

Sonoclot[®]
Coagulation & Platelet
Function
Analyzer
with Graphics Printer

For In Vitro Diagnostic Use

Operator's Manual
For Firmware Version 4.0

Copyright © 1990-2004 Sienco® Inc. All Rights Reserved.

Sienco®, Inc.

7985 N. Vance Drive, Suite 104

Arvada, CO 80003 USA

800/432-1624 • 303/420-1148

303/379-4403 (FAX) • sienco@sienco.com (e-mail)

Sonoclot is a registered trademark of Sienco®, Inc.

The Sonoclot Analyzers are protected under U.S. and foreign patents.

Table of Contents

Chapter 1 - Setup and Operation	1
Introduction	1
About the Sonoclot® Coagulation & Platelet Function Analyzer	1
Test Supplies and Consumables for the Sonoclot Analyzer.....	1
Organization of the Manual.....	2
Technical Support.....	3
Installation and Setup	3
Package Contents.....	3
Initial Setup.....	4
Connecting the Sonoclot Analyzer and Printer.....	4
Connecting the Sonoclot Analyzer and Computer Running Signature Viewer®	5
Sonoclot Analyzer Indicators and Controls	6
Principle of Operation	8
Performance Characteristics and Specifications	9
Running a Hemostasis Test with a Graphics Printer.....	10
Sonoclot Analyzer Preparation Before Running a Hemostasis Test	10
Cuvette and Probe Setup	11
Obtaining the Blood Sample.....	11
Running the Sonoclot Analyzer.....	12
Operational Precautions and Limitations.....	15
Running a Hemostasis Test with Signature Viewer	17
Sonoclot Analyzer Preparation Before Running a Hemostasis Test	17
Cuvette and Probe Setup	18
Obtaining the Blood Sample.....	19
Running the Sonoclot Analyzer.....	19
Operational Precautions and Limitations.....	22
Using Citrated Blood Samples.....	24
Initial Sonoclot Analyzer Preparation Before Running a Citrated Blood Test	25
Obtaining a blood sample.....	25
Sample Incubation	25
Cuvette and Probe Setup	25
Recalcifying.....	25
Running the Sonoclot Analyzer.....	26
Operational Precautions and Limitations:.....	26
Chapter 2 - Clinical Application	1
Overview	1
Review of Hemostasis Fundamentals.....	1
Coagulation	1
Fibrin Gel Formation.....	3
Clot Retraction, i.e. Platelet Function.....	3
Hyperfibrinolysis.....	7
How to Select the Right Test for Your Application.....	8
Normal Ranges for Sienco's Disposable Tests	9

Heparin Anticoagulant Management in Cardiopulmonary Bypass Surgery	10
Hemostasis Monitoring in Surgery	11
Cardiovascular Surgery Example #1 - Typical Case.....	11
Cardiovascular Surgery Example #2 - Platelet Dysfunction	13
Cardiovascular Surgery Example #3 - Identification of a Mechanical Bleeder.....	14
Cardiovascular Surgery Example #4 - Hyperfibrinolysis	15
Liver Transplant Example #1	16
 Chapter 3 - Sonoclot Signature Library.....	1
Overview of Library Signatures.....	1
Sonoclot Signature Visual Index.....	2
Signatures from Normals Section	2
Signatures from Poor Platelet Function Section.....	3
Signature of Blood Sample Drying and Forming a Crust.....	3
Normals	4
Poor Platelet Function Examples	6
Sample Forming a Crust	8
 Chapter 4 - Quality Control Procedures	1
Introduction	1
Running a 900-1302 Reference Viscosity Oil QC Kit.....	2
Frequency of Testing	2
Initial Preparation Before Running a Reference Viscosity QC Test.....	2
Running a Reference Viscosity Oil QC Test	2
Documenting the Reference Viscosity Oil QC Test Results.....	6
Operational Precautions and Limitations	7
Running a 900-1318 Reference Plasma QC Kit	8
Intended Use	8
Summary and Principles	8
Reagents.....	8
Storage and Stability	9
Additional Equipment:.....	9
Sonoclot Analyzer Preparation Before Running a Reference Plasma QC Test	9
Cuvette and Probe Setup	10
Plasma Preparation	11
Running the Sonoclot Analyzer.....	11
Expected Values.....	13
Limitations of the Procedure.....	13
Performance.....	13
Documenting the Reference Plasma QC Test Results.....	14
Operational Precautions and Limitations.....	15
 Chapter 5 - Configuring the Sonoclot Analyzer.....	1
Overview	1
Dip Switch Settings	2
Changing the Auto Stop Time	3
Changing the Clot Signal Scale.....	3

Configuring the Sonoclot Analyzer to Send Data to a Computer.....	5
Changing the Line Voltage Setting	6
Chapter 6 - Maintenance and Troubleshooting.....	1
Printer Maintenance.....	1
Loading Thermal Paper	1
Printer Troubleshooting.....	1
Sonoclot Analyzer Maintenance and Service	2
Precautions to Improve Analyzer Reliability	2
Cleaning.....	2
Calibration.....	3
Troubleshooting.....	3
Sonoclot Analyzer Warning and Error Messages	3
Changing the Lamp.....	5
Factory Service or Repair.....	6
Appendix	1
Warnings, Cautions, and Hazards	1
References.....	2
Warranty.....	6
Decontamination Form.....	7

Chapter 1 - Setup and Operation

Introduction

About the Sonoclot® Coagulation & Platelet Function Analyzer

The Sonoclot® Coagulation & Platelet Function Sonoclot Analyzer (the “Sonoclot Analyzer”) is a versatile instrument for measuring coagulation and platelet function. Each test analysis provides accurate information on the entire hemostasis process including coagulation, fibrin gel formation, clot retraction (platelet function) and fibrinolysis. The Sonoclot Analyzer generates both a qualitative graph (known as the Sonoclot Signature) and quantitative results on the clot formation time (ACT), and the rate of fibrin polymerization (Clot RATE) for identifying numerous coagulopathies including platelet dysfunction, factor deficiencies, anticoagulant effect, hypercoagulable tendencies and hyperfibrinolysis.

The Sonoclot Analyzer is a reliable and simple to use instrument that can be used in operating rooms, coagulation labs, STAT labs, and intensive care units. The Sonoclot Analyzer can provide numerous benefits including:

- Improved hemostasis management in surgery
- Reduced usage of donor blood products
- Fast identification of mechanical versus hemostatic bleeders
- Accurate and inexpensive heparin anticoagulation management
- Quick and easy screening for hypercoagulable patients
- Improved performance for hyperfibrinolysis monitoring or for monitoring very weak clots due to low platelet function

Healthcare professionals are pursuing a balance between quality of care and cost containment. Sienco is dedicated to helping you meet this challenge through cost-effective products of superior quality and reliability. In the prevailing hospital economic climate, the ability to provide cost savings while improving patient care is a powerful incentive for Sienco’s Sonoclot Analyzer and related tests.

Test Supplies and Consumables for the Sonoclot Analyzer

The Sonoclot Analyzer can run a variety of coagulation tests. Different tests incorporate different reagents for testing specific aspects of hemostasis. Sienco, Inc.. (“Sienco”) manufactures packaged test kits and basic supplies for general use with the Sonoclot Analyzer. These products are:

SonACT™ Kit (Part Number (P/N 800-0432 (100's), 800-0431 (24's))

A general purpose celite activated test for coagulation, platelet function, hypercoagulable, and hyperfibrinolysis screening.

SonACT™ Kit with Fenestrated Probes (P/N 800-0434 (50s), 800-0435 (20s))

Contains the celite activated SonACT test with a probe variation for improved hyperfibrinolysis monitoring and low platelet adhesion applications.

gbACT+ Kit (P/N 800-0412 (100's), 800-0411 (24's))

A glass bead activated ACT test, recommended for general coagulation and platelet function monitoring. The platelet function information is typically faster compared to the SonACT test. This test is not for high dose heparin management.

gbACT+ Kit with Fenestrated Probes (P/N 800-0414 (50's), 800-0415 (20's))

Contains the glass bead activated gbACT+ test with a probe variation for improved hyperfibrinolysis monitoring and low platelet adhesion applications.

kACT Kit (P/N 800-0400 (100's), 800-0401 (24's))

A kaolin activated ACT intended for high dose heparin management typically encountered during cardiopulmonary bypass surgery. The kACT result is substantially less affected by aprotinin than celite activated ACTs.

aiACT Kit (P/N 800-0442 (100's), 800-0441 (24's))

The patented aprotinin insensitive aiACT test is intended for high dose heparin anticoagulation management, especially in the presence of aprotinin, during cardiopulmonary bypass surgery. The aiACT activator has been tested and shown to be less affected by aprotinin than kaolin or celite activators. The aiACT test is not intended for platelet function assessment.

Non-Activated Kit (P/N 800-0425 (100's), 800-0426 (24's))

The Non-Activated kit contains everything to run a non-activated Sonoclot Analysis. This kit is also appropriate for running custom hemostasis tests with user-added activators or inhibitors.

Non-Activated Kit with Fenestrated Probes (P/N 800-0428 (50's), 800-0429 (20's))

Contains the Non-Activated test with a probe variation for improved hyperfibrinolysis monitoring and low platelet adhesion applications.

Probe Extractor (P/N 800-0601)

Plastic hand-held tool for removing used probes.

Lamp Bulb (P/N 290-0010)

Replacement bulb for platen surface.

For the most current list of products, please visit our website at www.sienco.com.

Please refer to Chapter 2 for information on selecting the best test for your application.

Please refer to page 4-1 for a list of quality control products available for the Sonoclot Analyzer.

Additional tests are under development. Contact Sienco for a current list of available tests.

Organization of the Manual

The manual includes six major sections. **Chapter 1** covers setup, principle of operations and normal use. **Chapter 2** discusses clinical uses beginning with an explanation of the Sonoclot Signature related to hemostasis, interpretation of a Sonoclot Signature, and guidelines for use of the instrument system in several clinical areas. This section is very important in order

to properly choose an appropriate Sonoclot test, determine preferred instrument setup, and correctly interpret the test results. **Chapter 3** contains a library of Sonoclot Signatures that illustrate normal and abnormal hemostasis as captured with a Sonoclot Signature. **Chapter 4** contains quality control procedures for the Sonoclot Analyzer. **Chapter 5** describes how to configure the Sonoclot Analyzer for specific applications. This section is not essential for normal users, but does address numerous convenience features of the Sonoclot Analyzer. **Chapter 6** covers maintenance and troubleshooting. The **Appendix** covers hazards, additional technical information, references, and warranty information.

Technical Support

If you have read this manual and have further questions or your instrument requires service, our address and phone numbers are:

Sienco, Inc.
7985 Vance Drive, Suite 104
Arvada, CO 80003 USA
1-800-432-1624
303/420-1148
303/379-4403 (FAX)
sienco@sienco.com (e-mail)

Our technical support staff can assist with both proper operation of the Sonoclot Analyzer and with clinical interpretation of specific Sonoclot Signatures. If you wish to discuss interpretation of a Sonoclot Signature, please include relevant patient history data so we can be as effective in assisting you as possible.

Installation and Setup

Package Contents

Depending on the Sonoclot Analyzer configuration you have purchased, the package you received from Sienco should contain one each of the following items:

<u>Part</u>	<u>Part Numbers</u>
Sonoclot Analyzer	Model DP-2951
Printer and Power Module or Signature Viewer Software CD	800-1108 800-2000
Power Cord (not supplied outside of North America)	260-0125
25 Pin Serial Cable or Serial Cable for either Mac or PC computer	260-0115 800-2110 (Mac)/800-2111(PC)
Operator's Manual	020-1001

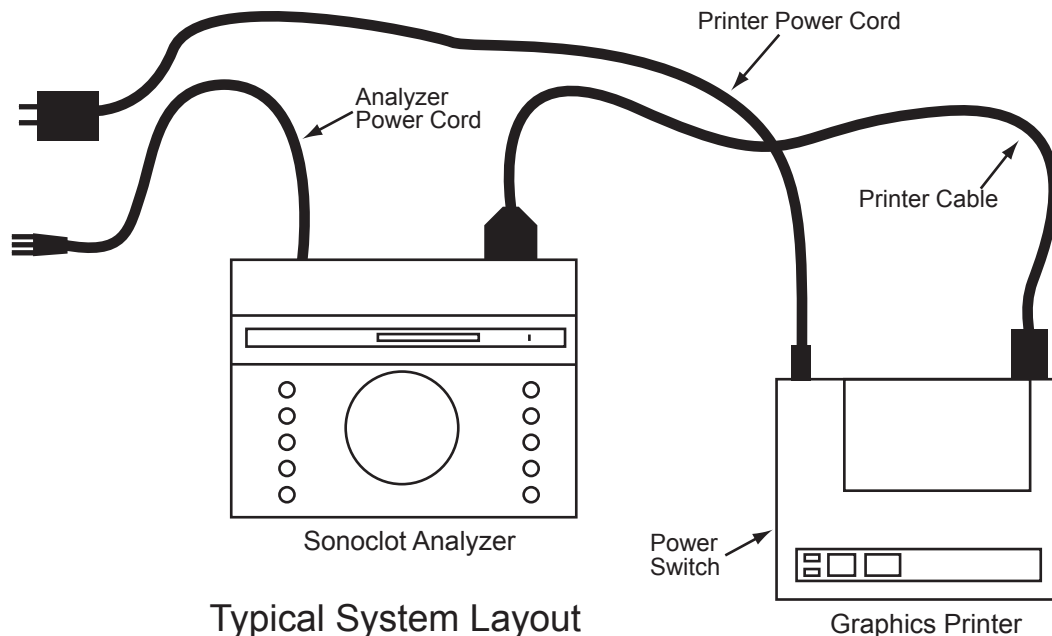
Initial Setup

Unpack the instruments from the shipping container. Set the Sonoclot Analyzer and Printer/ personal computer side by side on a sturdy table or cart. Gently remove the tape from the head of the Sonoclot Analyzer. Twenty inches of surface space is required for side-by-side placement of the Sonoclot Analyzer and the Printer; at least twenty-six inches of surface space is required for side-by-side placement of the Sonoclot Analyzer and computer, depending on the computer and/or monitor size.

Connecting the Sonoclot Analyzer and Printer

Plug the power cords into the back of the Sonoclot Analyzer and Printer and then into a grounded wall outlet. **We recommend you do not use an ungrounded extension cord or plug adapter with this instrument.** Check voltage setting to assure voltage is concurrent with your power mains. The voltage setting is on the fuse block located on the back of the Sonoclot Analyzer. Connect the Sonoclot Analyzer to the Printer by plugging the 25 pin connector on the Printer cable into the 25 pin connector located on the back of the Sonoclot Analyzer. Connect the 9 pin connector to the Graphics Printer.

Top View - Sonoclot Analyzer and Graphics Printer



Typical System Layout

The Printer power switch is located on the left side of the instrument. A green light on the front of the Printer indicates the power is ON. The green/orange lights on the top indicate the Printer is ON-LINE/OFF-LINE respectively. The Printer paper is pre-loaded and ready for use. See Chapter 6 for instructions on re-loading Printer paper.

The Sonoclot Analyzer power switch is found on the back of the instrument just above the power cord plug. When turned on, the Sonoclot Analyzer will beep and display a start-up message on the front Liquid Crystal Display ("LCD"). The Printer will also print a start-up message.

The Sonoclot Analyzer indicates that the power is on when the front panel "LCD" is illuminated. The Sonoclot Analyzer is at proper operating temperature (normally 37.0°C) when the temperature reading on the front panel "LCD" reads "37.0".

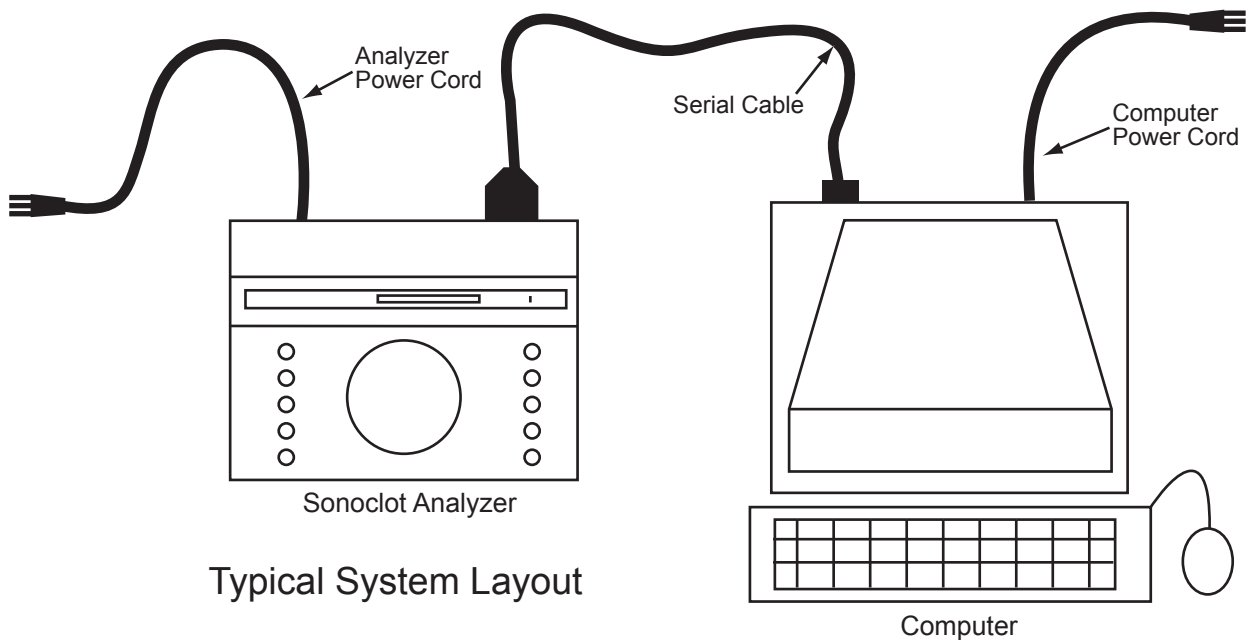
Connecting the Sonoclot Analyzer and Computer Running Signature Viewer®

Plug the power cords into the back of the Sonoclot Analyzer and then into a grounded wall outlet. **We recommend you do not use an ungrounded extension cord or plug adapter with this instrument.** Check voltage setting to assure voltage is concurrent with your power mains. The voltage setting is on the fuse block located on the back of the Sonoclot Analyzer. Plug in the computer and turn on according to the computer's set up instructions.

You will need a RS-232 cable to connect the Sonoclot Analyzer to a serial port on your computer. There are many different types of RS-232 cables. One end of the cable must have a 25-pin male connector for the Sonoclot Analyzer. The other end must be the type required by your computer. If you purchased a Sonoclot Analyzer with Signature Viewer package (P/N 900-2068), the appropriate serial cable (Mac or PC, specified with order) is included with the Sonoclot Analyzer.

Connect the Sonoclot Analyzer to the computer by plugging the serial cable into the 25-pin male connector located on the back of the Sonoclot Analyzer. Connect the other end of the RS-232 serial cable into the serial connector on your computer.

Top View - Sonoclot Analyzer and Computer Running Signature Viewer™

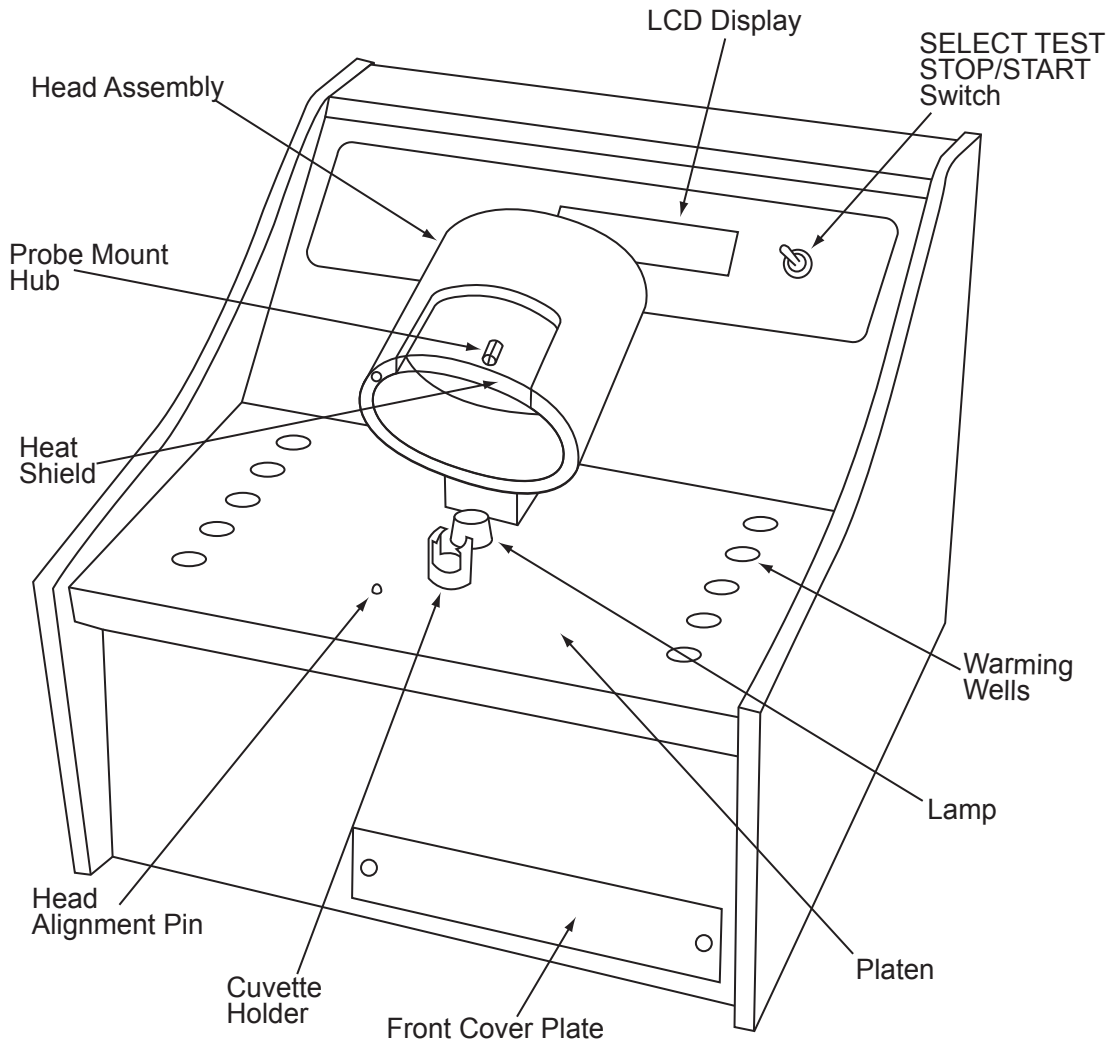


The Sonoclot Analyzer power switch is found on the back of the instrument just above the power cord plug. When turned on, the Sonoclot Analyzer will beep and display a start-up message on the front Liquid Crystal Display ("LCD"). Please see the Operator's Manual for Signature Viewer located on the Signature Viewer installation CD for further instructions on configuring the Signature Viewer software and the Sonoclot Analyzer.

