered with this number. Included with all weight sets up to 10kg.

TA-CW-2550KGC CALIBRATION WEIGHT SET, 10kg WITH CERTIFICATE
Set of two 5kg plates (total mass 10kg) to be used to check calibration of 25kg and 50kg CT3 Texture Analyzers. Includes verification certificate traceable to NIST standards, mounting ring and hanger (TIA-8021Y).

TA-CW-5000C 5kg CERTIFIED MASS
Additional 5kg plates to be used with TA-CW-2550KGC weight set. Order as many as needed to check calibration up to load cell maximum.

TIA-8021Y MOUNTING RING AND HANGER
Used for stacking TA-CW-5000C calibration weights for checking calibration of 25kg and 50kg CT3 Texture Analyzers. Included in TA-CW-2550KGC.

CCSCT3 Calibration & Certification for CT3

CT3 Train CT3 On-Site Installation and Training
one day on-site time

A-4 Gelatin Accessories

TA-GBB-2 BROOKFIELD GELATIN BLOOM BOTTLE KIT (12 pcs)
One dozen Brookfield gelatin bloom sample bottles w/BEL logo bottle holds 120ml volume and includes TA-SBS stoppers.

GELATIN BATH PREPARATION SYSTEM
Gelatin Preparation Bath System

TC-450MX (qty2) and TC-351 (qty1)
System is used by attaching TC-351 to one TC-450MX bath set to 10˚C. Second TC-450MX bath is set to 60˚C providing rapid transfer between the thermal environments necessary for conditioning gelatin for Bloom testing. Each bath has 29L reservoir and capacity for twelve (12) gelatin jars and a removable rack for easy handling. 21L of water is required for proper fluid level with rack and 12 bloom jars.

CT3-CS-100 BLOOM TEST STRIP
For use with 100g CT3 Texture Analyzer to check load calibration.

CT3-CS-1000 BLOOM TEST STRIP
For use with 1000g & 1500g CT3 Texture Analyzer to check load calibration.

Appendix B - Troubleshooting

If no power to the instrument:

Check:

- User replaceable fuses: two (2) fuses, 4 amp, 5 x 20 mm, time-lag located behind removable red color panel just above switch.
- Fuses located within power entry module on the rear of the instrument.
- If the fuses blow continually, serious damage to the instrument could result. Contact repair services immediately.

Probe won't attach:

- Check the thread on probe and probe shaft - remove any dirt.

Rotary Base table won't move:

- Ensure the locking knob is loose.
- Ensure the fine adjust nut is loose.

Rotary Base table will not travel to the lowest position:

- Loosen the fine adjust nut and rotate base table.
- Locate the table in center of T-slot.

Instrument is unsteady:

- Ensure that the bench top is stable.
- Adjust the CT3 feet.

Probe doesn't move when start is pressed:

- Ensure the emergency stop button is not pressed in (rotate clockwise).
- Ensure the test mode is not in Static Load.
- Ensure the probe is not in contact with sample (or base table).

Display shows "REMOTE OPERATION"

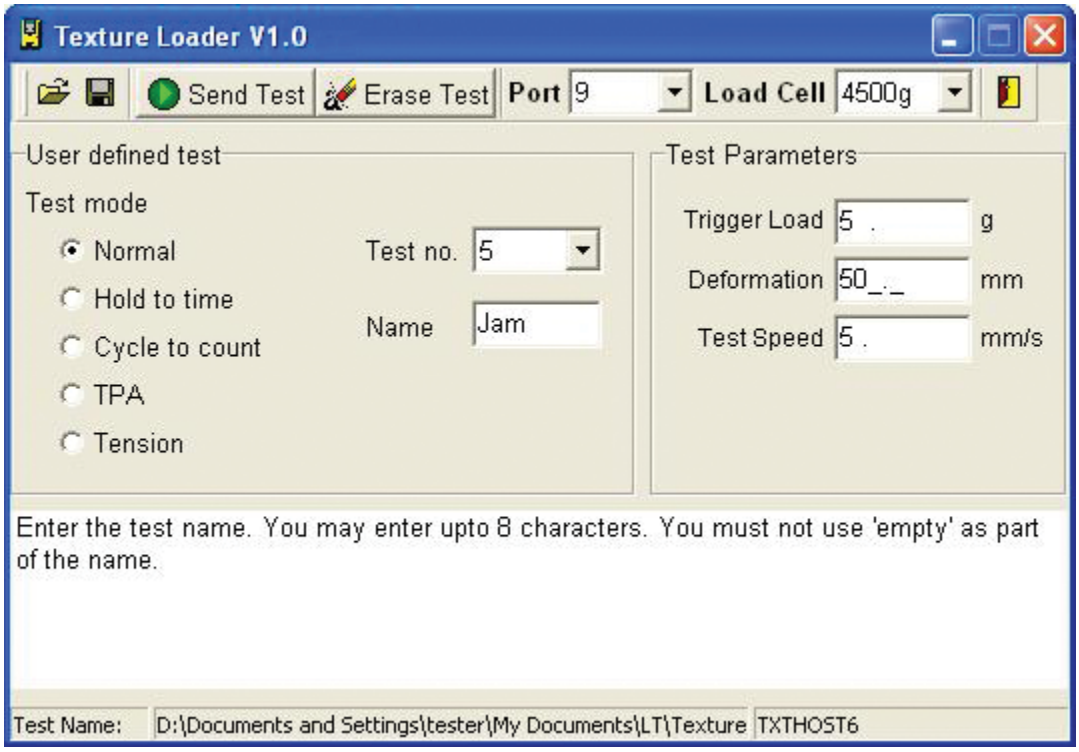
- This will always show when the computer interface cable is connected to the CT3. To use the CT3 without the computer program, the serial cable must be disconnected.