The Sonoclot Analyzer indicates that the power is on when the front panel "LCD" is illuminated. The Sonoclot Analyzer is at proper operating temperature (normally 37.0°C) when the temperature reading on the front panel "LCD" message reads "37.0°"

Sonoclot Analyzer Indicators and Controls

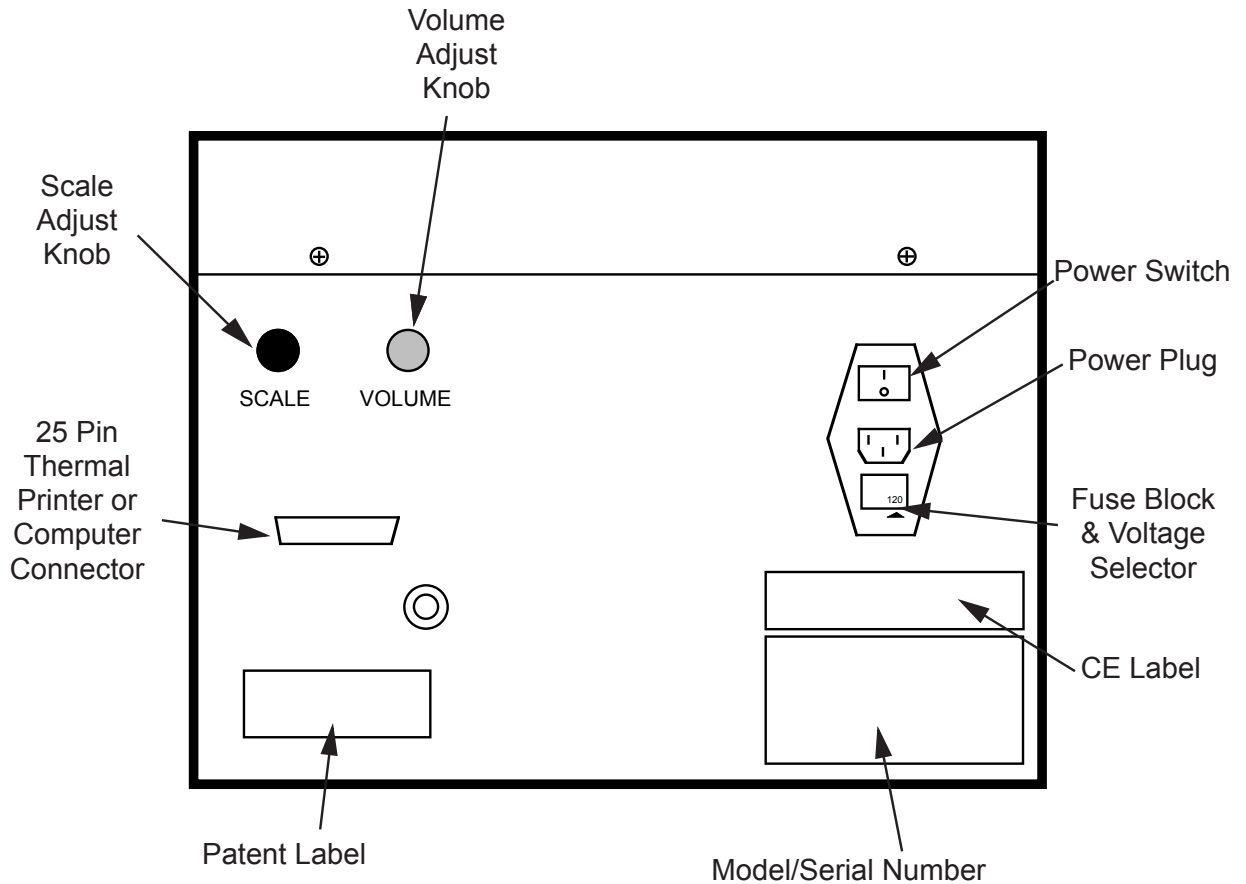
Before continuing, please take a few minutes to examine the front and rear view diagrams of the Sonoclot Analyzer.



Controls	SELECT TEST STOP/START switch	This momentary switch selects the type of test being run as well as starting and stopping a test.
Indicators	"LCD" Display	Liquid Crystal Display ("LCD") reports results, data, and user prompts

Several user selectable features are controlled with dip switches located under the front cover platen. For information regarding these features, see Chapter 5- Configuring the Sonoclot Analyzer.

Rear View



Controls

Volume Control Knob

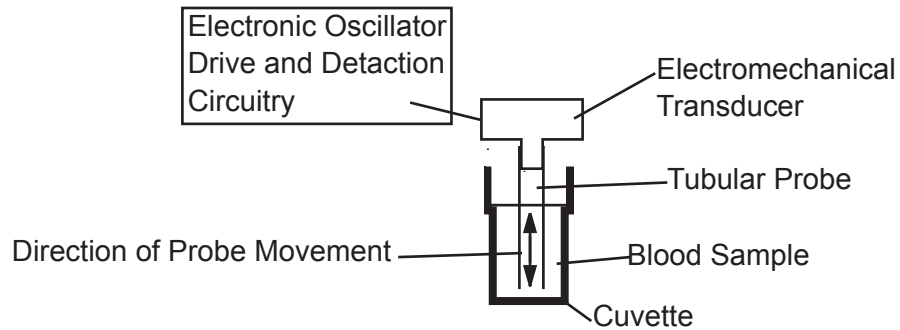
Controls tone volume

Scale Select Knob

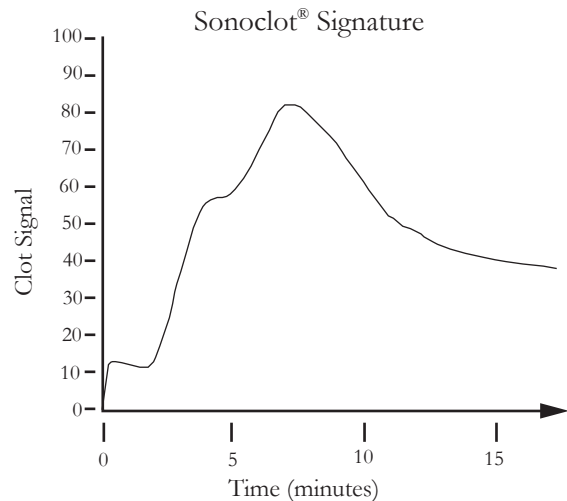
Selects range for Sonoclot Signal on graphic printout

Principle of Operation

The detection mechanism within the Sonoclot Analyzer responds to mechanical changes that occur within the blood sample. This mechanism consists of a tubular probe that oscillates up and down within a blood sample. The electronic drive and detection circuitry senses the resistance to motion that the probe encounters as the blood sample progresses through various stages of hemostasis. The resulting analog electronic signal is processed by a microcomputer within the Sonoclot Analyzer and is reported as the Clot Signal.



As the blood sample clots, numerous mechanical changes related to the performance of the patient's hemostasis system occur that alter the Clot Signal value. The record of the clot evolution is saved as a graph of the Clot Signal Value versus time and is printed on a thermal graphics printer or displayed in the Signature Viewer Data Collection Software. This graph is called the Sonoclot Signature. A typical Sonoclot Signature is shown to the right.



Performance Characteristics and Specifications

Sonoclot Analyzer Model DP-2951

Width	8.5"	21.5 cm
Depth	9.6"	24.5 cm
Height	7.5"	19 cm
Weight	12 lbs	5 kg
Electrical voltage requirement	100 to 120V~ or 230V~ 10%	
Electrical power requirement	55 watts	
Frequency	50/60 Hz	
Fuse specification	(2) 1A, 250V	
Temperature regulation of platen	37°C ± 0.5 C	
Viscosity range for test sample	<300 cP	

Printer P/N 800-1108

Width	6.75"	17 cm
Depth	6.75"	17 cm
Height	3.75"	9.5 cm
Weight	3 lbs	1.4 kg
AC Adaptors	PW-4007-J1 (100V ± 10% @ 50-60 Hz) PW-4007-U1 (120V ± 10% @ 60 Hz) PW-4007-E1 (230V ± 10% @ 50 Hz) 6.5V DC @ 2000 mA	
Printing Method	thermal serial dot	
Character	9 dots high x 8 dots wide	
Characters per line	80	
Dots per line	640	
Printing width	89.6 mm	

Signature Viewer Data Collection Software P/N 800-2000

See the Signature Viewer Operator's Manual for current hardware and software requirements and specifications.

Operating Conditions

Ambient temperature	15-30°C
Relative humidity	30%-80% RH
Other restrictions	avoid direct sunlight avoid air drafts

Sienco recommends that the Sonoclot Analyzer and the Printer be left on 24 hours a day so the instruments will always be warm and ready for use.

Sonoclot Analyzer with Graphics Printer:

The following section provides instructions for running hemostasis tests with the Sonoclot Analyzer and a graphics printer. Instructions differ slightly when the Sonoclot Analyzer is run with Signature Viewer. Please see page 1-17 for instructions for running a hemostasis test with the Sonoclot Analyzer and Signature Viewer.

Running a Hemostasis Test

The Sonoclot Analyzer monitors the mechanical changes that occur during hemostasis. This section presents the specific steps to prepare and run a hemostasis test with the Sonoclot Analyzer. Interpretation of test results is discussed in Chapter 2.

The time required to complete an analysis depends on the hemostasis information desired and the specific test used. Coagulation cascade test results require a few minutes; information on platelet function requires 10 to 30 minutes; information on fibrinolysis requires longer analysis—the time that it takes for lysis to occur.

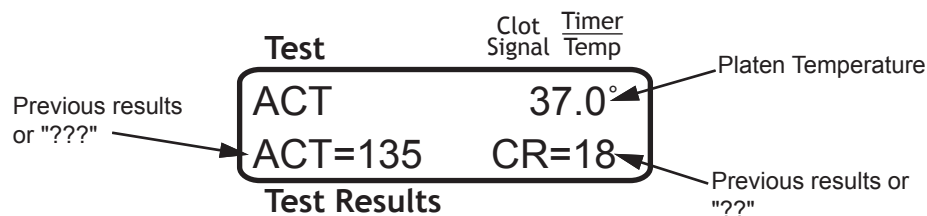
Sonoclot Analyzer Preparation Before Running a Hemostasis Test

Cuvettes should be placed in the warming holes in advance so that they will be warm and ready to go when the blood is drawn. Probes fit into the lids of the cuvettes so that they may be conveniently stored for use.

If the Sonoclot Analyzer has just been turned on, allow it to warm up with head assembly in the down position until the Sonoclot Analyzer reaches the desired controlled temperature.

Check that the Printer is ON and ON-LINE.

Prior to running a sample the Sonoclot Analyzer display should display the following:

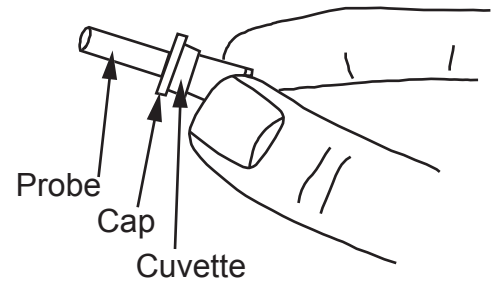


The Time Scale and Clot Signal Scale settings affect scaling of the Sonoclot Signature. These settings normally will be preset to the operator's desired values. The default settings are appropriate for whole blood coagulation tests. See Chapter 5- Configuring the Sonoclot Analyzer if you wish to modify these settings.

Cuvette and Probe Setup

Open head assembly by tilting it backwards.

Insert a clean disposable tubular probe over the probe mount hub inside the head assembly. The probe must be fully seated on the probe mount hub for proper operation. If the probe has been placed into the recess of the cuvette cap, then the cuvette can be used to mount the probe to the probe mount hub. Use the cuvette as a convenient probe mounting tool, as pictured, by holding the cuvette to position the probe over the probe mount hub.



Gently push the cuvette to push the probe fully over the probe mount hub. When the probe is fully seated on the probe mount hub, remove the cuvette; the probe remains on the hub.

If you are using an activated test cuvette, the activated cuvette contains a stir bar and activation powder. **Sharply tap** the cuvette on a hard surface to dislodge any activation powder from the sides and lid of the cuvette.

Remove the lid from the cuvette before placing the cuvette in the cuvette holder. To remove the cuvette lid, place the cuvette in a warming hole and pop the lid off with your thumb. **Do not remove the cuvette lid while the cuvette is in the cuvette holder;** the cuvette holder may break.

With a slight twisting motion, insert the cuvette into the cuvette holder. Ensure that the cuvette is fully seated in the cuvette holder.

NOTE: Different tests have slightly different set-up requirements. Please refer to the product insert for specific set-up instructions for each type of test.

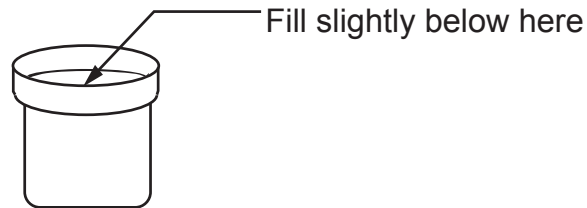
Obtaining the Blood Sample

Native whole blood must be analyzed by the Sonoclot Analyzer within 2 minutes or less of collection. When drawing the blood sample please observe the following precautions:

- 1: Sample withdrawal must be smooth, slow, and atraumatic. While this holds true for any type of blood study, the sensitivity of platelets to disturbance makes good sampling techniques especially important when the Signature will be used to evaluate platelet function. Under no conditions should a sample be drawn with force.
- 2: Care should also be exercised in deciding where the sample will be drawn. For example, heparin contamination from a heparinized line, or a heparin impregnated catheter will modify the Signature producing inaccurate results inconsistent with the patient's actual hemostatic condition. Heparin contamination may also occur from surgery prep saline lines. Sometimes identification of the source of heparin contamination can involve some careful troubleshooting.
- 3: Sienco recommends a two-syringe technique in drawing the blood sample from the patient, drawn from a port on the pump or from the anesthesia port. The first syringe of 2 to 3 ml is discarded and the second syringe is used for the sample. Plastic syringes are mandatory to avoid uncontrolled glass activation.

Running the Sonoclot Analyzer

Fill the warmed cuvette with the blood sample so that the fluid level is slightly below the inner rim of the cuvette as shown below. This volume is approximately 360 μl . Transfer the whole blood sample from the syringe into the cuvette. You may transfer the sample either without a needle or with a blunt needle. Sienco recommends using a blunt cannula tip (P/N 800-0610) for a clean and controlled fill.



Depress the SELECT TEST/(START/STOP) Switch immediately. The magnetic stirrer will automatically rotate and the Printer will begin to print.

The display will now read:

Test	Clot Signal	Timer Temp
ACT Mixing		
Test Results		

and the Printer will start printing.

After 10 seconds, the Sonoclot Analyzer will beep and the display will read:

Test	Clot Signal	Timer Temp
ACT Close Head		
Test Results		

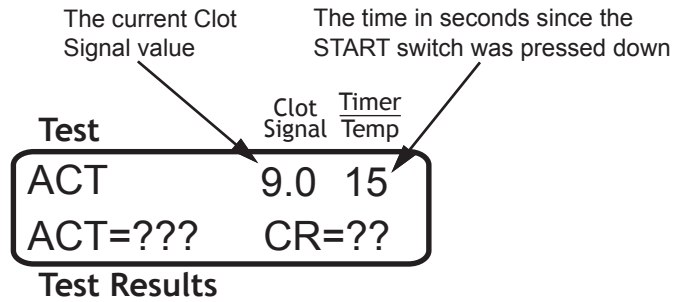
Close the head assembly.

At this time, if you wish to run an analysis for more than twenty to thirty minutes, carefully place a drop of SonOil™ on top of the sample. This will prevent the clot from drying out and forming a crust across the top of the sample.

After another 5 seconds, display will read:

Test	Clot Signal	Timer Temp
ACT	9.0	15
ACT=???	CR=??	

Test Results

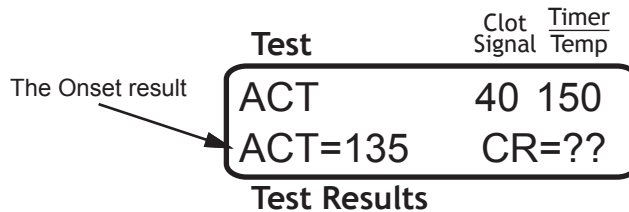


The question marks are displayed because no results have been found at this time.

The sample is initially a liquid. After several minutes, the sample begins to evolve into a clot. The instrument detects this initial clot formation, beeps and displays the time that the sample remained a liquid above the ACT legend on the front panel.

Test	Clot Signal	Timer Temp
ACT	40	150
ACT=135	CR=??	

Test Results



During the next several minutes of the analysis, the fibrinogen converts into a fibrin gel. The rate of the fibrin formation is clinically significant for some Sonoclot tests. The Sonoclot Analyzer determines this rate of formation by calculating the rate of change in the Clot Signal Value. When the Clot RATE result is available, the Analyzer beeps and reports the result on the LCD display and Graphics Printer.

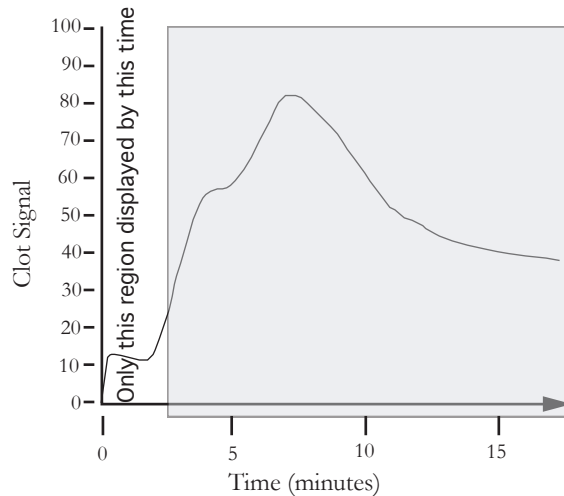
After the Clot RATE has been determined, the Analyzer beeps and the display appears as:

Test	Clot Signal	Timer Temp
ACT	56	226
ACT=135	CR=18	

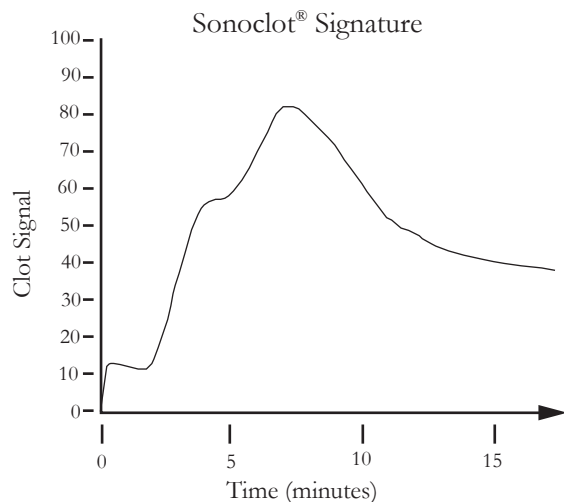
Test Results

The Clot RATE result

At this time in the analysis the Sonoclot Signature on the printer will have displayed only the beginning of the clot formation.



Continue to allow the instrument to run in order to obtain information on platelet function and fibrinolysis. If you are interested in monitoring clot retraction (platelet function), you should allow the analysis to continue for 20 to 30 minutes or until clot retraction completes. The example Signature to the right has substantially completed clot retraction after about 15 minutes.



When your analysis is complete, momentarily depress the SELECT TEST/ (START/STOP) switch to stop the test. The display contains results from the test as shown below.

Test	Clot Signal	Timer Temp
ACT	37.0°	
ACT=135	CR=18	

Test Results

Previous Onset results

Previous Clot RATE results

Open the head assembly. Remove the tubular probe (using the probe extractor) and the cuvette and properly discard them. Lower the head assembly to maintain temperature control of the head assembly.

When the Printer has stopped advancing, you may tear off the paper to analyze the Sonoclot Signature.

If you forget to press the START/STOP switch to discontinue printing, the test will automatically stop after 60 minutes (default value). The automatic shut-off feature can be customized to your specific requirements; see Chapter 5- Configuring the Sonoclot Analyzer.

Operational Precautions and Limitations

The quality of the Sonoclot Analyzer test results depend heavily on proper technique. Carefully observe or apply the following precautions.

- 1: Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.
- 2: As with any laboratory test result, diagnosis should not be based solely on the Sonoclot test result but should also consider the patient's condition and other test results.
- 3: Avoid heparin contamination from catheters.
- 4: Avoid blood sample contamination with tissue thromboplastin. Never use the first sample from a new line.
- 5: If the platen is not at the desired temperature setpoint (normally 37°C) then the Sonoclot Analyzer will display an error message and not run the test.
- 6: For consistent results the cuvettes must be pre-warmed prior to running the test. Place cuvettes in the warming wells for at least 5 minutes to pre-warm them. Do not store the cuvettes in the warming wells for extended periods of time (i.e. overnight) in order to avoid sample degradation due to prolonged exposure to heat.
- 7: If using an activation cuvette, tap it sharply on a hard surface to deposit the contact activator on the bottom of the cuvette.
- 8: The disposable probe must be fully seated against the shoulder of the probe mount hub to avoid interference between the probe and the stir-bar.
- 9: The disposable cuvette must be fully seated in the cuvette holder to avoid interference between the probe and stir-bar.
- 10: Native whole blood must be analyzed within 2 minutes or less of collection.
- 11: For best results, do not overfill the cuvette. The proper fill level is slightly below the inner rim of the cuvette.
- 12: Never reuse either a probe or a cuvette. Thrombin contamination may result.

- 13: Avoid contaminating the electromechanical transducer in the head assembly by keeping blood, dirt, or other contaminants away from the probe mount hub.
- 14: Periodically use QC testing to verify proper operation of the Sonoclot Analyzer and activation cuvettes.
- 15: Use proper handling techniques to dispose of probes and cuvettes.
- 16: The mechanical oscillator may be affected by mechanical disturbances. These disturbances may rarely result in incorrect results. Always inspect the Sonoclot Signature to ensure that the results are consistent.
- 17: For extremely high viscosity blood samples, > 8.0 cp, stratification may occur during mixing. For these types of blood samples, external mixing prior to analysis should be performed.

Sonoclot Analyzer with Signature Viewer:

The following section provides instructions for running hemostasis tests with the Sonoclot Analyzer and Signature Viewer Data Collection software. Instructions differ slightly when the Sonoclot Analyzer is run with a graphics printer. Please see page 1-10 for instructions for running a hemostasis test with the Sonoclot Analyzer and a graphics printer.

For instructions and troubleshooting specific to Signature Viewer, please refer to the Signature Viewer Operator's Manual included on the Signature Viewer installation CD.

Running a Hemostasis Test

The Sonoclot Analyzer monitors the mechanical changes that occur during hemostasis. This section presents the specific steps to prepare and run a hemostasis test with the Sonoclot Analyzer. Interpretation of test results is discussed in Chapter 2.

The time required to complete an analysis depends on the hemostasis information desired and the specific test used. Coagulation cascade test results require a few minutes: information on platelet function requires 10 to 30 minutes; information on fibrinolysis requires longer analysis—the time that it takes for lysis to occur.

In the following example, the gbACT+ test is used. For more information on specific tests, please refer to the test's product insert and the Signature Viewer Operator's Manual.

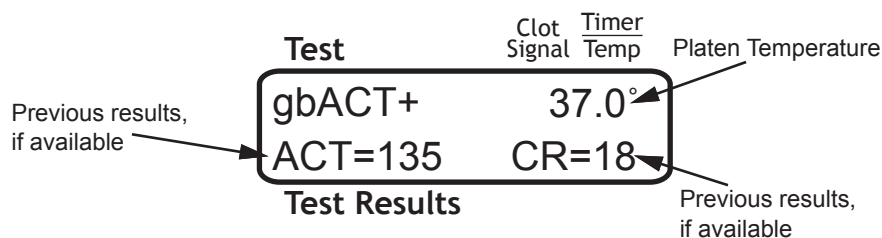
Sonoclot Analyzer Preparation Before Running a Hemostasis Test

Cuvettes should be placed in the warming holes in advance so that they will be warm and ready to go when the blood is drawn. Probes fit into the lids of the cuvettes so that they may be conveniently stored for use.

If the Sonoclot Analyzer has just been turned on, allow it to warm up with head assembly in the down position until the Sonoclot Analyzer reaches the desired controlled temperature.

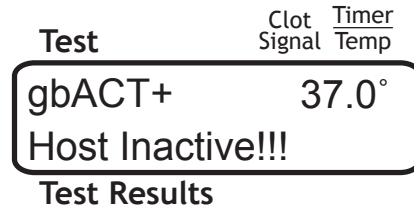
Check that your computer is turned on and that you are running the Signature Viewer Data Collection program.

Prior to running a sample the Sonoclot Analyzer display should display the following:



If results from a previous test are available, they will be shown in the LCD display. If no results are available, the bottom half of the LCD display will be blank.

If the computer is not on or Signature Viewer is not running, the display will read:



You will not be able to run a test until the computer and Signature Viewer are running and are correctly connected to the Sonoclot Analyzer. For more information on installing Signature Viewer and setting up the Sonoclot Analyzer and computer, please refer to the Signature Viewer Operator's Manual included on the Signature Viewer installation CD.

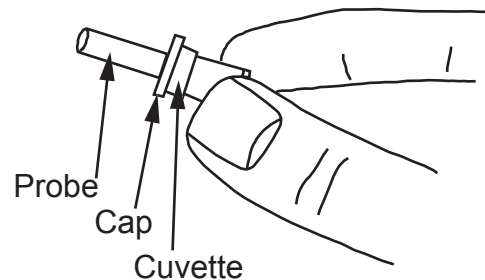
The Clot Signal Scale setting affects scaling of the Sonoclot Signature. This setting is normally preset to the operator's desired value. The default setting is appropriate for whole blood coagulation tests. See Chapter 5- Configuring the Sonoclot Analyzer if you wish to modify this setting.

Select the hemostasis test to be run by continually pressing the SELECT TEST / (START/ STOP) towards SELECT TEST until the desired test appears on the LDC display.

Cuvette and Probe Setup

Open head assembly by tilting it backwards.

Insert a clean disposable tubular probe over the probe mount hub inside the head assembly. The probe must be fully seated on the probe mount hub for proper operation. If the probe has been placed into the recess of the cuvette cap, then the cuvette can be used to mount the probe to the probe mount hub. Use the cuvette as a convenient probe mounting tool,



as pictured, by holding the cuvette to position the probe over the probe mount hub. Gently push the cuvette to push the probe fully over the probe mount hub. When the probe is fully seated on the probe mount hub, remove the cuvette; the probe remains on the hub.

If you are using an activated test cuvette, the activated cuvette contains a stir bar and activation powder. **Sharply tap** the cuvette on a hard surface to dislodge any activation powder from the sides and lid of the cuvette.

Remove the lid from the cuvette before placing the cuvette in the cuvette holder. To remove the cuvette lid, place the cuvette in a warming hole and pop the lid off with your thumb. **Do not remove the cuvette lid while the cuvette is in the cuvette holder;** the cuvette holder may break.

With a slight twisting motion, insert the cuvette into the cuvette holder. Ensure that the cuvette is fully seated in the cuvette holder.

NOTE: Different tests have slightly different set-up requirements. Please refer to the product insert for specific set-up instructions for each type of test.

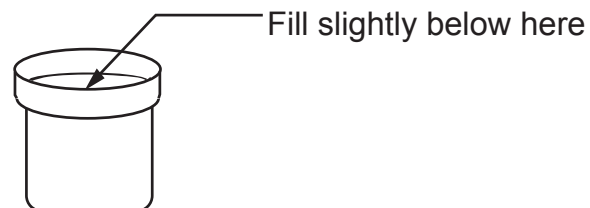
Obtaining the Blood Sample

Native whole blood must be analyzed by the Sonoclot Analyzer within 2 minutes or less of collection. When drawing the blood sample please observe the following precautions:

- 1: Sample withdrawal must be smooth, slow, and atraumatic. While this holds true for any type of blood study, the sensitivity of platelets to disturbance makes good sampling techniques especially important when the Signature will be used to evaluate platelet function. Under no conditions should a sample be drawn with force.
- 2: Care should also be exercised in deciding where the sample will be drawn. For example, heparin contamination from a heparinized line, or a heparin impregnated catheter will modify the Signature producing inaccurate results inconsistent with the patient's actual hemostatic condition. Heparin contamination may also occur from surgery prep saline lines. Sometimes identification of the source of heparin contamination can involve some careful troubleshooting.
- 3: Sienco recommends a two-syringe technique in drawing the blood sample from the patient, drawn from a port on the pump or from the anesthesia port. The first syringe of 2 to 3 ml is discarded and the second syringe is used for the sample. Plastic syringes are mandatory to avoid uncontrolled glass activation.

Running the Sonoclot Analyzer

Fill the warmed cuvette with the blood sample so that the fluid level is slightly below the inner rim of the cuvette as shown below. This volume is approximately 360 μl . Transfer the whole blood sample from the syringe into the cuvette. You may transfer the sample either without a needle or with a blunt needle. Sienco recommends using a blunt cannula tip (P/N 800-0610) for a clean and controlled fill.



Depress the SELECT TEST/(START/STOP) Switch immediately. The magnetic stirrer will automatically rotate, mixing the sample and activator in the test cuvette.

The display will now read:

Test	Clot Signal	Timer Temp
gbACT+		
Mixing		

Test Results

and Signature Viewer will start collecting a new Signature in the current Signature Group. For more information on Signature Groups and data collection, please refer to the Signature Viewer Operator's Manual.

After 10 seconds, the Sonoclot Analyzer will beep and the display will read:

Test	Clot Signal	Timer Temp
gbACT+		
Close Head		

Test Results

Close the head assembly.

At this time, if you wish to run an analysis for more than twenty to thirty minutes, carefully place a drop of SonOil on top of the sample. This will prevent the clot from drying out and forming a crust across the top of the sample.

After another 5 seconds, display will read:

Test	Clot Signal	Timer Temp
gbACT+	9.0	15

Test Results

The current Clot Signal value

The time in seconds since the START switch was pressed down

The sample is initially a liquid. After several minutes, the sample begins to evolve into a clot. The instrument detects this initial clot formation, beeps, and displays the time that the sample remained a liquid above the ACT legend on the front panel.

Test	Clot Signal	Timer Temp
gbACT+	40	150
ACT=135	CR=??	

Test Results

The Onset result

Typically a test reports an clot time result (ACT=), a Clot RATE (CR=), and a Platelet Function result (PF=). The LCD display will display two results at a time on a two second rotation. The LCD display will continue this rotation even after the test is ended, until you begin a new test.

During the next several minutes of the analysis, the fibrinogen converts into a fibrin gel. The rate of the fibrin formation is clinically significant for some Sonoclot tests. The Sonoclot Analyzer determines this rate of formation by calculating the rate of change in the Clot Signal Value. When the Clot RATE results is available, the Analyzer beeps and reports the result on the LCD display and in Signature Viewer.

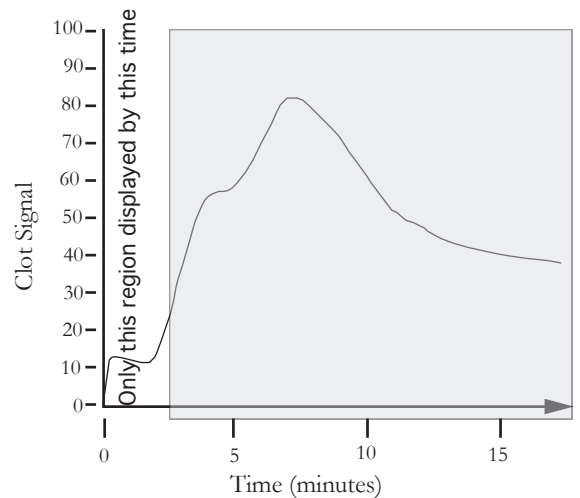
After the Clot RATE has been determined, the Analyzer beeps and the display appears as:

Test	Clot Signal	Timer Temp
gbACT+	56	226
ACT=135	CR=18	

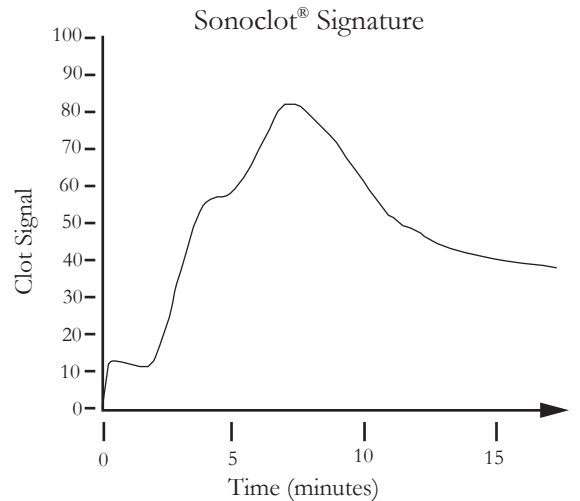
Test Results

The Clot RATE result

At this time in the analysis the Sonoclot Signature in Signature Viewer will have displayed only the beginning of the clot formation.



Continue to allow the instrument to run in order to obtain information on platelet function and fibrinolysis. If you are interested in monitoring clot retraction (platelet function), you should allow the analysis to continue for 20 to 30 minutes or until clot retraction completes. The example Signature to the right has substantially completed clot retraction after about 15 minutes.



When your analysis is complete, momentarily depress the SELECT TEST/ (START/STOP) switch to stop the test. The display contains results from the test as shown below.

Test	Clot Signal	Timer Temp
gbACT	37.0°	
ACT=135	CR=18	

Test Results

Previous Onset results

Previous Clot RATE results

Open the head assembly. Remove the tubular probe (using the probe extractor) and the cuvette and properly discard them. Lower the head assembly to maintain temperature control of the head assembly.

With Signature Viewer software, you can analyze the Sonoclot Signature throughout the test, as well as compare it to other previously collected Signatures. For more information on using Signature Viewer, please see the Signature Viewer Operator's Manual.

If you forget to press the SELECT TEST/(START/STOP) switch to discontinue data collection, the test will automatically stop after 60 minutes (default value). The automatic shut-off feature can be customized to your specific requirements; see Chapter 5- Configuring the Sonoclot Analyzer.

Operational Precautions and Limitations

The quality of the Sonoclot Analyzer test results depend heavily on proper technique. Carefully observe or apply the following precautions.

- 1: Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.
- 2: As with any laboratory test result, diagnosis should not be based solely on the Sonoclot test result but should also consider the patient's condition and other test results.
- 3: Avoid heparin contamination from catheters.
- 4: Avoid blood sample contamination with tissue thromboplastin. Never use the first sample from a new line.
- 5: If the platen is not at the desired temperature setpoint (normally 37°C) then the Sonoclot Analyzer will display an error message and not run the test.
- 6: For consistent results the cuvettes must be pre-warmed prior to running the test. Place cuvettes in the warming wells for at least 5 minutes to pre-warm them. Do not store the cuvettes in the warming wells for extended periods of time (i.e. overnight) in order to avoid sample degradation due to prolonged exposure to heat.
- 7: If using an activation cuvette, tap it sharply on a hard surface to deposit the contact activator on the bottom of the cuvette.
- 8: The disposable probe must be fully seated against the shoulder of the probe mount hub to avoid interference between the probe and the stir-bar.
- 9: The disposable cuvette must be fully seated in the cuvette holder to avoid interference between the probe and stir-bar.
- 10: Native whole blood must be analyzed within 2 minutes or less of collection.
- 11: For best results, do not overfill the cuvette. The proper fill level is slightly below the inner rim of the cuvette.
- 12: Never reuse either a probe or a cuvette. Thrombin contamination may result.

- 13: Avoid contaminating the electromechanical transducer in the head assembly by keeping blood, dirt, or other contaminants away from the probe mount hub.
- 14: Periodically use QC testing to verify proper operation of the Sonoclot Analyzer and activation cuvettes.
- 15: Use proper handling techniques to dispose of probes and cuvettes.
- 16: The mechanical oscillator may be affected by mechanical disturbances. These disturbances may rarely result in incorrect results. Always inspect the Sonoclot Signature to ensure that the results are consistent.
- 17: For extremely high viscosity blood samples, > 8.0 cp, stratification may occur during mixing. For these types of blood samples, external mixing prior to analysis should be performed.
18. If the proper test is not selected on the instrument, the test run and/or results may be affected (for example, there is no mixing cycle when the Sonocal Oil QC test is selected.) Check that the correct test is selected before running a test.

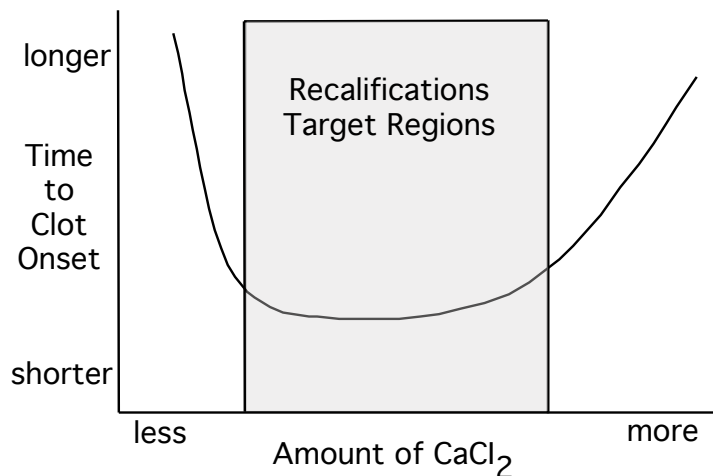
Using Citrated Blood Samples

Background

Citrated blood samples can be used with the Sonoclot Analyzer. However, citrated samples are different than native whole blood samples and the results that are obtained are also different. **When interpreting results, do not apply the sample normal ranges for citrated samples that you would apply to native whole blood samples.**

Special care should be used when testing citrated samples in order to ensure consistent results. Test results are effected by the accuracy of recalcification and sample aging.

The quantity of calcium chloride added to the sample during recalcification affects the test results. A typical dose response curve for the time the blood sample remains a liquid versus varying quantity of CaCl_2 for recalcification has the general shape drawn below.



Fortunately, the dose response curve is relatively flat in the region of proper recalcification so small recalcification error will not result in significant test error. For standard blue top vacutainers, the recommended recalcification is $\approx 15 \mu\text{l}$ of 0.25 M calcium chloride (CaCl_2) for whole blood or $\approx 30 \mu\text{l}$ of 0.25 M calcium chloride for plasma or platelet rich plasma. For accurate results, it is best to run a dose response curve to determine proper recalcification for you specific collection tube. For applications such as testing sequestered platelets, the amount of citrate is unknown and proper recalcification will require determining the actual recalcification dose response curve.

Analyzing a citrated sample is similar to analyzing a native whole blood sample but requires additional steps for proper incubation and recalcification.

The time required to complete and analysis depends on the hemostasis information desired and the specific test used. Coagulation cascade test results require a few minutes; information on platelet function requires 10 to 30 minutes; information on fibrinolysis requires longer analysis - the time that it takes for lysis to occur.

Initial Sonoclot Analyzer Preparation Before Running a Citrated Blood Test

Sonoclot Analyzer preparation before running a citrated test is the same as preparation before running a native test. For preparation instructions for the Sonoclot Analyzer and a graphics printer please see page 1-10. For preparation instructions for the Sonoclot Analyzer and Signature Viewer, please see page 1-17.

Obtaining a blood sample

The coagulation test results run on citrated blood samples are affected by the storage time of the citrated sample. For best results test the citrated sample within 30 minutes of collection. Draw the blood by observing the following precautions:

- 1: Sample withdrawal must be smooth, slow, and atraumatic. While this holds true for any type of blood study, the sensitivity of platelets to disturbance makes good sampling techniques especially important when the Signature will be used to evaluate platelet function. Under no conditions should a sample be drawn with force.
- 2: Care should also be exercised in deciding where the sample will be drawn. For example, heparin contamination from a heparinized line or a heparin impregnated catheter will modify the Signature producing inaccurate results in comparison to the patient's actual hemostatic condition. Heparin contamination also may occur from surgery prep saline lines. Sometimes identification of the source of heparin contamination can involve difficult troubleshooting.
- 3: Sienco recommends a two step technique in drawing the blood sample from the patient, which should be drawn from a port on the pump or from the anesthesia port. The first syringe of 2 to 3 ml is discarded and the second syringe or vacutainer is used for the sample.

Sample Incubation

The blood sample should be incubated to 37°C prior to testing. Do not use an activated cuvette for incubation.

Cuvette and Probe Setup

Cuvette and probe setup for running a citrated test is the same as cuvette and probe setup for running a native test. For setup instructions for the Sonoclot Analyzer and a graphics printer please see page 1-11. For setup instructions for the Sonoclot Analyzer and Signature Viewer, please see page 1-18.

Recalcifying

Add the proper amount of calcium chloride (CaCl₂) for recalcification to the cuvette.

Running the Sonoclot Analyzer

Fill the cuvette with 330 µl of the blood sample. Use a pipette to transfer the sample from the collection tube into the cuvette.

NOTE: The total volume in the cuvette should not exceed 360 µl in order to obtain optimal mixing of sample and activator. Also, a minimum of 300 µl should be used to ensure proper measurement of the sample by the Sonoclot Analyzer.

Depress the SELECT TEST/(START/STOP) Switch immediately.

Once you have filled the cuvette and started the test, running a citrated sample is the same as running a native sample. For instructions on running a sample on the Sonoclot Analyzer and graphics printer, please refer to pages 1-12 to 1-15. For instructions on running a sample on the Sonoclot Analyzer and Signature Viewer, please refer to pages 1-19 to 1-22.

If you wish to check for fibrinolysis, carefully place a drop of SonOil on top of the sample. This will prevent the clot from drying out and forming a crust across the top of the sample as fibrinolysis measurements must run for longer periods of time.

Operational Precautions and Limitations:

The quality of the Sonoclot Analyzer test results depend heavily on proper technique. Carefully observe or apply the following precautions.

- 1: Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.
- 2: As with any laboratory test result, diagnosis should not be based solely on the Sonoclot test result but should also consider the patient's condition and other test results.
- 3: Proper incubation of the sample is important to obtain accurate results.
- 4: Proper recalcification is important to obtain accurate results. Either too little or too much calcium chloride will prolong the ACT and attenuate the Clot RATE.
- 5: The blood or plasma sample should not be exposed to any activating reagent prior to recalcification in order to obtain accurate results.
- 6: For consistent results the cuvettes must be pre-warmed prior to running the test. Place cuvettes in the warming wells for at least 5 minutes to pre-warm them. Do not store the cuvettes in the warming wells for extended periods of time (i.e. overnight) in order to avoid sample degradation due to prolonged exposure to heat.
- 7: If using an activation cuvette, tap it sharply on a hard surface to deposit the contact activator on the bottom of the cuvette.
- 8: The disposable probe must be fully seated against the shoulder of the probe mount hub to avoid interference between the probe and the stir-bar.
- 9: The disposable cuvette must be fully seated in the cuvette holder to avoid interference between the probe and stir-bar.

- 10: For best results, do not overfill the cuvette. The proper fill level is slightly below the inner rim of the cuvette.
- 11: Avoid heparin contamination from catheters.
- 12: Avoid blood sample contamination with tissue thromboplastin. Never use the first sample from a new line.
- 13: Never reuse either a disposable probe or a disposable cuvette. Thrombin contamination may result.
- 14: Use proper handling techniques to dispose of probes and cuvettes.
- 15: Avoid contaminating the electromechanical transducer in the head assembly by keeping blood, dirt, or other contaminants away from the probe mount hub.
- 16: Periodically use QC testing to verify proper operation of the Sonoclot Analyzer and activation cuvettes.
- 17: The mechanical oscillator may be affected by mechanical disturbances. These disturbances may rarely result in incorrect results. Always inspect the Sonoclot Signature to ensure that the results are consistent.
- 18: For extremely high viscosity blood samples, > 8.0 cp, stratification may occur during mixing. For these types of blood samples, external mixing prior to analysis should be performed.
- 19: If the proper test is not selected on the instrument, the test run and/or results may be affected (for example, there is no mixing cycle when the Sonocal Oil QC test is selected). Check that the correct test is selected before running a test.

Chapter 2 - Clinical Application

Overview

The Sonoclot Analyzer provides information on the entire hemostasis process including coagulation, fibrin gel formation, clot retraction (i.e. platelet function) and hyperfibrinolysis. The test results are recorded on the Printer as both a qualitative graph, known as the Sonoclot Signature, and quantitative results (ACT time and Clot RATE). The graphic Signatures listed in this Clinical Applications Chapter and the Sonoclot Signature Library are for reference purposes. Actual results will vary and not necessarily match the reference Signatures.

The value of the Sonoclot Signature is the convenient information on hemostasis that it provides. Before discussing specific clinical applications of the Sonoclot Analyzer, it is important that the user has an understanding of hemostasis. A brief review of hemostasis from the perspective of a Sonoclot Signature is provided as a foundation for Sonoclot Signature interpretation. Later discussion addresses the ACT result for the Sonoclot Analyzer and its application in heparin management and clinical bleeding management.

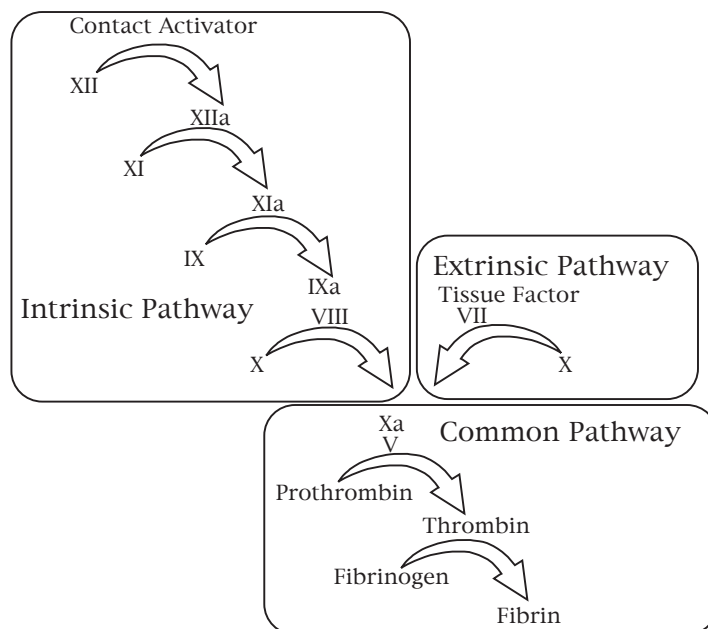
Review of Hemostasis Fundamentals

This review is not intended to be a complete discussion of hemostasis. It is only a simplified overview of the major components. For a more detailed presentation of hemostasis please refer to the references.

Coagulation

The coagulation process addresses the reactions occurring in blood or plasma that precede and initiate the formation of a fibrin clot. This process has been explained with a cascade hypothesis. Over years of research this coagulation hypothesis has been revised and expanded, however, it still provides a foundation for most coagulation testing. The coagulation cascade hypothesis defines three pathways leading to initial fibrin formation: the intrinsic, extrinsic, and common pathways.

Coagulation Cascade Hypothesis

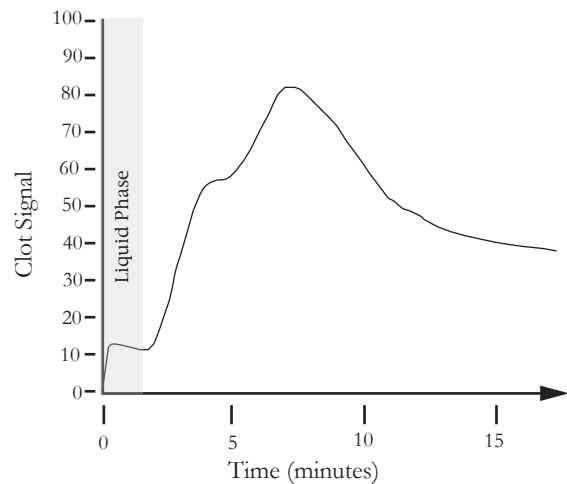


The intrinsic and extrinsic pathways merge into the common pathway when factor X becomes activated Xa.

Classical coagulation tests including the Prothrombin Time (PT), activated Partial Thromboplastin Time (aPTT), Thrombin Time (TT), and activated clotting time (ACT) measure the time required to progress through different paths of the coagulation cascade. All of these tests end with the initial formation of fibrin.

The PT, aPTT, and TT were originally performed on plasma. Now, whole blood variations of these tests are also available. The PT uses tissue factor to activate the extrinsic pathway. The aPTT uses a contact activator to initiate the intrinsic pathway and phospholipid which substitutes for platelets. The TT uses thrombin activation and skips all the cascade steps except the final step of the common pathway - the fibrinogen to fibrin conversion. The ACT is similar to the aPTT in that it uses a contact activator to activate factor XII at the beginning of the intrinsic pathway. However, the ACT is run on whole blood and does not use phospholipid since platelets are present in whole blood.

In relation to the Sonoclot Signature the coagulation cascade occurs from the beginning of the graph and continues throughout the liquid phase. The liquid phase ends when the viscosity of the sample begins to increase with thrombin generation and the resulting initial fibrin formation. The time that the blood in the Sonoclot Signature remains a liquid is reported as the ACT result. This time is the endpoint for coagulation cascade tests.

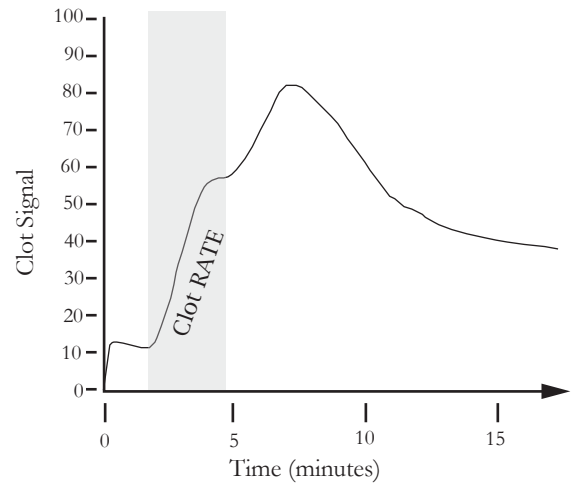


The sample Sonoclot Signatures shown here and elsewhere in this manual were run with Sienco's SonACT™ test #800-0432 on whole blood. This test contains a contact activator, celite, resulting in an Activated Clotting Time. ACT testing is used extensively in heparin anticoagulant management.