Appendix C - Texture Loader Programming

OVERVIEW

Texture Loader software is provided to allow you to create on a PC and download into the CT3 up to ten test methods specific to your product. You may set up any CT3 test (Normal, Hold Time, Cycle, TPA or Tension) with test parameters specific to your product. Your product name may even appear as the test name, subject to an eight character limit.

There are ten memory slots for such programs available in the CT3, labeled 0-9. All memory slots containing tests will appear in sequence as the SELECT/SCROLL knob is rotated. Memory slots can later be hidden by erasing a test using the Erase Test button when its Test No. is selected.



OPERATION OF TEXTURE LOADER

The supplied communication cable, USB or RS232, must be connected to both the CT3 and any valid port on your computer. Turn on the CT3, select StandAlone mode and rotate the SELECT/SCROLL knob to *DOWNLOAD TEST FROM PC.

Start TextureLoader software. Be sure to select the correct load cell of your CT3 and choose the correct communications port on your computer. You are now ready to create and load custom programs into your CT3 Texture Analyzer.

User defined test window

1) Test mode: Choose the type of test you wish to create.

2) Test Number.: Select from the list the number of the memory slot in the CT3 where you wish to load the test.

3) Name: Enter the name of test as you wish it to appear on the screen of the CT3.

Test Parameters window
Enter the desired test parameters. The specific test parameters available will vary depending upon the test mode chosen.

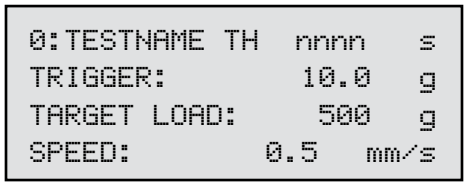
Now that you have created the test, you may:

1) Save test if desired by clicking on diskette icon button.

2) Click Send Test button to download the test to the CT3.

3) If you decide to change a parameter in a test that has been downloaded to the CT3, you can make the change and download the test to the same memory slot in the CT3. This will overwrite the initial program.

Target Hold is added to the user defined downloadable tests. The com spec "xx" field for "TXTNAME<xx><nnnnnnnn><CR>" is changed from values of 00-04 to 00-05. "05" represents the added test type Target Hold. The PGM command field "xxxx" is used for the target load value. The home screen for this test is shown below. Note that the test type is displayed as "TH".

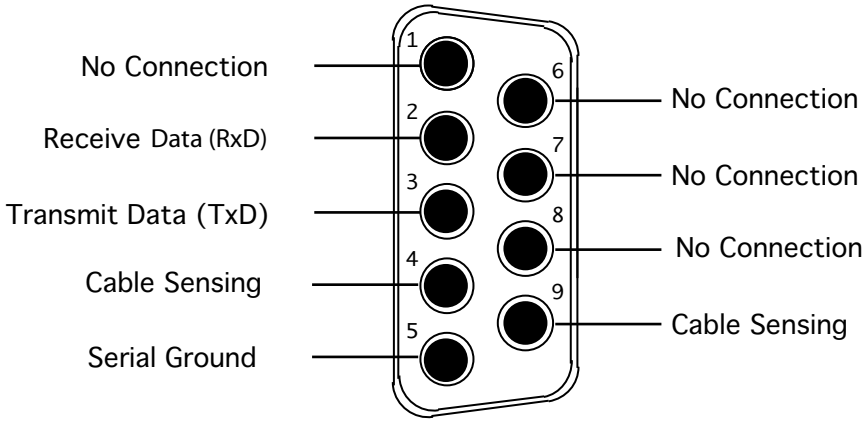


The User Defined target hold test will operate the same as the standard target hold test except that there will be no ability to modify field values manually. It will essentially operate in a similar manner to other User Defined tests.