Fibrin Gel Formation

Once thrombin forms in the test sample, the fibrinogen converts to fibrin monomers. The fibrin monomers spontaneously polymerize into a fibrin gel. Gel formation is effected by the rate of thrombin formation, the rate of thrombin neutralization, and the amount of fibrinogen.

The fibrin gel formation is characterized by the slope of the Sonoclot Signature during the gel formation (Clot RATE) and by the height of the Signature when gel formation is completed. This information is important in several clinical applications including identifying hypercoagulable screening, anticoagulant management and fibrin hemodilution.

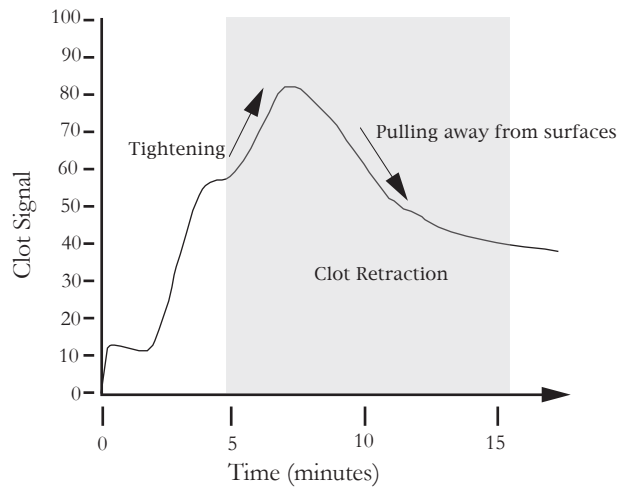


Clot Retraction, i.e. Platelet Function

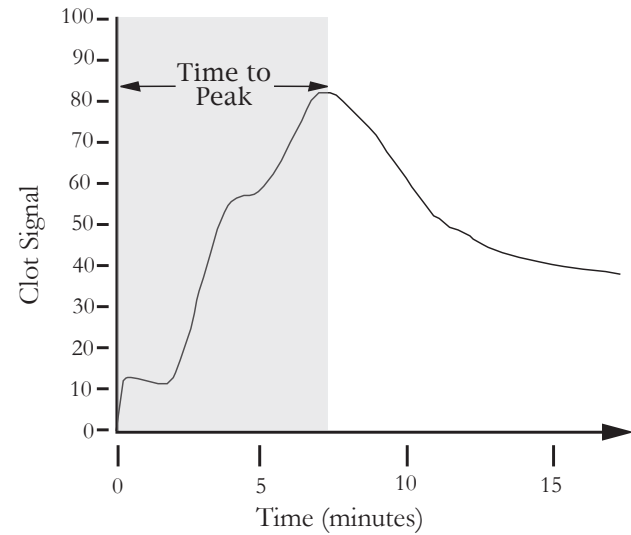
Clot retraction occurs when platelets function properly. In a Sonoclot Analysis platelets will retract the fibrin gel. One very valuable feature of the Sonoclot Analyzer is its ability to capture the clot retraction that functioning platelets perform on a fibrin clot. The photograph to the right shows the role of platelets in retracting a clot. The dark lines are strands of fibrin. These fibrin strands link together into a gel. The platelets adhere to multiple nodes of the fibrin gel and cause the gel to collapse together or retract.



The Sonoclot Signature responds to the clot retraction occurring within the test sample. As the clot retracts it tightens causing the Sonoclot Signature to rise. Eventually, the clot will often pull away from some of the surfaces of the cuvette or probe. The Sonoclot Signature falls when the clot pulls away from the inner surface of the cuvette or probe.



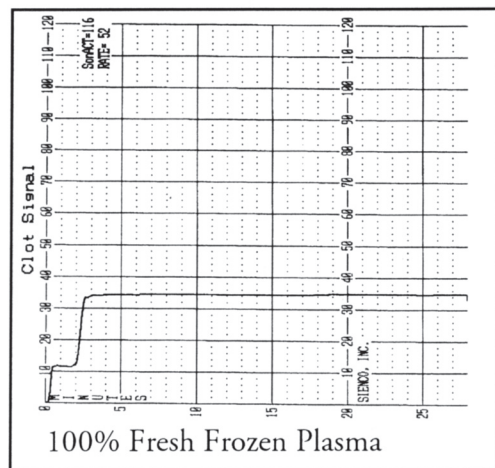
Clot retraction is measured by both the time it takes for retraction and the degree of retraction. One useful measurement to characterize clot retraction is the Time to Peak. Generally, the faster the Time to Peak the greater the platelet function. Also, a qualitative assessment of the clot retraction is useful. Sharp well defined peaks indicate strong retraction; dull or poorly defined peaks indicate weak retraction.



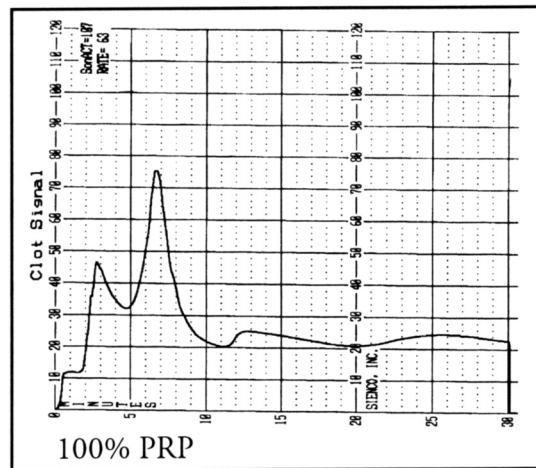
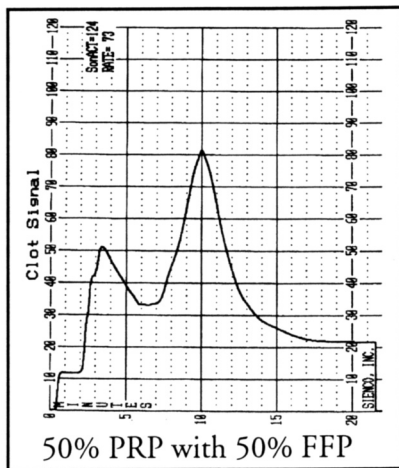
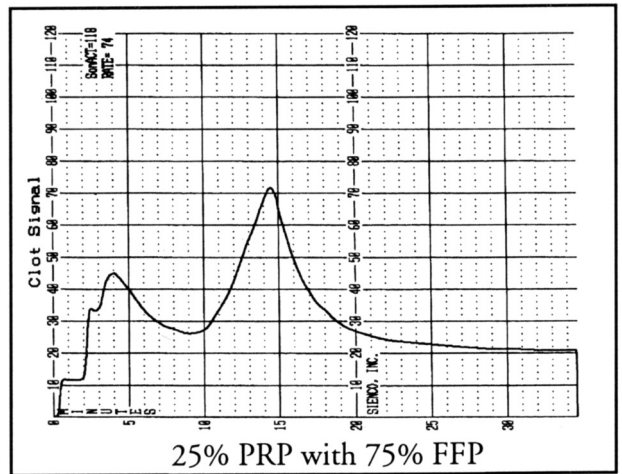
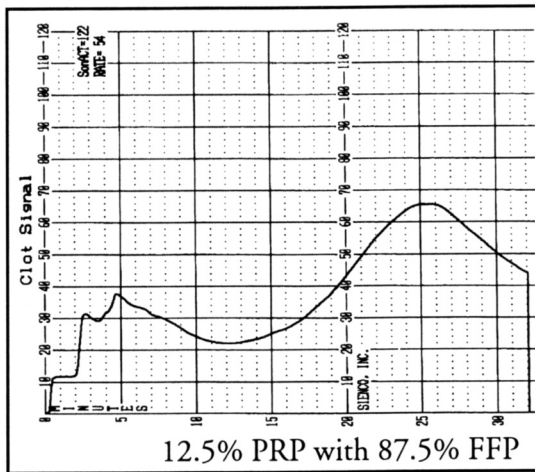
Clot retraction is also reported quantitatively by the Platelet Function result. A low platelet function result indicates poor platelets, a high platelet function result indicates good platelet function.

At this point it may be useful to digress and illustrate the effect of the platelet count on clot retraction. The following Sonoclot Signatures were collected using mixtures of fresh frozen plasma (FFP) and platelet rich plasma (PRP) to vary the platelet count.

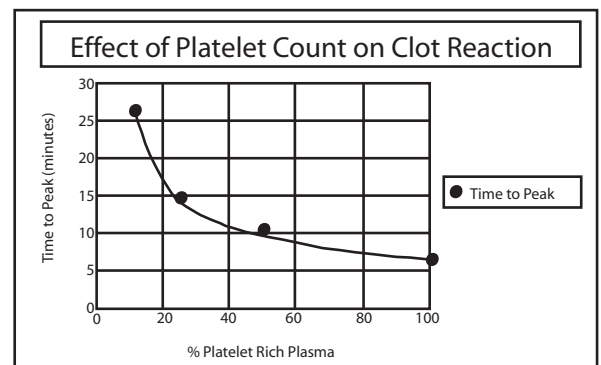
The first Signature contains only fresh frozen plasma. The coagulation cascade develops during the liquid phase, a fibrin gel forms quickly and the sample remains a gel. No retraction occurs; after the gel forms, the sample simply remains a gel, and the Sonoclot Signature remains flat.



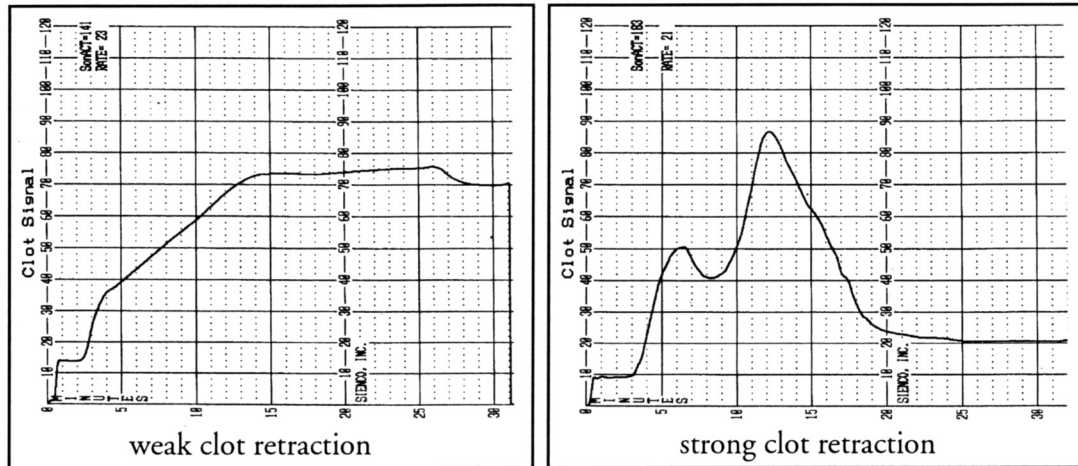
The subsequent Signatures contain increasing percentages of platelet rich plasma with the fresh frozen plasma.



Notice that as the percent of platelet rich plasma increases, the time it takes for clot retraction to occur decreases. The adjacent graph plots the Time to Peak versus the percent of platelet rich plasma for these Signatures. As the platelet count increases (higher percentage of platelet rich plasma) the clot retracts faster.



The preceding Sonoclot Signatures were from fresh frozen and platelet rich plasma samples and look quite different than whole blood Sonoclot Signatures. In platelet rich plasma retraction is exaggerated, both because the platelet concentration is higher than in whole blood, and because the red blood cells in whole blood impede retraction by taking up a large percentage of the sample volume. With whole blood, the evaluation of platelet function from the Sonoclot Signature is in part a qualitative observation. Here are two Sonoclot Signatures showing both weak and strong retraction.

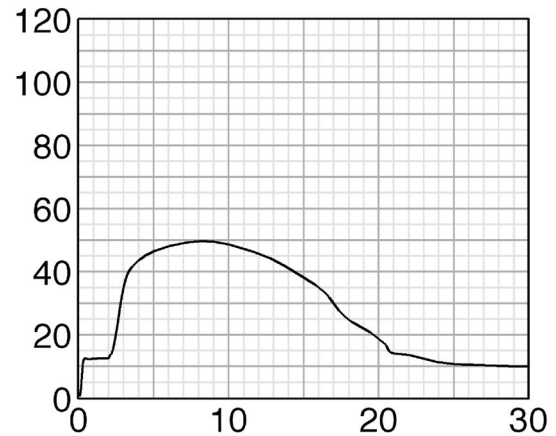


In the above Sonoclot Signatures the Time to Peak for the Signature illustrating weak clot retraction is 14 minutes and in the strong clot retraction example the Time to Peak is only slightly less, 12 minutes. However, the strong clot retraction example shows the well defined primary peak resulting from substantial retraction of the fibrin gel.

Hyperfibrinolysis

Eventually, fibrin clots dissolve through the activation of the fibrinolytic system. The activated enzyme plasmin is formed from plasminogen and breaks fibrin strands into smaller fibrin split products. The fibrin split products do not polymerize so as this lysing progresses, the fibrin gel dissolves.

With normal hemostasis the process of fibrinolysis occurs at much slower rates than coagulation, fibrin gel formation or clot retraction. For a normal sample lysis will occur only after many hours. Since most Sonoclot test runs do not extend beyond 45 to 60 minutes, lysis will be detected on a Sonoclot Signature only when hyperfibrinolysis occurs. The Sonoclot Signature to the right captures hyperfibrinolysis.



Several important comments pertain to identification of hyperfibrinolysis.

- Coagulation and fibrin gel formation are not impaired by fibrinolytic activity
- Platelet function may be significantly reduced by fibrinolytic activity. Notice that the above Sonoclot Signature never develops the characteristic rise that would occur when the platelets begin tightening the fibrin gel
- As the fibrin gel dissolves the Clot Signal falls smoothly back to a value near and often slightly below the original liquid response
- The hyperfibrinolysis diagnosis can be easily confirmed by inspecting the blood sample after running the test. If the sample is completely liquid, lysis has occurred.

How to Select the Right Test for Your Application

Sienco offers several different tests that are effective for different applications. It is important that you choose the correct test for you application to ensure the best patient care.

Pre and Post CPB

Sienco recommends the gbACT+ test for all testing done on non-heparinized patients. The gbACT+ test provides the best over-all hemostasis analysis and is especially good at assessing platelet function. This is an excellent test to run before and after surgery to determine overall hemostasis performance and pin point any coagulation problems such as poor platelet function. The gbACT+ test cannot be used when heparin is present.

During CPB without Aprotinin

During surgery, Sienco recommends either the SonACT test, the kACT test, or the aiACT test. All three tests provide information on the ACT when heparin is present. These tests are not good at assessing platelet function

During CPB with Aprotinin

Aprotinin prolongs the celite ACT Sienco recommends the use of at least the kACT and preferably the aiACT test. The aiACT test has been formulated to be sensitive to aprotinin than either the SonACT or kACT tests, or any other celite or kaolin test.

Liver Transplant Surgery, ICU, DIC, Sepsis:

Sienco recommends the gbACT+ test because this test will provide information on clotting factors, fibrin formation, and clot retraction (platelet function) in a single test. If hyperfibrinolysis is a concern, the gbACT+ test with Fenestrated probes will provide more reliable performance in extremely poor hemostatic conditions, such as late stage DIC or sepsis.

Sienco also offers a non-Activated test for use with user provided custom reagents.

When interpreting a Sonoclot Signature, it is essential that the user know what test was run on the Sonoclot Analyzer and how the sample was collected. Different tests use different reagent quantities or formulations that dramatically affect how the clot forms during the Sonoclot Analysis. Different sample collection methods also greatly affect clot formation. Any of these possible variations will alter the Sonoclot Signature and the corresponding test results. When you are interpreting a Sonoclot Signature, you are really interpreting a Sonoclot Signature of a blood sample collected in a specific manner and tested with a specific type of cuvette and reagent formula.

Normal Ranges for Sienco's Disposable Tests

Before the normal ranges are presented, it is important to know that normal ranges for a healthy population may be different than the average results at a specific institution. Medication and variations in operator technique can alter average test results at each institution. It is also true that the hemostatic system responds to the stress of surgery in ways that affect the Sonoclot Signature—typically in accelerating clot retraction. Even though there may be sources for variability, the following normal ranges provide a useful baseline.

The normal values presented here are for native whole blood run on the Sonoclot Analyzer within 1 to 2 minutes from sample collection. Please refer to the product inserts included with your disposable tests for the most current normal range data.

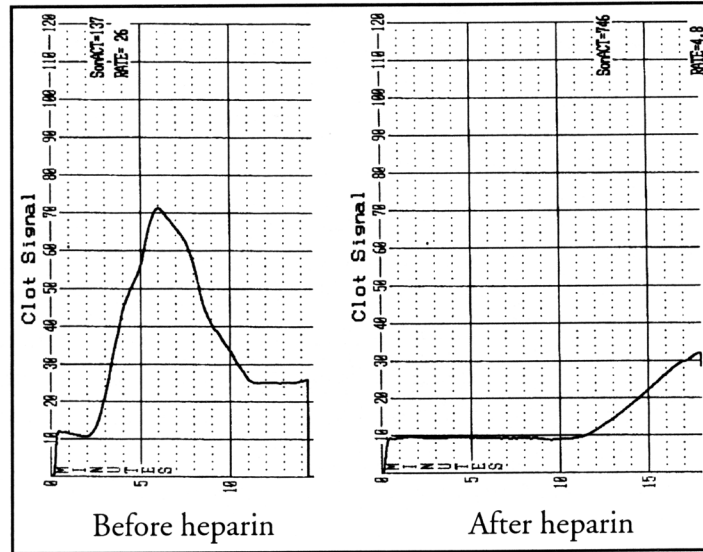
Test	Normal Range:ACT	Normal Range:Clot Rate
SonACT #800-0432	85-145 seconds	15-45 Clot Signal Units/Minute
gbACT+ #800-0412	119-195 seconds	7-23 Clot Signal Units/Minute
kACT #800-0400	94-178 seconds	15-33 Clot Signal Units/Minute
aiACT #800-0442	62-93 seconds	22-41 Clot Signal Units/Minute

Review the sample Normal Sonoclot Signatures in Chapter 3 to develop an awareness of the typical shapes of normal Sonoclot Signatures.

Heparin Anticoagulant Management in Cardiopulmonary Bypass Surgery

Effects of Heparin on a Sonoclot Signature

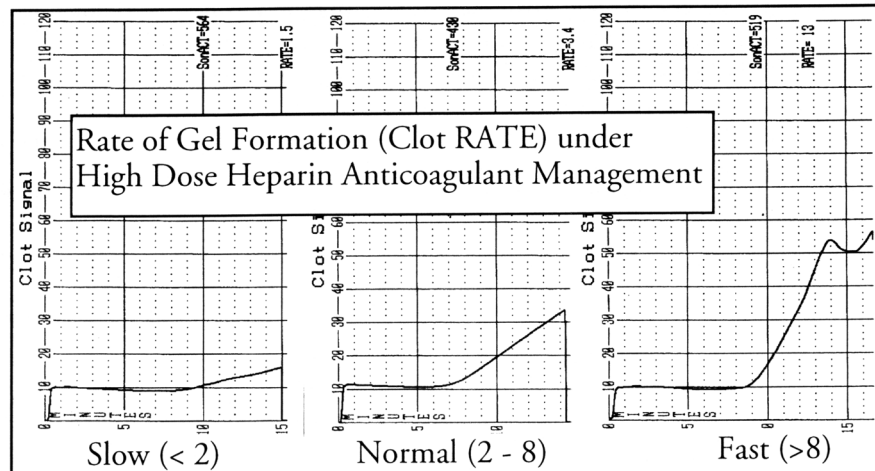
Heparin inhibits the formation and accelerates neutralization of thrombin by greatly multiplying the potency of the thrombin inhibitor, ATIII. Thrombin plays multiple roles in hemostasis including cleaving fibrinogen into fibrin monomers and stimulating platelets to aggregate. Because of the multifaceted role of thrombin and heparin's antithrombin effect (through ATIII), it isn't surprising that heparin has multiple effects on a Sonoclot Signature. This is a typical response to heparin tested with Sienco's celite-activated SonACT test (P/N 800-0432).



Three separate effects of heparin on the Sonoclot Signature are:

- The sample remains a liquid longer (longer ACT)
- The gel formation occurs slower (lower Clot RATE)
- Clot retraction is either very slow or not observed (less platelet activity)

Patients respond to heparin differently. The Clot RATE result is very useful in further quantifying the anticoagulant effect beyond just the ACT. The Clot RATE monitors the performance of thrombin inhibitors in removing circulating thrombin and thus slowing the fibrin formation process. The following examples all have ACTs of approximately 500 seconds indicating similar anticoagulant effect in preventing thrombin formation. However, these Sonoclot Signatures show vast difference in the effectiveness of the thrombin inhibitors.



Hemostasis Monitoring in Surgery

The Sonoclot Analysis test provides information on the entire hemostasis process including coagulation, fibrin gel formation, clot retraction (i.e. platelet function) and hyperfibrinolysis. The resulting test information is useful in providing qualitative information to aid in hemostasis and blood product management for a patient. The information can identify coagulopathies including:

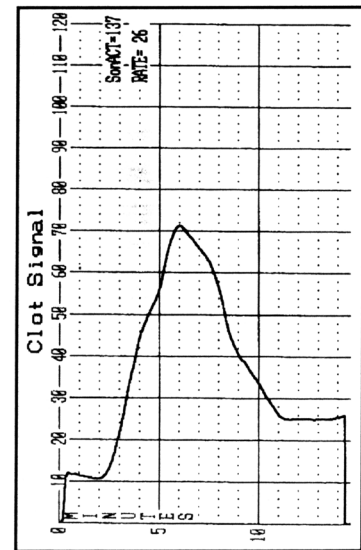
- Coagulation factor deficiencies
- Fibrin dilution
- Poor platelet function
- Hyperfibrinolysis

When interpreting a Sonoclot Signature, it is often easiest to start at the beginning of hemostasis (coagulation), then progress throughout the clot evolution including fibrin formation, clot retraction, and finally, fibrinolysis. This start to finish approach makes sense because without normal coagulation, fibrin polymerization is altered; without normal fibrin polymerization, clot retraction is difficult to observe. Hyperfibrinolysis, although rare, can occur with or without clot retraction.

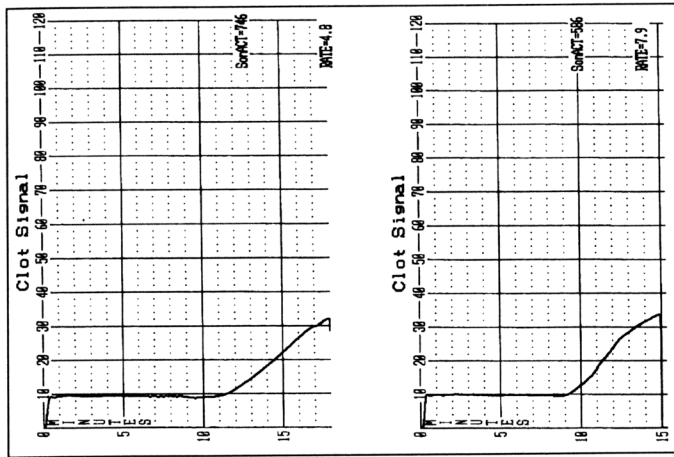
Cardiovascular Surgery Example #1 - Typical Case

Cardiovascular surgery subjects the hemostatic system to multiple stresses from intraoperative bleeding, anticoagulant treatment, red blood cell washing, and physical trauma. Hemostasis monitoring in cardiovascular surgery involves running a baseline Sonoclot Test to screen for potential coagulopathies, running SonACT tests while the patient is anticoagulated to determine the adequacy of anticoagulant effect, running a post protamine Sonoclot Test to identify any hemostasis deficiencies, and running additional Sonoclot Tests in the ICU when managing post operative patients with excessive bleeding.

This case study includes Signatures from a typical cardiovascular surgery case that did not experience excessive bleeding. The first Signature identifies a strong hemostatic system. The time for initial fibrin formation was normal (ACT = 137 seconds), the fibrin formation was normal (Clot RATE = 26 units per minute), and the clot retraction was both fast and strong (Time to Peak = 6 minutes).

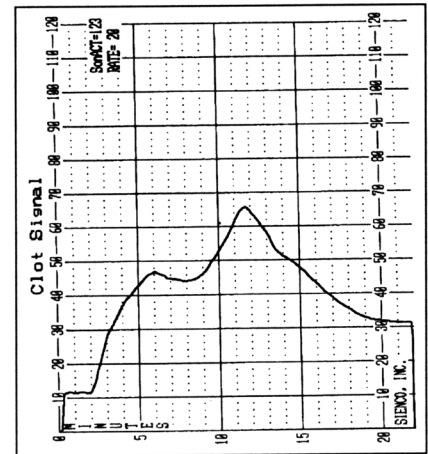


The next two Signatures were taken while the patient was anticoagulated with heparin. Notice in the Signature just to the right that the patient showed a normal response to heparin; the ACT extended from 137 to 746 seconds, and the Clot RATE attenuated from 26 to 4.8 units per minute.

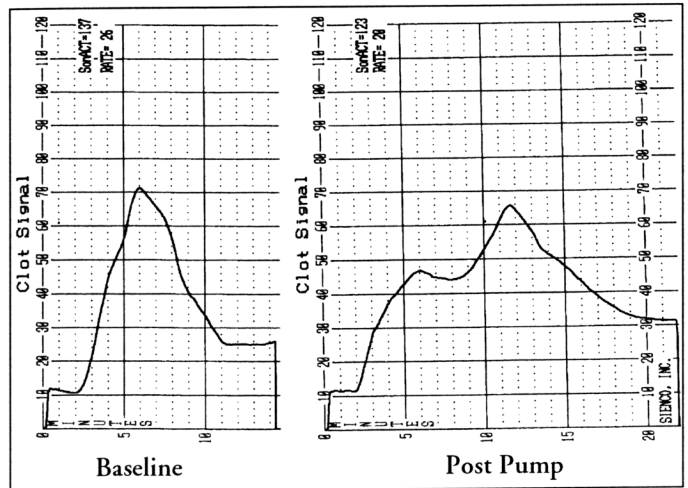


Later while still anticoagulated, the Signature shows the effects of heparin have slightly diminished, but the patient is still well anticoagulated. The ACT of 586 seconds and Clot RATE of 7.9 units per minute confirm adequate anticoagulation.

After heparin reversal, the Sonoclot Signature records a normal hemostatic profile. The clot begins to form in a normal amount of time (ACT = 123 seconds); the fibrin polymerization is normal (Clot RATE = 20 units per minute), and the clot retraction of the fibrin gel is normal (Time to Peak = 11.5 minutes). The Signature shows no hemostatic deficiencies.



It is useful to compare the baseline Signature with the post bypass Signature. In this patient, when these Signatures are compared, you can observe some reduction in the strength of the fibrin gel. Look at the height of the Signature after gel formation. In the baseline Signature the Clot Signal value is about 50 Clot Signal units (4.5 minutes into the Signature) when the fibrin formation nears completion. This Clot Signal value in the post bypass Signature has reduced slightly to a value of about 45 Clot Signal units (6 minutes into the Signature).



The degradation in clot retraction (platelet function) is more pronounced. The baseline Time to Peak was 6 minutes and the post bypass Time to Peak extended to 11.5 minutes. Some degradation in hemostatic performance should be expected after cardiovascular surgery.

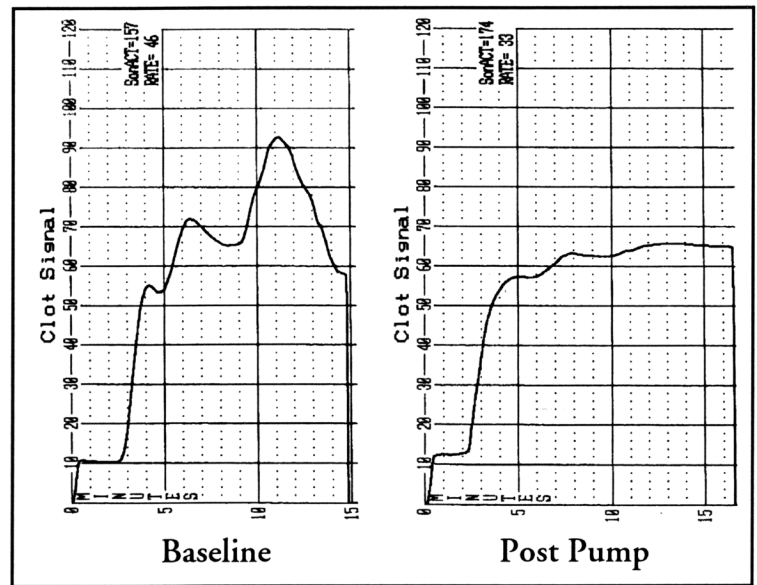
Cardiovascular Surgery Example #2 - Platelet Dysfunction

Platelet dysfunction is often a major factor in excessive bleeding in cardiovascular surgery. The platelet dysfunction may be present prior to surgery or it may develop during the procedure.

This case example begins with the baseline Signature at the right. Hemostasis is normal; the liquid phase (clotting factors), gel formation (primarily fibrin), and clot retraction (platelet function) are normal.

Post protamine the Signature has changed dramatically from the baseline Signature. Although the liquid phase and gel formation are normal, clot retraction is nearly absent. A patient with a post protamine Signature lacking significant

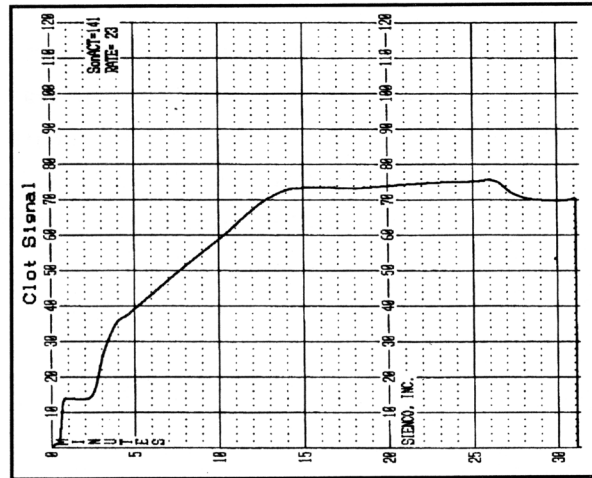
clot retraction is a likely candidate for oozing and increased post operative bleeding. Quick identification of a platelet dysfunction and proper intervention can help reduce post operative bleeding and possible additional coagulopathies associated with blood loss.



Cardiovascular Surgery Example #3 - Identification of a Mechanical Bleeder

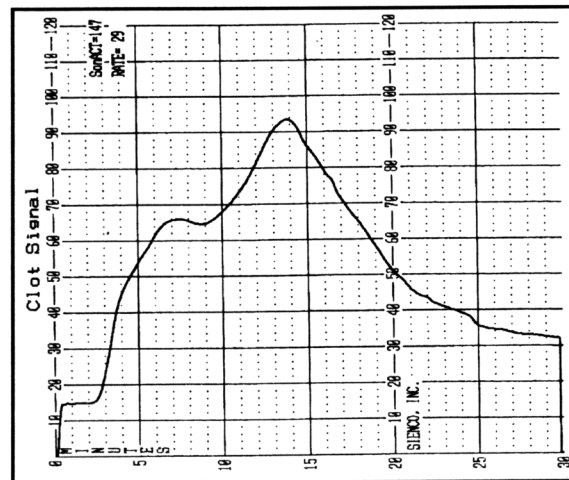
A cardiovascular surgery patient was experiencing excessive post operative bleeding. The Sonoclot Signature taken in the intensive care unit is shown.

This blood remained a liquid for 141 seconds so there are sufficient clotting factors to begin clot formation in a normal manner. The Clot RATE is 23 which indicates a normal rate of fibrin polymerization. The clot retraction is somewhat slow and the Peak is poorly defined, indicating slightly below normal platelet function.



The initial step to control the post operative bleeding was to build up the hemostatic system. A shotgun approach was attempted by administering routine quantities of cryoprecipitate, platelets, DDAVP, fresh frozen plasma and 50 mg. protamine. The effect of this intervention on the Sonoclot Signature is shown to the right.

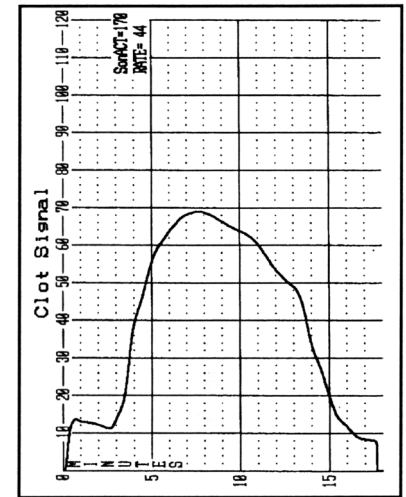
This Sonoclot Signature showed strong hemostasis performance from coagulation through gel formation and clot retraction. However, the post operative bleeding was not corrected until this patient was taken back to the operating room. This illustrates one use of the Sonoclot Analyzer in differentiating hemostatic bleeders from mechanical bleeders.



Cardiovascular Surgery Example #4 - Hyperfibrinolysis

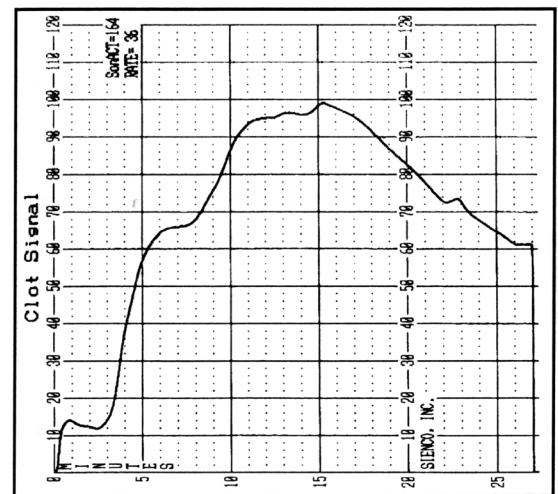
Hyperfibrinolysis is not common in cardiovascular surgery, but when it occurs, quick identification with proper intervention can help avoid a severe bleeding complication.

This Signature was run after heparin reversal. The Signature shows the classic hyperfibrinolysis indicator of the Clot Signal returning to a value at or below the initial Clot Signal value during the liquid phase. A clot formed and then it dissolved back into a liquid.



This patient was given Amicar® to treat the hyperfibrinolysis. The result on the Sonoclot Signature substantiates that the hyperfibrinolysis has been reduced.

Several points related to hyperfibrinolysis management should be understood. Plasmin is the active enzyme that dissolves fibrin. Plasmin is formed when the fibrinolytic system is activated. The trauma of cardiovascular surgery activates the fibrinolytic system. The common approach to treat hyperfibrinolysis is to inhibit or remove plasmin.



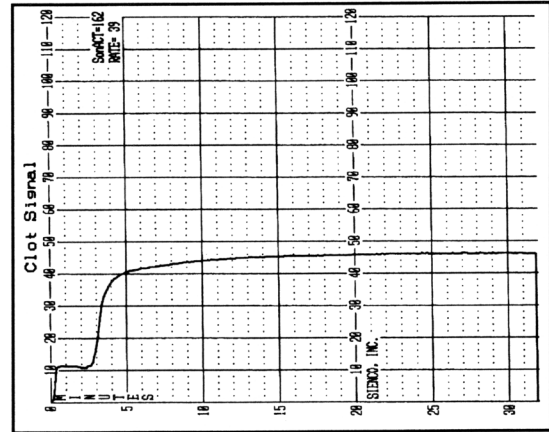
Amicar is the most common antifibrinolytic drug. It inhibits the formation of plasmin but does not remove plasmin that has already formed. Consequently, Amicar will not produce immediate results. The response to Amicar depends on the patient's ability to remove the circulating plasmin.

Aprotinin is another antifibrinolytic drug. It acts directly on plasmin and inhibits circulating plasmin. It can have a rapid effect on reversing hyperfibrinolysis.

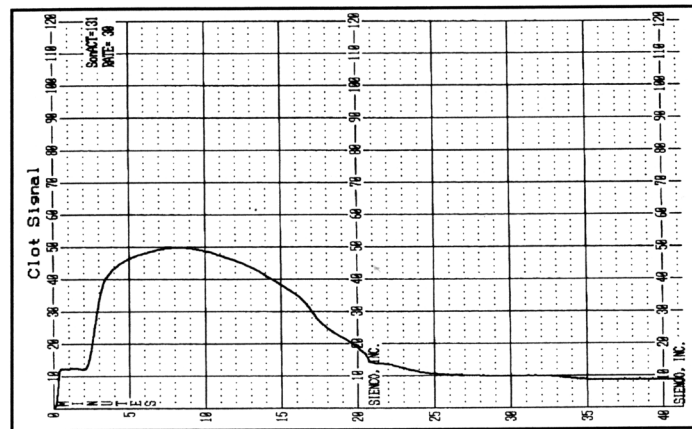
Plasmin also inhibits platelets. Sometimes a Sonoclot Signature will capture improved platelet function after aprotinin or Amicar treatment if poor clot retraction is the result of plasmin inhibited platelets.

Liver Transplant Example #1

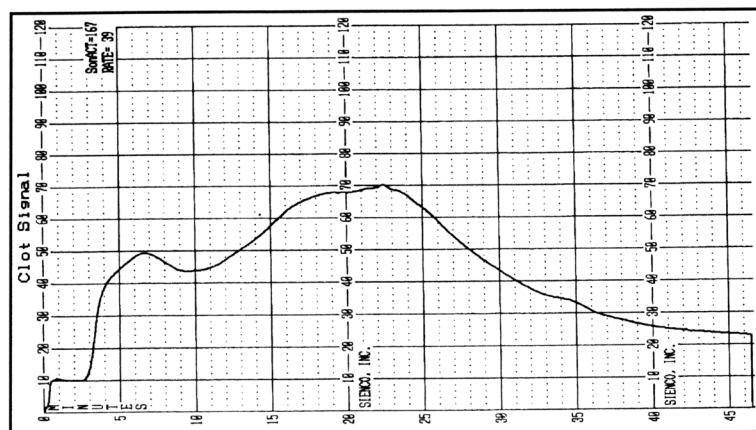
The Sonoclot Analyzer is used in liver surgery. In these cases severe coagulopathies are much more frequent than in most other procedures. During this liver transplant procedure, ten Signatures were collected. For convenience the progression of hemostasis changes are summarized using only three of the Signatures. The baseline Signature at the right shows a slightly prolonged liquid phase with a ACT of 162 seconds and normal gel formation with a Clot RATE of 39. However, the Signature does not contain any clot retraction. After the blood formed a gel, it remained a gel without any clot retraction (no platelet function). Platelet dysfunction is common with liver disease.



During the surgery the Signature shows classic hyperfibrinolysis. The sample formed a gel and the gel dissolved back into a liquid. The Signature does not show any indication of clot retraction.



This third Signature was run after the new liver had been functioning within the patient for sufficient time to reduce hyperfibrinolysis. Notice that the Signature contains the normal components of hemostasis. The clot begins to form after a normal time delay. The fibrin gel forms normally. Clot retraction is now apparent in the Signature, although still prolonged.

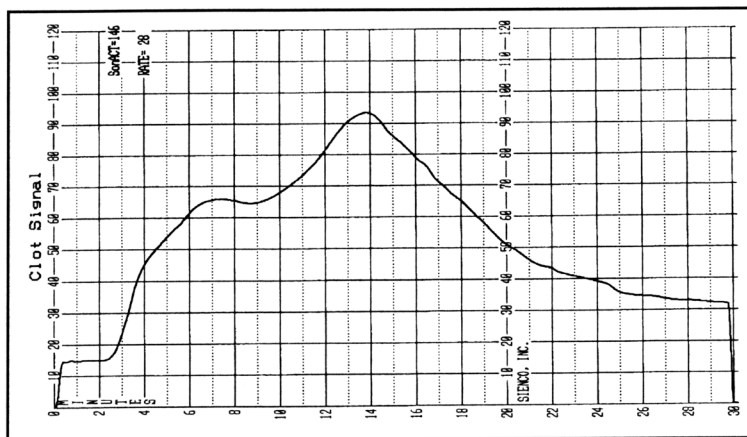
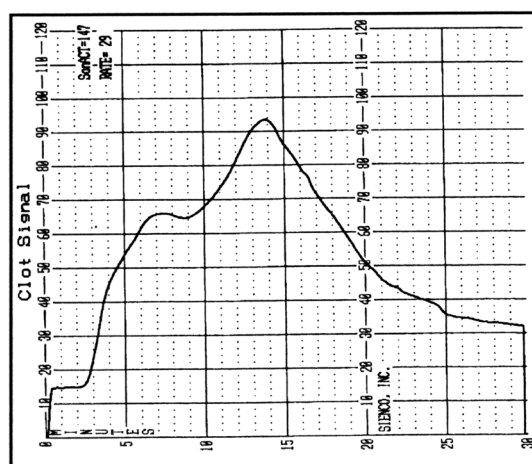


Chapter 3 - Sonoclot Signature Library

Overview of Library Signatures

The hemostasis information provided through the Sonoclot Signature is quite extensive and covers coagulation, fibrin gel formation, clot retraction (platelet function) and lysis. To use this information, the user must be able to qualitatively evaluate a Sonoclot Signature. This evaluation is normally performed through pattern matching a new Signature to prior Sonoclot Signatures. The following Sonoclot Signatures form a foundation of Signature characteristics of both normal and abnormal hemostasis. All of the Sonoclot Signatures were collected from native whole blood using Sienco's SonACT Test (P/N 800-0432) unless otherwise noted. The graphic Signatures listed in this Sonoclot Signature Library and the Clinical Applications Chapter are for reference purpose. Actual results will vary and not necessarily match the reference Signatures.

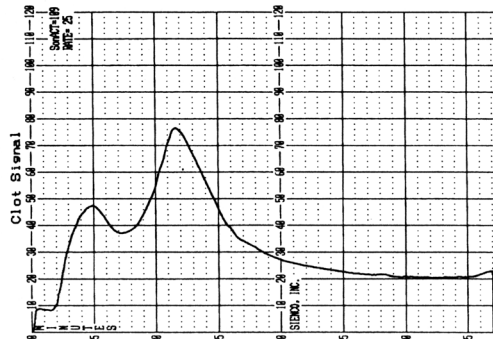
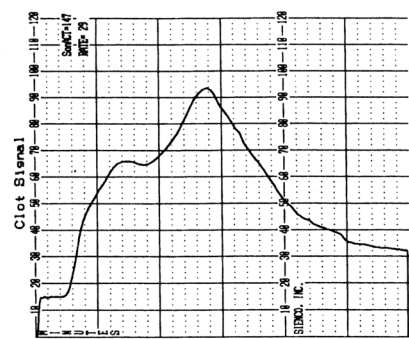
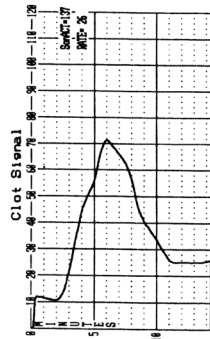
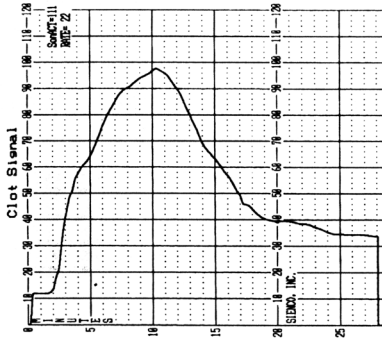
All of the library Sonoclot Signatures are printed using recommended settings for the Clot Signal Scale and the Time Scale. For most whole blood Sonoclot Signatures the Clot Signal Scale used is 0-120 AUTO, and the Time Scale is 0.33 cm per minute. The visual perception of a Sonoclot Signature is strongly influenced by the scale settings. Please be aware that your Sonoclot Signatures will look different than these library signatures if you choose to use scale settings different than Sienco's recommended scale settings. To illustrate this effect on your visual perception a Sonoclot Signature is shown twice - the upper Signature was printed with recommended scale settings, the lower Signature used a Clot Signal Scale of 0-150 and a Time Scale of 0.50 cm per minute.



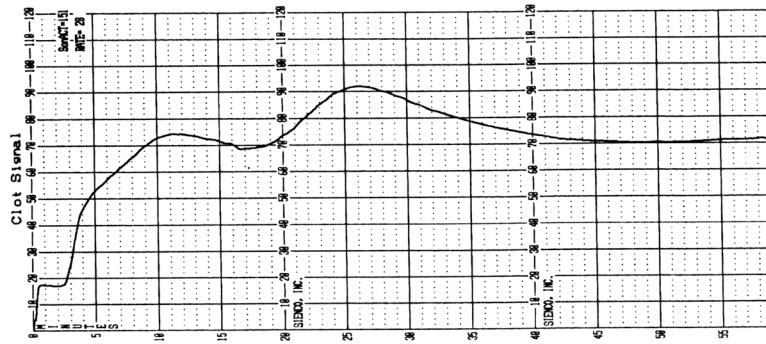
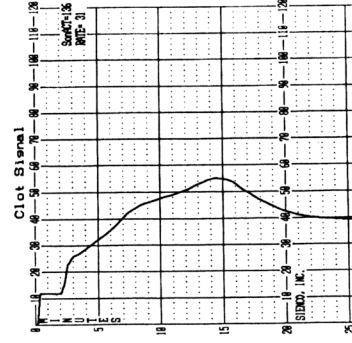
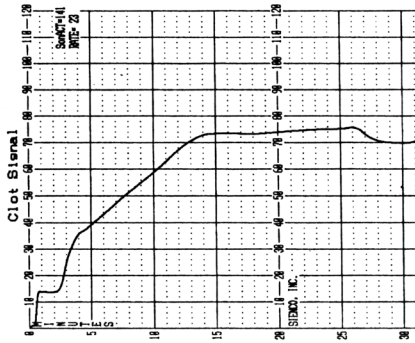
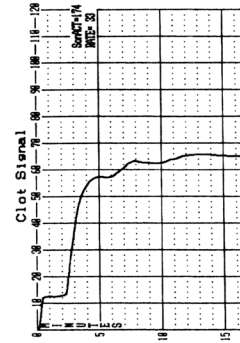
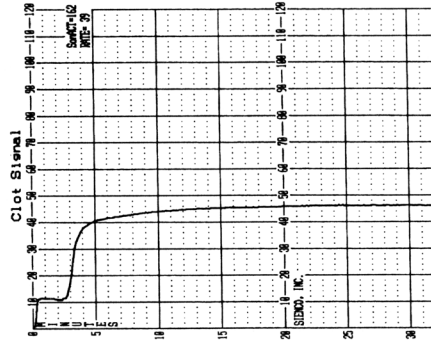
Sonoclot Signature Visual Index

All the Sonoclot Signatures included within this library are first printed in reduced size as a visual index. This visual index identifies the specific section of the library that discusses the corresponding Sonoclot Signature. The Sonoclot Signatures in the library are included either as case studies or isolated examples.