Appendix D - CT3 Connector Wiring

Serial (RS-232) Communications Parameters

Baud Rate	115200
Data Bits	8
Stop Bits	1
Parity	None
Handshake	None



Pins 4 and 5 are used to sense presence of serial cable.

USB (DVP-202)Type B Port Communications Parameters

PIN 1: POWER	PIN 3: + Data
PIN 2: - Data	PIN 4: Cable Gnd

Appendix E - Online Help and Additional Resources

www.brookfieldengineering.com**
The Brookfield website is a good resource for additional and self-help whenever you need it. Our website offers a selection of "how-to" videos, application notes, conversion tables, instructional manuals, material safety data sheets, calibration templates and other technical resources.

http://www.youtube.com/user/BrookfieldEng
Brookfield has its own YouTube channel. Videos posted to our website can be found here as well as other "home-made" videos made by our own technical sales group.

Viscosityjournal.com
Brookfield is involved with a satellite website that should be your first stop in viscosity research. This site serves as a library of interviews with experts in the viscosity field as well as Brookfield technical articles and conversion charts. Registration is required, so that you can be notified of upcoming interviews and events, however, this information will not be shared with other vendors, institutions, etc..

Article Reprints

- **Available in Print Only**
- Brookfield has an extensive library of published articles relating to viscosity, texture and powder testing. Due to copyright restrictions, these articles cannot be emailed. Please request your hardcopy of articles by calling our customer service department directly or by emailing: marketing@brookfieldengineering.com
- **Available Online**
- Brookfield has a growing number of published articles that can be downloaded directly from the Brookfield website. These articles can be found on our main site by following this path: http://www.brookfieldengineering.com/support/documentation/article reprints

More Solutions to Sticky Problems
Learn more about viscosity and rheology with our most popular publication. This informative booklet will provide you with measurement techniques, advice and much more. It's a must-have for any Brookfield Viscometer or Rheometer operator. More Solutions is avaiable in print and also as a downloadable pdf on the Brookfield website by following this path:
http://www.brookfieldengineering.com/support/documentation

Training/Courses
Whether it is instrument-specific courses, training to help you better prepare for auditing concerns, or just a better understanding of your methods, who better to learn from than the worldwide leaders of viscosity measuring equipment? Visit our Services section on our website to learn more about training.

** Downloads will require you to register your name, company and email address. We respect your privacy and will not share this information outside of Brookfield.

Appendix F - Warranty and Repair Service

Brookfield Texture Analyzers are guaranteed for one year from date of purchase against defects in materials and workmanship. The Texture Analyzer must be returned to **Brookfield Engineering Laboratories, Inc.** or to the Brookfield dealer from whom it was purchased for a warranty evaluation. Transportation is at the purchaser's expense.

For repair or service in the **United States** return to:

Brookfield Engineering Laboratories, Inc.
11 Commerce Boulevard
Middleboro, MA 02346 U.S.A.

Telephone: (508) 946-6200 FAX: (508) 923-5009
www.brookfieldengineering.com

For repair or service outside the United States consult Brookfield Engineering Laboratories, Inc. or the dealer from whom you purchased the instrument.

For repair or service in the **United Kingdom** return to:

Brookfield Viscometers Limited
1 Whitehall Estate
Flex Meadow, Pinnacles West
Harlow, Essex CM19 5TJ, United Kingdom

Telephone: (44) 27/945 1774 FAX: (44) 27/945 1775
www.brookfield.co.uk

For repair or service in **Germany** return to:

Brookfield Engineering Laboratories Vertriebs GmbH
Hauptstrasse 18
D-73547 Lorch, Germany

Telephone: (49) 7172/927100 FAX: (49) 7172/927105
www.brookfield-gmbh.de

For repair or service in **China** return to:

Guangzhou Brookfield Viscometers and Texture Instruments Service Company Ltd.
Room C1, 5/F, Tianxing Building East Tower, No. 21, Zhongshan Yi Road, Yuexiu District
Guangzhou, 510600, P. R. China

Telephone: (86) 20/3760-0548 FAX: (86) 20/3760-0548
www.brookfield.com.cn

On-site service at your facility is also available from Brookfield. Please contact our Service Department in the United States, United Kingdom, Germany or China for details.