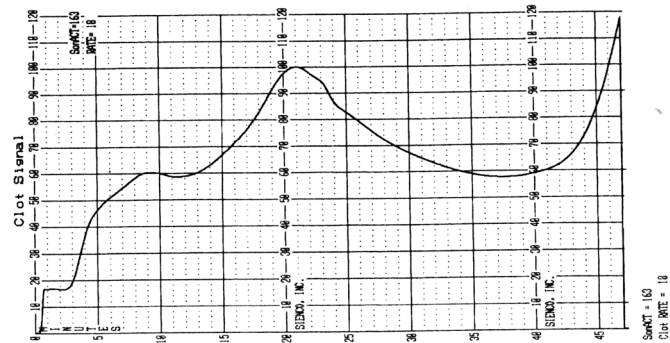
Signatures from Normals Section



Signatures from Poor Platelet Function Section



Signature of Blood Sample Drying and Forming a Crust

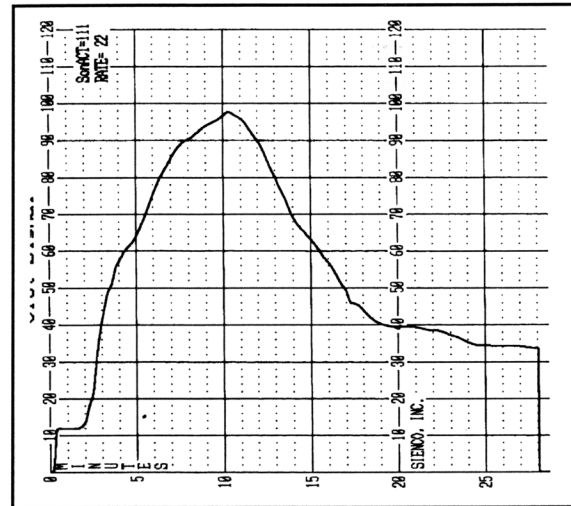


Normals

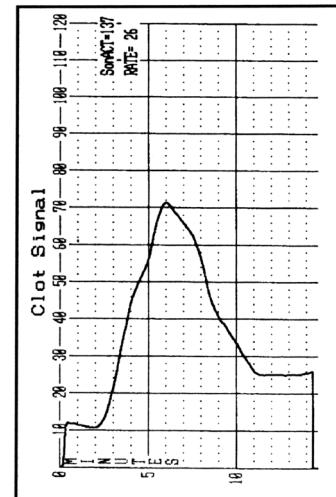
The range of normal Sonoclot Signatures is extensive because the Sonoclot Signature detects mechanical changes occurring throughout the multiple steps of hemostasis. The following Sonoclot Signatures are provided to illustrate the range of normals for the different stages of clot development including the coagulation cascade, fibrin gel formation and clot retraction.

Clot retraction is the phase of the Sonoclot Signature that has the broadest spectrum of shapes. The examples vary from single well-defined peaks capturing rapid clot retraction through poorly defined peaks that show little evidence of clot retraction. Strong clot retraction indicates good platelet function. Weak or poorly defined clot retraction indicates either low platelet count or poor platelet function.

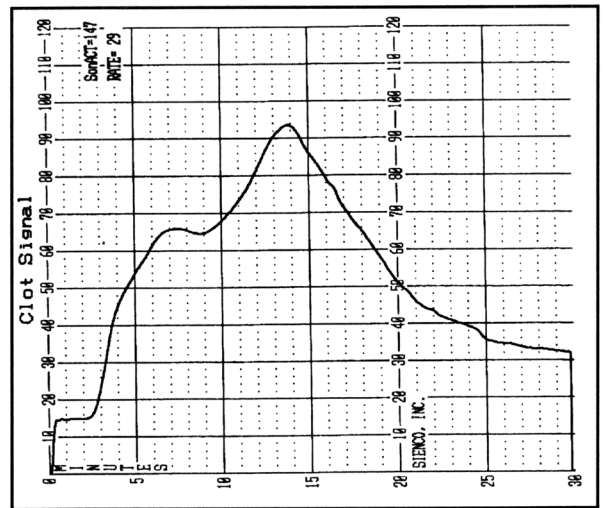
The Sonoclot Signature to the right has a ACT time time of 111 seconds and a Clot RATE of 22. Both of these results are within normal ranges. The clot retraction has a well defined peak at approximately 10 minutes and reaches completion within 25 minutes. This is good clot retraction.



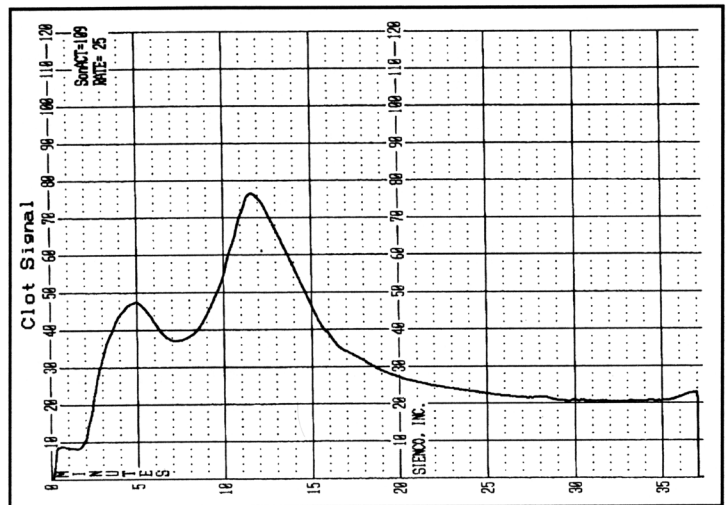
Clot retraction is rarely faster than this example with a Time to Peak of 6 minutes and full retraction in 11 minutes.



The clot retraction in this example, Time to Peak: 14 minutes and full retraction in 29 minutes, is well defined and shows good platelet function.



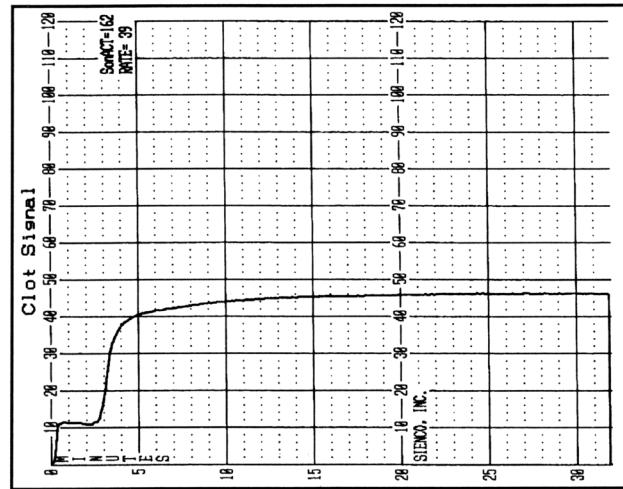
Many normal Sonoclot Signatures will begin with a small peak before the primary peak. In this example the Time to Peak is actually 11.5 minutes not 5 minutes. One useful rule of thumb for results using the SonACT P/N 800-0432 test is: The Time to Peak is often approximately half the time for complete retraction. Based on this rule of thumb and observing that complete retraction occurs in 27 minutes, the primary peak would be expected to occur at 13.5 minutes which is in close agreement with the actual Time to Peak, 11.5 minutes.



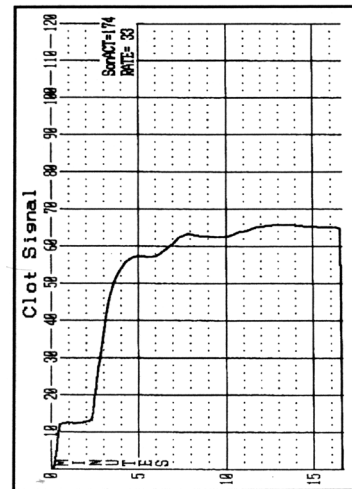
Poor Platelet Function Examples

The poor platelet function examples are presented beginning with extreme platelet dysfunction and progressing to moderate dysfunction, then to mild dysfunction.

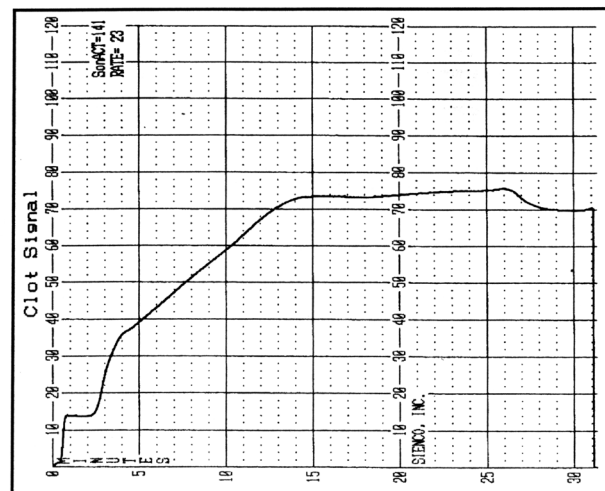
This first example of poor platelet function could be characterized as complete platelet dysfunction. The sample forms a good gel, but no retraction occurs. This sample was a pre-surgery screen for a patient undergoing a liver transplant. Additional Sonoclot Signatures from this case are included in Chapter 2: Liver Transplant Example 1.



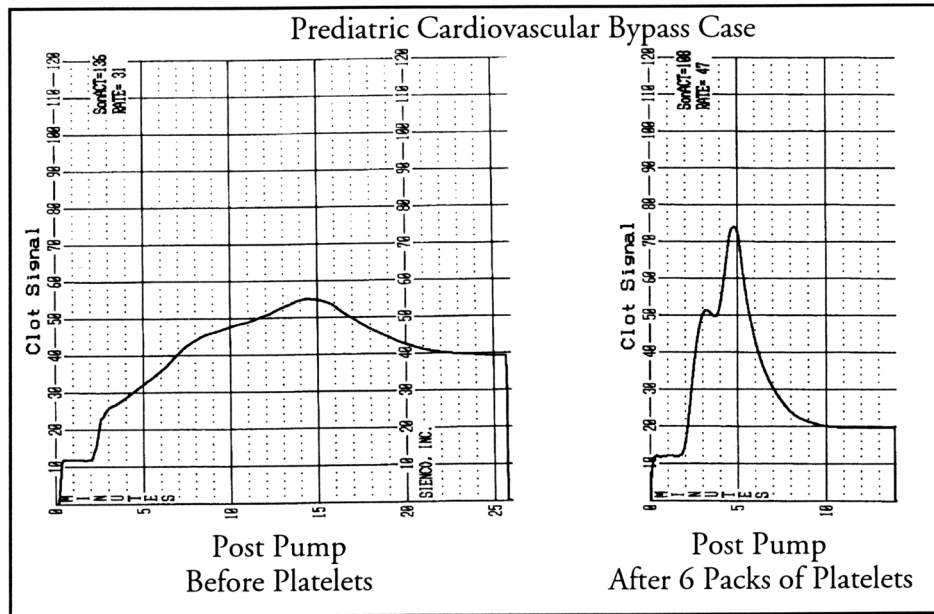
The Signature to the right shows almost no evidence of clot retraction. The slight rise occurring between 6 and 8 minutes on the Signature indicates possible platelet activation, but clot retraction did not occur. This Signature was run post protamine during cardiovascular surgery - see Chapter 2: Cardiovascular Surgery Example 2 - Platelet Dysfunction



The clinical context of this Signature is discussed in Chapter 2: Cardiovascular Surgery Example 3 - Mechanical Bleeder. This Signature shows some clot retraction, but the peak is dull and prolonged.

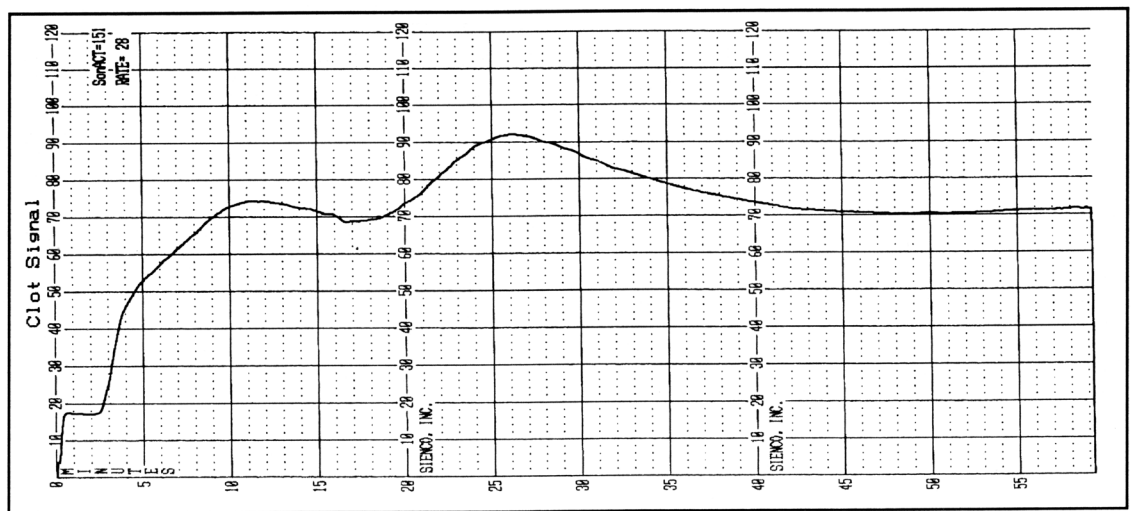


The Signatures below show the response of a 22 kg child to 6 packs of platelets after cardiovascular surgery. The Signature on the left shows both a poor gel and minimal clot retraction. The Signature on the right shows the same patient after receiving 6 packs of platelets. The post platelet Signature shows dramatic and rapid clot retraction - far greater than normal. Perhaps 6 packs of platelets was overkill.

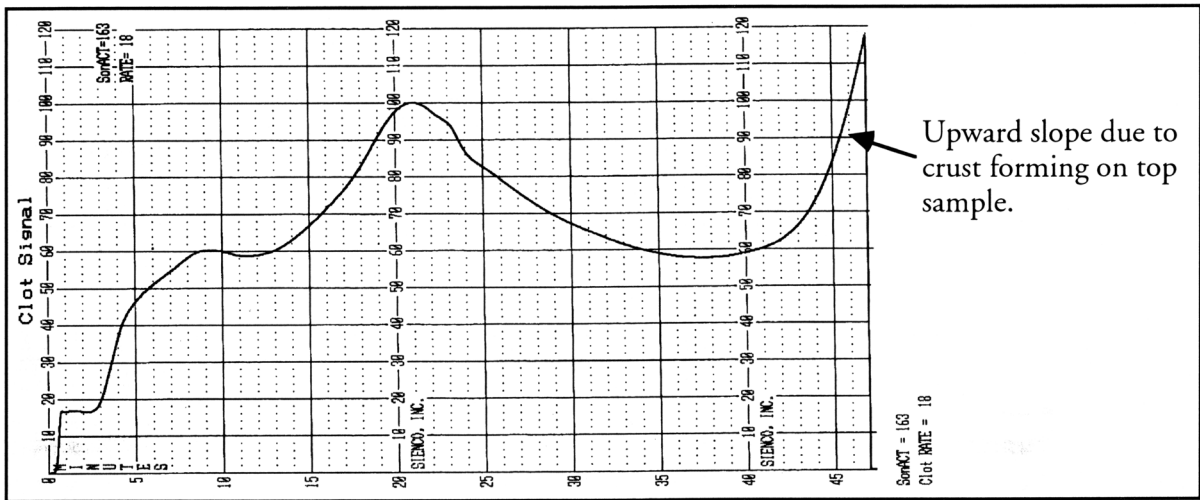


The last poor platelet function example is provided below. The Sonoclot Signature has clot retraction (Time to Peak: 26 minutes), but the retraction is prolonged. This example falls into that gray area of marginal platelet function to mild platelet function deficiency.

The platelet function is longer than average but not significantly abnormal. If this patient was oozing in the operating room or experiencing excessive post-operative bleeding, platelets would likely improve hemostatic performance. If the patient does not show signs of bleeding, then hemostasis apparently is adequate despite slow clot retraction.



Sample Forming a Crust



If a sample runs for an extended period of time, a crust may form on the top of the sample. This crust formation is captured on the Sonoclot Signature as an upward slope. This upward progression of the Sonoclot Signature will progress beyond the upper limit of the Clot Signal Scale setting. The example Sonoclot Signature shown here begins to form a crust at about 45 minutes. After 55 minutes the crust stiffened to the point that the Clot Signal was over 120.

There is no known clinical significance to a sample forming or not forming a crust. Low humidity contributes to quicker crust formation, as does weak clot retraction.

To avoid forming a crust, a drop of SonOil™ may be applied over the top of the cuvette after the probe is immersed within the sample. To do this, the heat shield must be slid upward to allow access to the cuvette while the head assembly is down.

Chapter 4 - Quality Control Procedures

Introduction

A quality control protocol should be structured to be comprehensive, well documented, convenient and low cost. Quality control of the Sonoclot Analyzer involves both verification of the Analyzer and verification of the test reagents. Verification of the Sonoclot Analyzer performance can be easily checked using either a reference viscosity oil or reference plasmas. Verification of the activation cuvette performance requires reference plasma QC.

Sienco provides both viscosity fluid and reference plasma quality control products. The reference plasmas are available in both kit and bulk packaging. The bulk packaging is appropriate for laboratory QC. The kit packaging has been designed for non-laboratory personnel using syringes that are provided within the kit rather than pipettes oriented for laboratory use.

Sienco's quality control products for the Sonoclot Analyzer are:

900-1302 Reference Viscosity Oil Quality Control (QC) Kit - This kit provides all necessary materials for running two point verification testing of the Sonoclot Analyzer. The kit contains 24 tests.

900-1318 Reference Plasma Quality Control (QC) Kit - This kit provides all necessary materials for running a two level reference plasma test to verify performance of both the Sonoclot Analyzer and activation test reagent. Quality Control Reference Plasma, distilled water, calcium chloride, Non-Activated Cuvettes with probes, and five 1 ml syringes are included. This test is best run with the Plasma QC Heating Block, 800-0618.

800-0701 Quality Control Reference Plasma - Package of ten 6 ml vials containing a lyophilized preparation of citrated animal plasma, stabilizers, and buffer. Contains no human material.

800-0703 Distilled Water - Package of ten 6 ml vials containing 5.0 ml laboratory grade distilled water.

800-0704 Calcium Chloride - Package of ten 6 ml vials containing 5.0 ml 0.02 M Calcium Chloride.

800-0705 1 ml Plastic Syringes - Package of ten 1 ml plastic syringes for use with Quality Control Reference Plasma bulk reagents and the Plasma QC Heating Block.

800-0618 Plasma QC Heating Block - This reusable heating block is a convenient tool to assist in warming and running plasma tests without the need for water baths or pipettes. This tool is designed to assist quality control testing in point-of-care environments including operating rooms, STAT labs, and intensive care units.

For the most current list of quality control products, please visit Sienco's website at www.sienco.com.

Sienco recommends that quality control procedures be run periodically as specified to ensure confidence in the Sonoclot results. Users should also follow QC requirements of local, state, and federal agencies.

Running a Reference Viscosity Oil QC Verification

The reference viscosity QC or SonoCAL™ test is a simple means of verifying proper operation of the Sonoclot Analyzer and Printer/Signature Viewer Data Collection Program. This test consists of a two point verification of the electromechanical oscillator and also ensures that the platen heating control is operating accurately. The two points are: 1) Probe-In-Air, and 2) Probe-In-SonoCAL. The Probe-In-Air is the response of the electromechanical oscillator to air. This response should be close to zero. The Probe-In-SonoCAL is the response of the electromechanical oscillator to a reference viscosity liquid. This response should be close to 53. Since the viscosity of SonoCAL is significantly temperature dependent, the Probe-In-SonoCAL test point also verifies the platen temperature regulation.

Frequency of Testing

The reference viscosity QC procedure is simple, easy to perform, and requires little operator time. This verification takes less than a minute to setup and results are available in about 10 minutes. Sienco recommends that you run the reference QC procedure once each day prior to sample testing. More frequent testing may be required to comply with local, state, and federal QC requirements.

Initial Preparation Before Running a Reference Viscosity QC Test

In order to run the reference viscosity QC procedure you need the Sonoclot Analyzer System and the following components found within the Quality Control Kit (P/N 900-1302):

- | | |
|---|--|
| 1 | Probe |
| 1 | Quality Control Cuvette |
| 1 | SonoCAL fluid vial |
| 1 | Quality Control Instructions and Record Form |

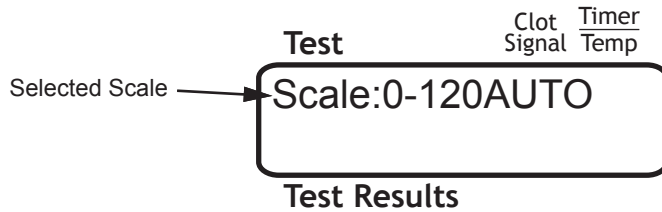
Running a Reference Viscosity Oil QC Test

The Sonoclot Analyzer should maintain the platen temperature at 37°C. If the Sonoclot Analyzer has just been turned on, allow the instrument to warm up with the head assembly in the down position until the temperature on the LCD reads. “37.0°.” (Warm-up takes approximately 15 minutes).

If you are using the Sonoclot Analyzer with a graphics printer, check that the Printer is ON and ON-LINE.

If you are using the Sonoclot Analyzer with Signature Viewer, check that the computer is turned on and that the Signature Viewer program is running. Press the SELECT TEST/(START/STOP) switch to the SELECT TEST position until “SonoCal” appears on the LCD display.

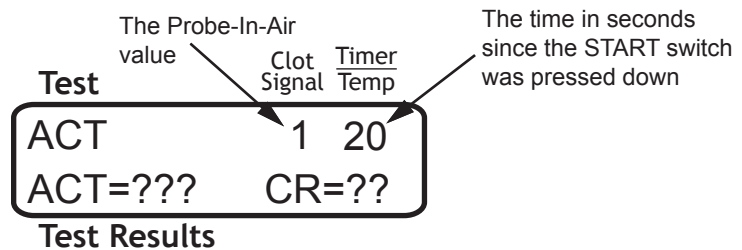
Set the Clot Signal scale to 0-100, 0-100 Auto, 0-120, or 0-120 Auto by turning the scale knob on the back of the unit until the LCD display shows the desired scale. Whenever the scale knob position is changed, the new selected scale is shown on the top line of the LCD display. The selected scale message will be displayed for 2 seconds after turning the scale knob.



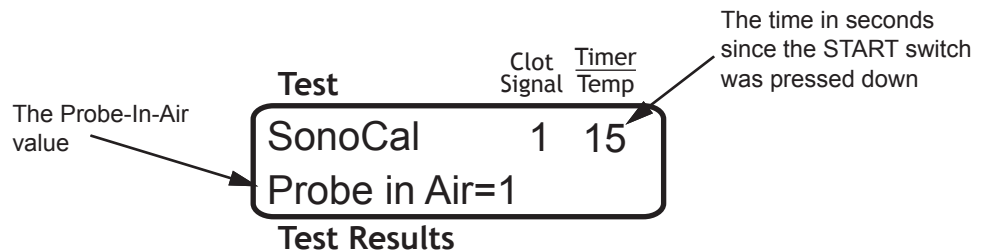
Open head assembly by tilting it backwards.

With a slight twisting motion, insert a clean disposable tubular probe onto the probe mount hub inside the head assembly until it is fully seated. Insert a red quality control cuvette into the cuvette holder with a slight twisting motion. Ensure that the cuvette is fully seated in the cuvette holder with the bottom of the cuvette in contact with the cuvette holder. Close the head assembly and momentarily depress the SELECT TEST/(START/STOP) switch to the START/STOP position.

If you are using a graphics printer, wait at least 20 seconds. The LCD display will now show the Probe-In-Air value below the Clot Signal legend.

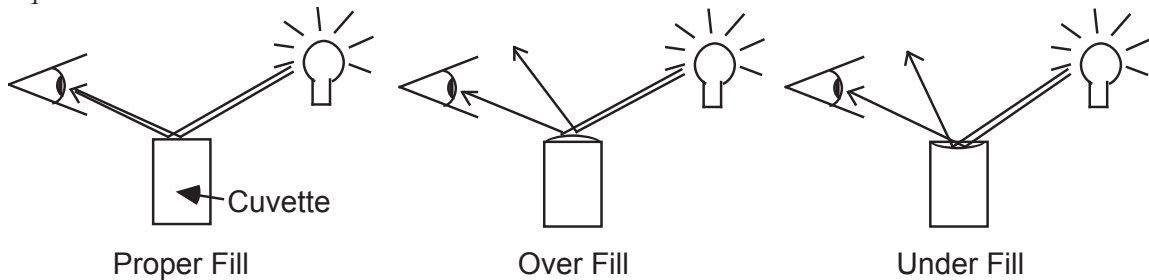


If you are using Signature Viewer, the Probe-in-Air value will be reported on the LCD display and in Signature Viewer after 15 seconds.



Record this Clot Signal Value on the Quality Control Record form in the Probe-In-Air column. This result should be ≤ 3 .

Next, open the head assembly and fill the cuvette with the SonoCAL liquid so that the fluid is exactly level with the rim of the cuvette. Accurate fill can be observed by noticing the reflection of light off the fluid surface. A properly filled cuvette will have a flat surface with minimum reflection distortion (see diagram below). There should be no air bubbles in the SonoCAL liquid in the cuvette.

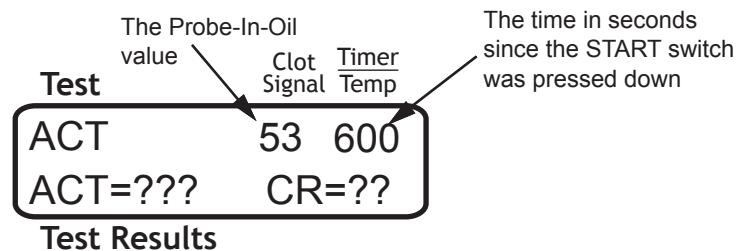


Visual Verification of Accurate SonoCAL Fill

Close head assembly to lower the probe into the SonoCAL liquid.

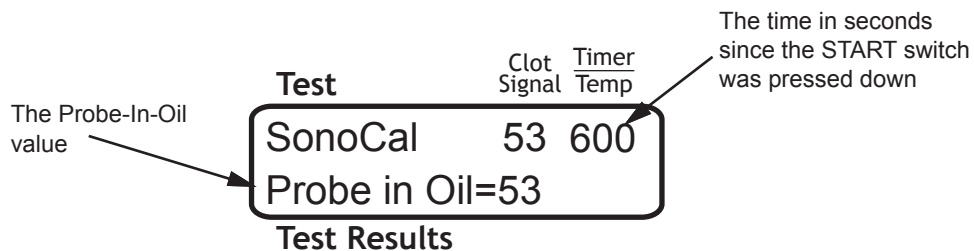
If you are using a graphics printer, immediately depress the SELECT TEST/(START/STOP) switch to begin timing the QC verification. The stir motor will run for the first 10 seconds of the verification. No stirring will occur since the QC cuvette does not contain a stir bar. As the test proceeds, the measurement results are taken from the Sonoclot Signature on the Printer. During the verification analysis no Onset or Clot RATE will be found.

After at least 10 minutes have passed, the display will read something like:



After the time displayed exceeds 600 seconds (10 minutes), momentarily depress the SELECT TEST/(START/STOP) switch up to end the test.

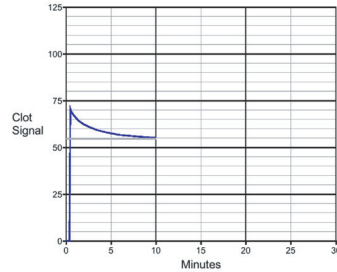
If you are using Signature Viewer, **DO NOT PRESS THE SELECT TEST/(START/STOP) SWITCH.** The test will automatically begin collecting data once you close the head assembly. After ten minutes, the Probe-in-Oil will be reported on the LCD display and in Signature Viewer, and the test will automatically stop.



On the Quality Control Record Form, record the Signature value at 10 minutes in the column marked "Clot Signal SonoCAL @ 10 min."

Open the head assembly. Using the probe extractor, remove the tubular probe and the red cuvette and discard them. Lower the head assembly to maintain temperature control of the head assembly.

When the Printer paper has stopped advancing, tear off the paper and look at the Signature, or look at the Signature in Signature Viewer. It should look something like the Sonoclot Signature below.



The value should normally be between 50 and 58. If the value is outside this range, see the Operational Precautions and Limitations at the end of this section. If the value continues to be outside this range for several tests in a row and the procedure has been followed exactly, contact Sienco, Inc. at 1-800/432-1624.

Operational Precautions and Limitations

Since the Sonoclot Analyzer is a very sensitive instrument, the slightest variation in procedural technique can produce noticeable differences during quality control tests. If the test results are outside of the stated value of 50-58, check the following items:

- 1: Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.
- 2: The SonoCAL sample must be accurately filled. Under- or over-filling a cuvette will affect the results. Inaccurate filling is the most common error when running the reference viscosity QC test.
- 3: The probe must be fully seated on the probe mount hub.
- 4: The cuvette must be fully seated in the cuvette holder.
- 5: The Sonoclot Analyzer requires a warm-up time to thoroughly heat the Head Assembly. Not allowing the Sonoclot Analyzer to warm up to 37 °C will vary the numerical reading. A low instrument temperature will yield a high numerical reading. This is one reason why we recommend leaving the Analyzer on continuously.
- 6: Mechanical factors: Fragments of dried blood in the transducer hub of the head assembly can interfere with the electromechanical oscillator and alter the results.
- 7: The Reference Viscosity Oil QC test does not validate the performance of activation reagents. Plasma QC testing should be run to QC activation reagents.
- 8: If the lamp bulb under the head assembly is not on, the Clot Signal at 10 minutes will be slightly elevated. See Chapter 6 for instructions on replacing the lamp bulb.
- 9: If the Sonoclot Analyzer is being used with Signature Viewer and the SELECT TEST/(START/STOP) switch is depressed after filling the cuvette with the SonoCal fluid, Signature Viewer will start a new QC test. This will result in the calculation of a new probe-in-air value. Since the cuvette is now filled with oil, the new Probe-in-Air value will be incorrect. Should this happen, remove the cuvette and probe and start over.

Running a 900-1318 Reference Plasma QC Kit

This procedure describes how to validate and document the performance of the Sonoclot Analyzer and activation cuvettes using Sienco's 900-1318 Reference Plasma QC Kit. This procedure has been designed for use with syringes—no pipettes or water baths are needed. This kit contains a lyophilized animal plasma and Non-Activated cuvettes to be run as an abnormal control. Initial test result acceptance ranges are provided for reference purpose only. Actual test result ranges should be determined based on historical performance of the reference plasma with the specific activation cuvette.

Intended Use

This Reference Plasma Quality Control Kit is for use with the Sonoclot® Analyzer System to verify performance of activation cuvettes and/or the Sonoclot Analyzer. If it is being run to QC activation cuvettes only, testing should be performed prior to the use of a new shipment and monthly throughout use of the stock. If this plasma kit is being run to QC both the Sonoclot Analyzer and activation cuvettes, then testing should be performed once each day prior to sample testing. In either case, more frequent testing may be required to comply with local, state, and federal QC requirements.

Summary and Principles

The use of coagulation controls in coagulation testing is an important quality control procedure. A two level approach is used to perform quality control of the activator used in an activated coagulation test. Level I is run with the activator on the reference plasma. Level II is run with the non-activated test on the reference plasma. These two tests confirm the effectiveness of the activator to perform its intended coagulation activation.

Reagents

Each Kit contains:

- 1 vial Reference Plasma Control - 6 ml vial containing a lyophilized preparation of citrated animal plasma, stabilizers and buffer. Contains no human material.
- 1 vial Distilled Water - 6 ml vial containing 5.0 ml laboratory grade distilled water.
- 1 vial 0.02 M Calcium Chloride - 6 ml vial containing 5.0 ml 0.02 M Calcium Chloride.
- 5 plastic 1 ml syringes
- 2 Non-Activated test cuvettes (blue with clear caps, stir bars, and probes)

The Quality Control Reference Plasma is manufactured for Sienco, Inc. by Analytical Control Systems, Inc., Fishers, Indiana, 46038.

Storage and Stability

When stored at 2-8° C, all unopened vials are stable to expiration date. Unreconstituted plasma control vials are stable for 7 days when stored at room temperature. After reconstitution, the plasma controls are stable for 4 hours at room temperature. Calcium chloride and distilled water are good until expiration date after opening and may be stored at room temperature.

Caution: To avoid contamination, a clean syringe should be used with each reagent. If the distilled water or calcium chloride looks cloudy, there is evidence of contamination and the vial should be discarded.

Additional Equipment:

- (1) Sonoclot Analyzer
- (2) Reference Plasma QC Heating Block (Sienco part #800-0618)

Sonoclot Analyzer Preparation Before Running a Reference Plasma QC Test

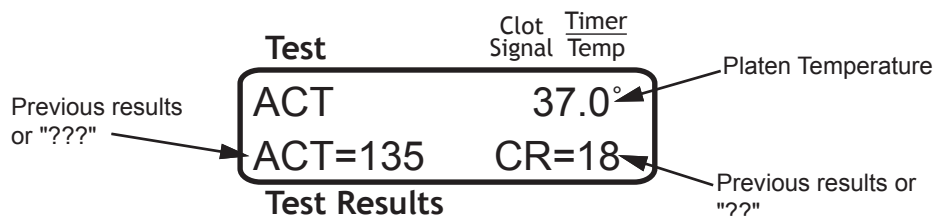
Cuvettes should be placed in the warming holes in advance so they will be warm and ready for immediate use. **Sharply tap** the cuvette on a hard surface to dislodge any activator powder from the sides and lid of the cuvette. Prior to placing each cuvette in the warming well, insert a probe into the recess of the cuvette cap for convenient storage.

If the Sonoclot Analyzer has just been turned on, allow it to warm up with head assembly in the down position until the Sonoclot Analyzer reaches the desired controlled temperature.

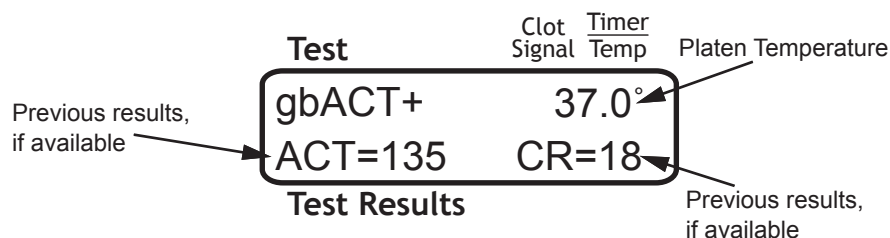
Check that the Printer is ON and ON-LINE or that the Signature Viewer Data Collection program is running on your computer.

Prior to running a sample, the Sonoclot Analyzer display should display the following:

Display with graphics printer:

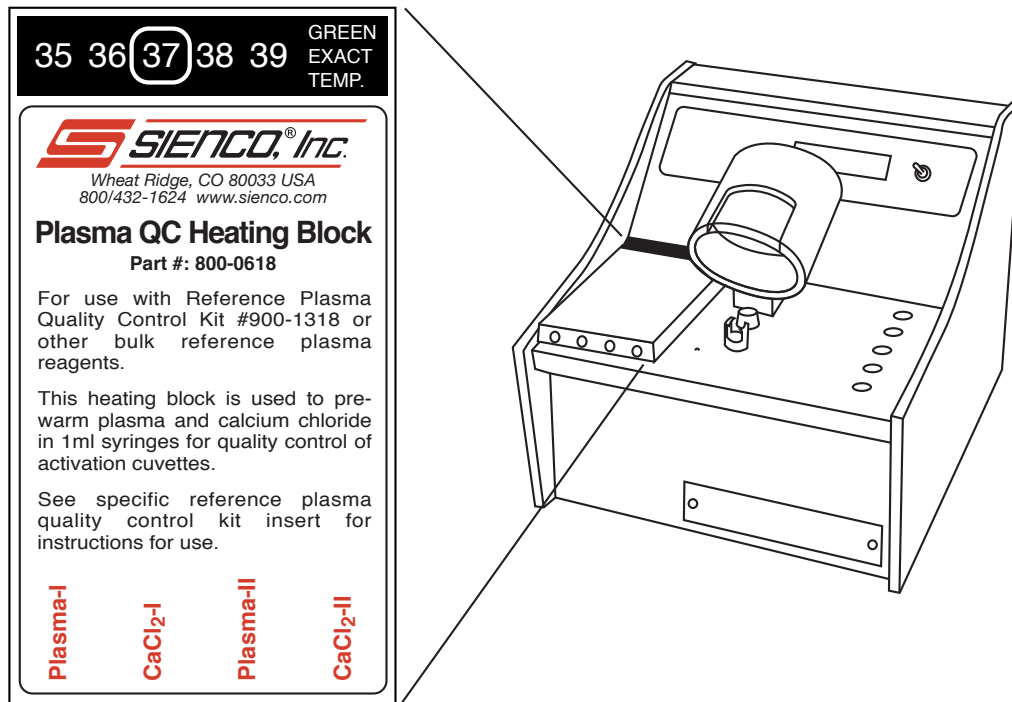


Display with Signature Viewer:



The Clot Signal Scale setting affects scaling of the Sonoclot Signature. This setting is normally pre-set to the operator's desired value. The default setting is appropriate for plasma QC tests. See Chapter 5 - Configuring the Sonoclot Analyzer if you wish to modify this setting.

Place the Reference Plasma QC Heating Block onto the Sonoclot Analyzer. Allow about 5 minutes for the heating block to reach operating temperature. Check the temperature indicator strip to ensure the heating block is within the 35-39 °C operating range before inserting syringes. The heating block and its orientation on the Sonoclot Analyzer are shown below.

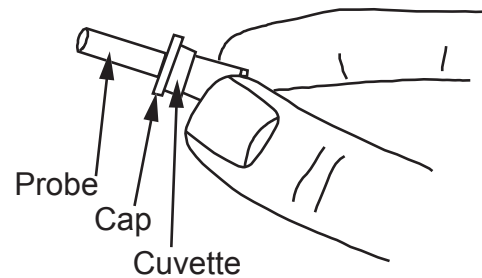


Heating Block for Syringes

Cuvette and Probe Setup

Open head assembly by tilting it backwards.

Insert a clean disposable tubular probe over the probe mount hub inside the head assembly. The probe must be fully seated on the probe mount hub for proper operation. If the probe had been placed into the recess of the cuvette cap, then the cuvette can be used to mount the probe to the probe mount hub. Use the cuvette as a convenient probe mounting tool, as pictured, by holding the cuvette to position the probe over the probe mount hub. Gently push the cuvette to push the probe fully over the probe mount hub. When the probe is fully seated on the probe mount hub, remove the cuvette; the probe remains on the hub.



If you are using an activated test cuvette, the activated cuvette contains a stir bar and activation powder. **Sharply tap** the cuvette on a hard surface to dislodge any activation powder from the sides and lid of the cuvette.

Remove the lid from the cuvette before placing the cuvette in the cuvette holder. To remove the cuvette lid, place the cuvette in a warming hole and pop the lid off with your thumb. **Do not remove the cuvette lid while the cuvette is in the cuvette holder;** the cuvette holder may break.

With a slight twisting motion, insert the cuvette into the cuvette holder. Ensure that the cuvette is fully seated in the cuvette holder.

Plasma Preparation

Remove the metallic seal and rubber stopper from the Quality Control Reference Plasma and distilled water vials. Add 1.2 ml of distilled water to the plasma control. A 1 ml syringe provided in the kit may be used by adding 0.6 ml distilled water two times to achieve a total volume of 1.2 ml. Avoid contact between the syringe tip and plasma solution. Discard syringe. Allow plasma vial to stand until the contents are dissolved. This will take approximately 5 minutes. Gently swirl vial.

Carefully draw 0.18 ml reconstituted reference plasma into a new 1 ml syringe and place in heating block well labelled Plasma-I. Draw an additional 0.18 ml reconstituted reference plasma into another 1 ml syringe and place the syringe in heating block well labelled Plasma-II.

Remove the metallic seal and rubber stopper from the calcium chloride vial. Carefully draw 0.18 ml calcium chloride into a new syringe and place in heating block well labelled CaCl₂ -I. Repeat this step with a second syringe and place in heating block well labelled CaCl₂ -II.

Allow the syringes to warm for 5 minutes.

Running the Sonoclot Analyzer

At this point, an activation cuvette should already be inserted in the cuvette holder and a probe should be attached to the probe mount hub. If not, then review this section for proper test setup. Sequentially dispense the contents of the Plasma-I and CaCl₂ -I syringes into the activation cuvette. Immediately depress the SELECT TEST/(START/STOP) switch. The magnetic stirrer will automatically rotate and the Printer will begin to print or Signature Viewer will begin data collection.

Display with a graphics printer:

Test	Clot Signal	Timer Temp
ACT		
Mixing		
Test Results		

Display with Signature Viewer:

Test	Clot Signal	Timer Temp
gbACT+		
Mixing		
Test Results		

The display will now read:

and if you are using a graphics printer, the Printer will start printing.

Display with a graphics printer:

Test	Clot Signal	Timer Temp
ACT		
Close Head		
Test Results		

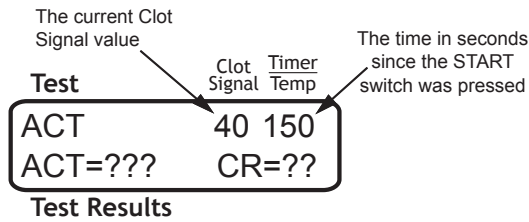
Display with Signature Viewer:

Test	Clot Signal	Timer Temp
gbACT+		
Close Head		
Test Results		

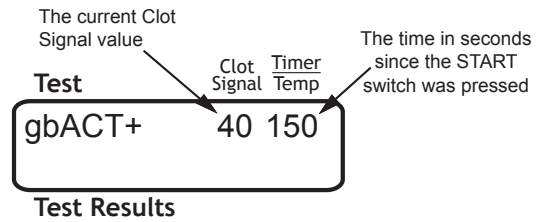
After 10 seconds, the Sonoclot Analyzer will beep and the display will read:

Close the head assembly.

Display with a graphics printer:



Display with Signature Viewer:

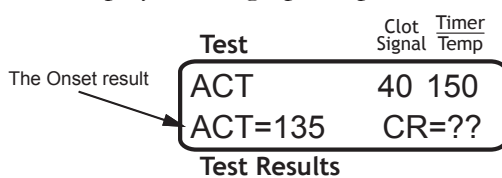


After another 5 seconds, the display will read:

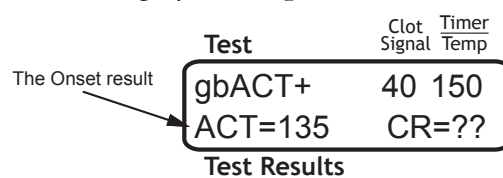
The question marks are displayed because no results have been found at this time.

The plasma sample is initially a liquid. After several minutes, the sample begins to evolve into a clot. The instrument detects this initial clot formation, beeps and displays the time that the sample remained a liquid as the ACT result on the front panel.

Display with a graphics printer:

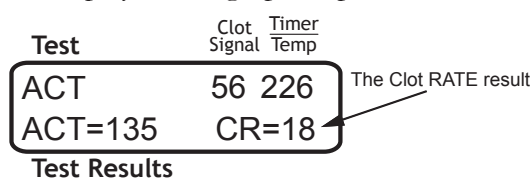


Display with Signature Viewer:

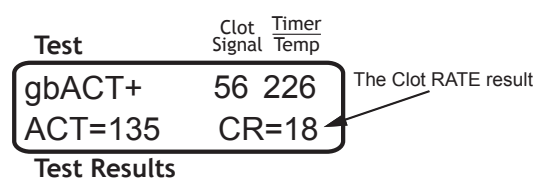


During the next several minutes of the analysis, the fibrinogen converts into a fibrin gel. The rate of the fibrin formation is clinically significant for some Sonoclot tests. The Sonoclot Analyzer determines this rate of formation by calculating the rate of change in the Clot Signal value. When the Clot RATE result is available, the Analyzer beeps and reports the result on the LCD display and Graphics Printer/Signature Viewer.

Display with a graphics printer:



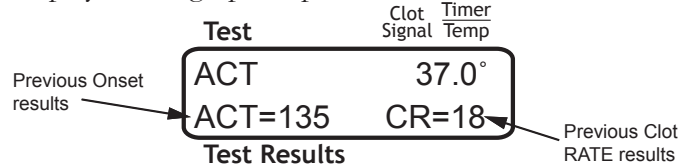
Display with Signature Viewer:



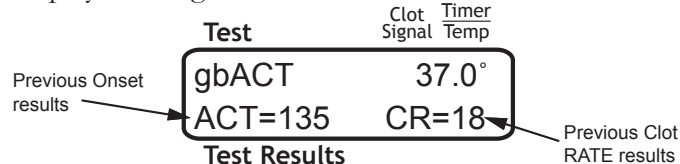
After the Clot RATE has been determined, the Analyzer beeps and the display appears as:

After the ACT and Clot RATE results are found, the analysis is complete. At this time terminate the analysis by momentarily depressing the SELECT TEST/(START/STOP) switch to stop the test. The display will now contain results from the test as shown below.

Display with a graphics printer:



Display with Signature Viewer:



Open the head assembly. Remove the tubular probe (using the probe extractor) and the cuvette and properly discard them. Lower the head assembly to maintain temperature control of the head assembly.

After the Plasma I test results are available, repeat this procedure using a Non-Activated test cuvette and the Plasma-II and CaCl₂ -II syringes.

Expected Values

The Plasma I test gives results in the normal range for Onset for the specific activated cuvette being tested. The Plasma II test gives prolonged Onset results in the abnormal range. Expected value ranges are provided in the table below. These values are provided only as a guideline. Each Sonoclot user should determine their own expected values for the particular tests being used. Please refer to the Reference Plasma Quality Control Kit instructions for the most current expected values.

EXPECTED VALUES	
Type of Test	Acceptance Specifications
Non-Activated (control)	≥ 350 seconds
gbACT+	≤ 315 seconds
SonACT	≤ 205 seconds
aiACT	≤ 190 seconds
kACT	≤ 180 seconds

Limitations of the Procedure

Failure to obtain the expected control values may be an indication of product deterioration or improper testing. A study of each component of the system (reagents, instrument, and technical procedure) should be performed so that the actual problem may be identified.

Performance

The Onset CV should not exceed 15%. Each user should establish a mean and standard deviation on a month-to-month basis as a quality control monitor.

The test results should provide confidence in the performance of the activation cuvette. This testing should confirm that the stock performed as intended prior to its initial use and continued to perform as intended throughout the stock use or shelf life.

Documenting the Reference Plasma QC Test Results

The results of the reference plasma QC test for the Plasma-I and Plasma-II tests should be recorded on a Quality Control Record form. A sample form is included below.

Sonoclot® Coagulation & Platelet Function Analyzer Quality Control Report for Reference Plasma Testing of Activated Clotting Tests

Sienco, Inc.
7985 N. Vance Drive, Ste 104
Arvada, CO 80003 USA
303-420-1148 (phone)
303-379-4403 (fax)
support@sienco.com (e-mail)

Institution: _____ Sonoclot Analyzer Serial Number: _____
Department: _____ Lab Supervisor: _____

By	Time	Date	Reference Plasma Lot #/ exp date	Type of Activated Test	Lot Number of Activated Test	Acceptance Specification	Onset/ACT Result (seconds)	Accept ✓ if OK

Operational Precautions and Limitations

The quality of the Sonoclot Analyzer test results depend heavily on proper technique. Carefully observe or apply the following precautions.

- 1: Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.
- 2: Handle the reference plasmas as if capable of transmitting infectious agents.
- 3: Proper incubation of the sample is important to obtain accurate results.
- 4: Proper recalcification is important to obtain accurate results. Either too little or too much calcium chloride will prolong the Onset and attenuate the Clot RATE.
- 5: The plasma sample should not be exposed to any activating reagent prior to recalcification in order to obtain accurate results.
- 6: The disposable probe must be fully seated against the shoulder of the probe mount hub to avoid interference between the probe and stir bar.
- 7: The disposable cuvette must be fully seated in the cuvette holder to avoid interference between the probe and stir bar.
- 8: Never reuse either a disposable probe or disposable cuvette. Thrombin contamination may result.
- 9: Use proper handling techniques when disposing of probes and cuvettes to avoid contact.
- 10: Avoid contaminating the electromechanical transducer in the head assembly by keeping blood, dirt or other contaminants away from the probe mount hub.
- 11: When using the Sonoclot Analyzer with Signature Viewer, if the proper test is not selected on the instrument, the test run and/or results may be affected (for example, there is no mixing cycle when the SonoCal QC test is selected). Check that the correct test is selected before running a test.

Chapter 5 - Configuring the Sonoclot Analyzer

Overview

The Sonoclot Analyzer is factory configured for general purpose hemostasis analysis and normally does not require any user customization. However, the Sonoclot Analyzer can be configured in several ways to support different applications. This chapter describes how to perform this custom configuration and is intended to be used only by the person with responsibility for initial setup or an experienced user. Before configuring your Sonoclot Analyzer, please first read this entire chapter.

The available configuration features of the Sonoclot Analyzer are controlled by the firmware program within the instrument. Since revisions to the firmware program may be made in the future, it is important that you follow the configuration instructions for the specific firmware version within your Sonoclot Analyzer. Check that your Sonoclot Analyzer has firmware revision 4.0, which is easily found on the heading of each Sonoclot Signature printed on a graphics printer. Below is an example of this heading.

```
SIENCO Sonoclot® Coagulation & Platelet Function Analyzer  
Firmware Version 4.0.0 Copyright 1992-2004 Serial Number 0639  
Board Rev 3.9 Scale: 0-120 Auto      Temperature Setpoint: 37.00  
Automatic shutoff after 60 minutes
```

If you are using Signature Viewer, turn the instrument off using the power switch located on the back of the instrument. Then turn the instrument back on while watching the LCD display. The firmware version will be displayed on the LCD display as a part of the instrument start up sequence.

If the Firmware Version on the Sonoclot Analyzer you have is not 4.0, then contact Sienco for assistance.

For firmware versions 4.0.x, the following features are user configurable.

Auto Stop Time: Allows you to set the time at which the printer will discontinue printing.

Clot Signal Scale: The Clot Signal full scale for the Sonoclot Signature can be adjusted for any of eight different settings ranging from 0-25 to 0-200. There are also two settings that allow automatic rescaling so that information is not lost when the Clot Signal moves outside the full scale range setting.

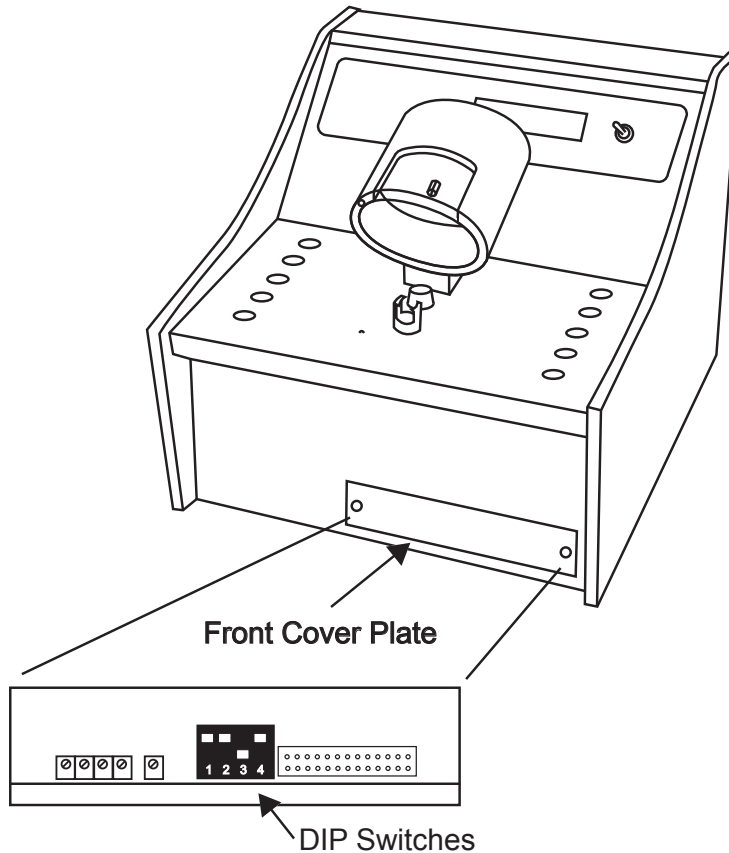
Connecting to a Computer: The Sonoclot Analyzer can be configured so that the Clot Signal data can be sent to a computer. In this configuration, the Printer is not used.

Dip Switch Settings

Two features on the Sonoclot Analyzer are configured through dip switches located behind the front cover plate on the Sonoclot Analyzer. These features are:

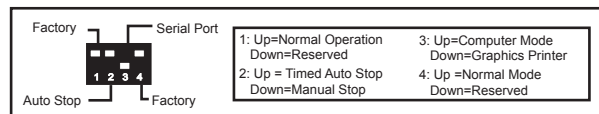
- Enabling/disabling the autostop time for an analysis
- Selecting the serial port for either the Printer or ASCII text

This section only describes how to access the dip switches and identifies the default settings. Details for how to determine what dip switch settings are appropriate for a specific configuration are provided in later sections of this chapter.



To access dip switches, remove the front panel with a 1/16 Allen wrench.

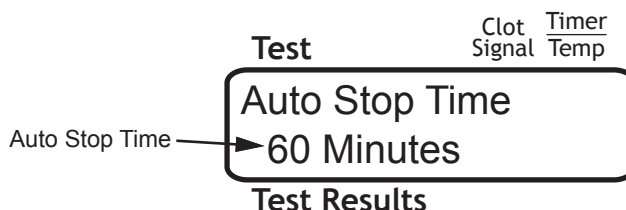
With regards to the dip switches, switches 1 and 4 should always be set to the UP position. If you want the printer to automatically stop printing a Signature after a certain amount of time, set switch 2 in the UP position. To keep printing until the STOP switch is raised, set switch 2 in the DOWN position.



Dip switch 3 selects the serial port for either the printer or ASCII text (for running the Sonoclot Analyzer with Signature Viewer Data Collection software). The default setting for this switch is in the DOWN position if you purchased your Sonoclot Analyzer with a graphics printer, and in the UP position if you purchased your Sonoclot Analyzer with Signature Viewer Data Collection software. To change this setting, set switch 3 in the DOWN position to run the Sonoclot Analyzer with a graphics printer or to the UP position to run the Sonoclot Analyzer with Signature Viewer.

Changing the Auto Stop Time

The Auto Stop Time feature allows you to set the time at which the printer will graph the Sonoclot Signature during a test analysis. You can inspect or modify the Auto Stop Time through use of the SELECT TEST/(START/STOP) switch. To do this first make sure that the Sonoclot Analyzer displays the type of test and temperature in the upper line of the LCD display¹. Next, hold the SELECT TEST/(START/STOP) switch in the SELECT TEST position for three seconds. When the display shows:



release the switch. The Auto Stop Time can be adjusted from 10 minutes up to 100 minutes. To change the time, lower the SELECT TEST/(START/STOP) switch until you have reached the desired setting. To return to normal operation or the next option, momentarily raise the SELECT TEST/(START/STOP) switch to the SELECT TEST position.

NOTE: The Auto Shut-off feature is only available if **DIP Switch #2** is in the **UP** position (Factory Setting is **UP**). If the LCD does not display Auto Stop Time after holding the SELECT TEST switch up for several seconds, then this feature is disabled. Refer to the section on setting the dip switches to enable this feature.

Changing the Clot Signal Scale

The Clot Signal scale for the Sonoclot Signature can be adjusted for any of eight different settings ranging from **0-25** to **0-200**. There are also two settings that allow automatic rescaling so that information is not lost when the Clot Signal moves outside the full scale range setting.

The Sonoclot Analyzer allows the user to select the scale size recorded on the Printer. This feature provides the flexibility to accurately graph different types of blood samples. Use the following table to determine a preferred Clot Signal Scale.

Test	Recommended Scales
Blood viscosity	0-25, 0-40
Platelet poor plasma	0-50, 0-75
Whole blood	0-100, 0-100 Auto, 1-120, 0-120 Auto
Other scales	0-150, 0-200

The two AUTO scales, **0-100 Auto** and **0-120 Auto** are useful in capturing Sonoclot Signatures for test samples that exceed the initial maximum scale. If during an analysis the Clot Signal exceeds the initial maximum scale setting, the scale will automatically increase to the next highest setting, up to the highest scale setting.

¹If the Analyzer does not display the test and temperature, momentarily depressing the SELECT TEST/(START/STOP) switch to the START/STOP position will stop any test in progress and return the Analyzer to the ready state.

For your applications, if you find that the Sonoclot Signatures too frequently go off the Printer scale, then increase the scale setting. If the Sonoclot Signatures are compressed into the lower part of the graph, decrease the scale setting. Once you have determined an appropriate scale for your application, stick with it. Users are sometimes confused if they see a Sonoclot Signature printed on a new scale they are not accustomed to.

The Clot Signal Scale is changed by turning the scale knob on the back of the Sonoclot Analyzer. Simply turn the knob until the white line points to the desired setting. For your convenience, the scale is also displayed on the LCD while you are turning the knob. When you find the proper setting, stop at that point. The message on the display will disappear after 2 seconds.

If you change the scale while the Printer is printing, the new scale takes effect 2 seconds after the knob is turned. This delay allows you to display the current scale by turning the knob one position and then return it back quickly without changing the Sonoclot Signature being printed.

Changing the **CLOT SIGNAL SCALE** alters the overall shape of the Sonoclot Signature. In order to avoid confusion in reading a Sonoclot Signature, it is recommended that once settings for the Sonoclot Signature are configured for anticipated use, the configuration should not be modified.

Configuring the Sonoclot Analyzer to Send Data to a Computer

The Sonoclot Analyzer may be connected to a computer instead of the Printer. In this configuration, the Sonoclot Analyzer sends filtered Clot Signal data to the computer in ASCII format rather than the graphics data that is sent to the Printer.

To run the Sonoclot Analyzer with a computer rather than a Printer, set DIP Switch #3 in the UP position. The Sonoclot Analyzer may be connected to an IBM compatible computer with a straight through RS-232 cable.

The serial communication specifications are:

Receptacle on Sonoclot Analyzer: 25 pin D-Sub socket

Baud Rate	9600 bps
Date bit length	8 bits
Parity	NONE
Stop bits	1
Handshake Protocol	Hardware

Serial Input/Output (to/from instrument) Signal Pins

<u>Pin</u>	<u>Name</u>	<u>I/O</u>	<u>Description</u>
2	Data In	1	serial receive data - not used
3	Data Out	0	serial transmit data
4			connected to pin 5
5			connected to pin 4
6	Ready	0	set when instrument is on, connected to pin 8
7	GND		ground
8		0	connected to pin 6
20	Busy		Must be high for Sonoclot to send data

Changing the Line Voltage Setting

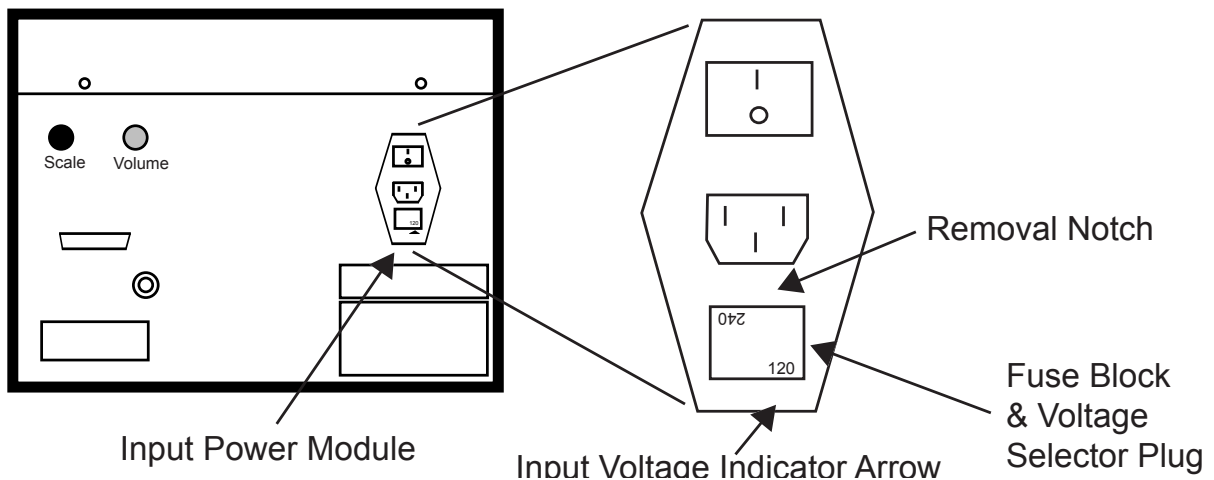
Sonoclot Analyzer

The Sonoclot Analyzer can be configured for common input voltages used throughout the world. The Sonoclot Analyzer has input line voltage settings and each setting supports a wide range of input line voltages. The settings and the corresponding input voltage ranges are:

120 Vac for 100 to 130 Vac
240 Vac for 210 to 260 Vac

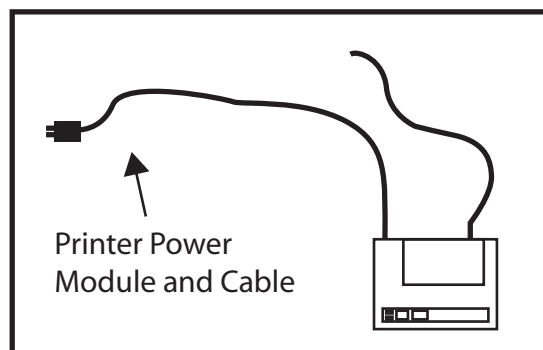
The input voltage setting is set with the Fuse Block & Voltage Selector Plug (Voltage Selector Plug) on the Input Power Module on the rear of the Sonoclot Analyzer. This plug can be removed by first removing the power cord and then inserting a small blade screwdriver into the removal notch and prying the Voltage Selector Plug out. The Voltage Selector Plug may be inserted into the Input Power Module in either of two different orientations: 120 or 240. The input voltage setting is selected by inserting the Voltage Selector Plug oriented so that the Input Voltage Indicator Arrow points to the desired input voltage range.

Rear View of Sonoclot Analyzer



Printer

The input voltage for the Printer is determined by the Printer Power Module. Two modules are available: 120 Vac or 240 Vac. Each module is labeled with its required input voltage range.



Chapter 6 - Maintenance and Troubleshooting

This chapter covers normal maintenance, troubleshooting and factory service for the Printer and Sonoclot Analyzer. After reviewing the following information, if you are still experiencing problems call the Sienco Service Department at 800/432-1624 or 303/420-1148.

Printer Maintenance

Loading Thermal Paper

To re-load Printer paper, carefully follow these instructions. Using your thumb, pull paper holder cover towards the back of the Printer and lift cover upwards. Cut the beginning of the paper in an inverted “V” and set the roll on the cover so that the start of the roll feeds from the bottom. Push the paper into the inlet until you can see top of the paper from the paper cutter. With the printer OFF LINE, press the feed switch until the paper catches on the roller and starts feeding. Advance the paper; close the cover; and tear-off the “V”.

Printer Troubleshooting

The following is a list of areas to check if you have any problems with your Sienco Sonoclot Analyzer or Printer. If after checking these procedures you are still experiencing problems, call the Sienco Service Department at 800/432-1624 or 303/420-1148.

Printer fails to print

Check to ensure that the cables are securely connected and Printer is plugged in, ON and ON-LINE. The Printer should begin printing when the START switch is lowered. To run a Printer self test, turn off the Printer. Next, while pressing down on the paper feed switch, turn the Printer ON and release paper feed switch. The self test will generate fonts in condensed, ordinary and double-width printer mode.

Printer appears to print but nothing appears on the paper

If the paper roll has been installed upside down, characters will not appear. Follow the instructions above to re-load the thermal paper.

Printer occasionally prints garbage characters

This may happen if the buffer for print characters fills and characters are lost. Reset Printer by turning it off and then back on.

Printer OFF-LINE lamp is flashing

This indicates the Printer paper has run out. Instructions on how to re-load paper are found at the top of this page.

Printer ON-LINE and OFF-LINE lamps are on

Turn off power switch and remove any objects that may be preventing the head from returning to the home position. If the room temperature is extremely cold, this will also cause these lights to flash, since the Printer must be in a location where the temperature is between 0 °C to 40 °C. Turn ON the power switch.

Printing is very light or very dark

A low grade of thermal paper will make a difference in the quality of the output. Printer paper may be purchased from Sienco, P/N 800-0518. We recommend it be stored in a cool, dark place.

Printer stops printing before an analysis is complete

The Sonoclot Analyzer is factory set to stop printing after a Signature has been running for 60 minutes. If you would like to change this time, see Chapter 5 Changing the Auto Stop Time for this option.

Printer scale changes in the middle of a Signature

If the scale knob is set to either AUTO 100 or AUTO 120, the scale will change if the Clot Signal exceeds the maximum scale value. This will also occur if the scale knob is manually turned while a Signature is printing.

Sonoclot Analyzer Maintenance and Service

Precautions to Improve Analyzer Reliability

The reliability of the Sonoclot Analyzer depends heavily on proper technique. Carefully observe or apply the following precautions.

- 1: Always insert the probe by pressing the probe straight over the probe mount hub. **Avoid moving the probe mount hub sideways. This is the single most important point in Sonoclot reliability!**
- 2: Always remove the cap from the test cuvette prior to placing the cuvette into the cuvette holder. If the cap is not removed, the electromechanical transducer can be damaged when the head is lowered - crushing the probe into the cuvette cap.
- 3: Always remove the probe by pulling the probe straight away from the probe mount hub. **Avoid moving the probe mount hub sideways.**

Cleaning

Cleaning should be performed after use to reduce any bio-hazard risk. The instrument may be sprayed or wiped with a disinfectant approved by your institution. **Keep the head closed when spraying any cleaner to avoid contaminating the transducer inside the head.** Always lightly spray or wipe the instrument to avoid excess wetting. Use a wipe to clean around the cuvette holder or inside the head. Only clean the probe mount hub (located near the transducer) if it is absolutely necessary. The transducer attached to the probe mount hub is easily damaged by any debris or liquid.

Do not use isopropyl alcohol or other solvents on the front panel of the Analyzer or LCD cover.

Calibration

The Sonoclot Analyzers in clinical use in the United States require factory calibration and can not be calibrated by the user. Running the reference viscosity quality control will verify if the Sonoclot Analyzer is operating within calibration standards. If your analyzer requires calibration, contact Sienco, Inc. or your distributor.

Troubleshooting

Reference viscosity quality control value changed significantly

The reference viscosity quality control procedure outlined in Chapter 4 should yield consistent results over time (variation of ± 2 Clot Signal units). Technique is very important when performing the QC test. Refer to the Operational Precautions and Limitations for running the QC in Chapter 4 for detailed suggestions.

Probe will not center in cuvette:

Return the instrument to Sienco, Inc. for re-alignment and re-calibration.

Signature goes off Clot Signal Scale:

The Clot Signal value will go off scale under two scenarios:

- The selected Clot Signal Scale is set too low. Refer to Chapter 5 - Changing the Clot Signal Scale for guidelines in selecting an appropriate Clot Signal Scale for your applications.
- The electromechanical oscillator is not oscillating properly. This can happen during extended test runs. See the example Clot Sample Forming Crust in Chapter 3 for guidelines to identify and correct this problem.

Sonoclot Analyzer Warning and Error Messages

The Sonoclot Analyzer will occasionally display messages that may not be familiar. Below are some examples of these messages and procedures to follow, if necessary.

Test	Clot Signal	Timer Temp
ACT	65	93
	NOISE	

Test Results

NOISE indicates that the Clot Signal is being disturbed by either mechanical noise, such as bumping the instrument, or by interference between the probe and the cuvette. Check to ensure that the tubular probe is snug against the probe mount hub and the cuvette is in contact with the bottom of the cuvette holder. This message should disappear within a few seconds.

Test	Clot Signal	Timer Temp
ACT		
ERROR ###		

Test Results

ERROR indicates that the self test routines in the Sonoclot Analyzer software have detected a problem, which will be printed on the Printer. The message normally will disappear after several seconds, but if it does not, make a note of the error number and call Sienco's Service Department.

Test	Clot Signal	Timer Temp
ACT		
Check Printer!!!		

Test Results

CHECK PRINTER indicates that the Sonoclot Analyzer detects a problem with the Printer: either it is not turned ON or it is not properly connected. The Printer should be ON and ON-LINE (indicated by the green light on the Printer) and the Printer cables securely fastened. If this condition is detected while running a sample, the Sonoclot Analyzer will beep to warn to check the Printer.

Test	Clot Signal	Timer Temp
gbACT+		37.0°
Host Inactive!!!		

Test Results

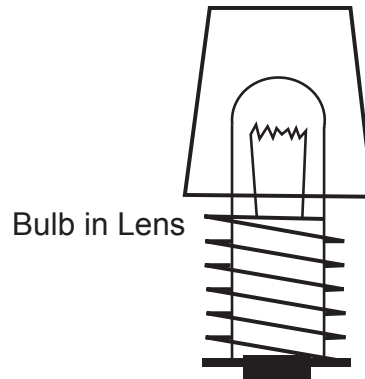
HOST INACTIVE indicates that the Sonoclot Analyzer detects a problem with the computer or Signature Viewer. Either the computer is not turned ON or it is not properly connected, or Signature Viewer is not running. The computer should be on and running Signature Viewer and the serial cables securely fastened. Also, dip switch 3 should be in the UP position (see the section on setting the dip switches in Chapter 5). If this condition is detected while running a sample, the Sonoclot Analyzer will beep to warn to check the computer and Signature Viewer.

If you have any questions in regards to a display message, call Sienco's Service Department at 800/432-1624 or 303/420-1148.

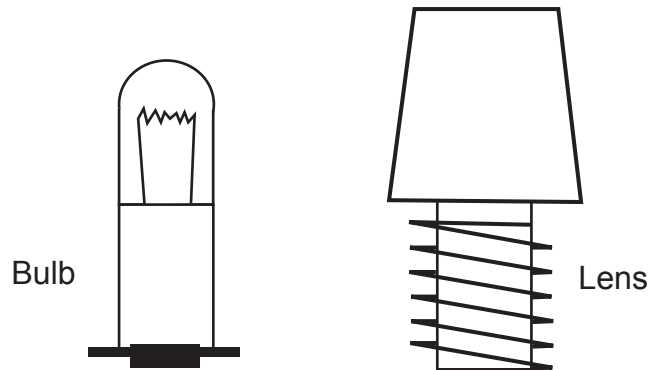
Changing the Lamp Bulb (P/N 290-0010)

Please follow these instructions to replace the light bulb on the Sonoclot Analyzer.

- 1: Clean and decontaminate the Sonoclot Analyzer with a disinfectant to reduce any biohazard.
- 2: Remove the burned out bulb by first unscrewing the white lamp bulb lens. The lamp bulb lens contains the lamp bulb. This assembly looks like this:



- 3: To remove the lamp bulb (P/N 290-0010) from the lens, first partially separate the lamp bulb from the lens while trying not to damage the threads on the lens. Then



use a needle nose pliers to grasp the bulb and pull it out of the lens.

- 4: Press a new lamp bulb into the lens and screw the lens into the Sonoclot Analyzer with your hand. Do not over tighten.

Factory Service or Repair

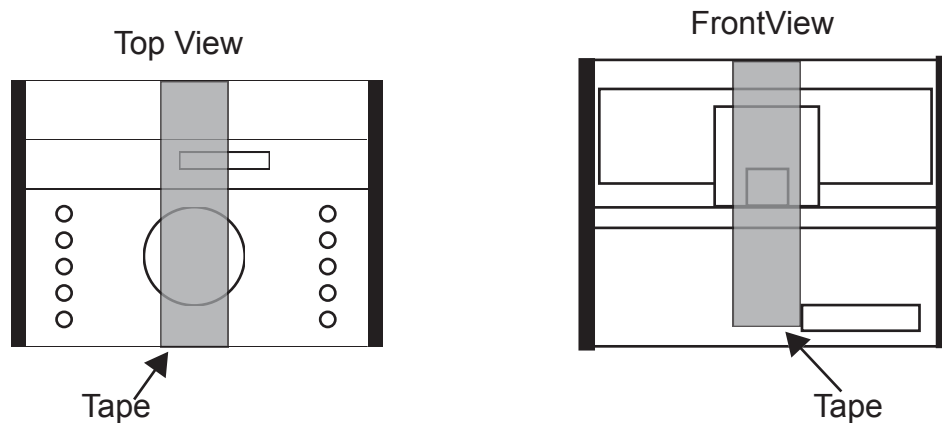
If your Sonoclot Analyzer needs service or you have any questions regarding repairs, call 800/432-1624 or 303/420-1148. In the instance you need to send your Sonoclot Analyzer to Sienco for repairs, we will be happy to supply you with a loaner instrument in the interim.

Sienco requires all returned instrument be thoroughly cleaned and decontaminated per the guidelines followed by your institution. **Please see the Appendix for a copy of the Sonoclot Analyzer Decontamination Form.**

If your Sonoclot Analyzer is no longer under warranty or if you do not have a Service Contract, you may call for a repair estimation before any work is done. When sending the Sonoclot Analyzer in for repairs, include a brief description of the problem along with a contact name and phone number. We will accept a purchase order to cover all repair costs. If you should send your instrument in for repairs and later decide not to have the work done, you will be expected to pay a minimum service charge for unit checkout.

The Sonoclot Analyzer should be shipped in the original packing materials, if possible. If not, please use the box and materials your loaner will arrive in. Decontamination and shipping instructions will be included with the loaner unit, or you may call Sienco. If the instrument is damaged in transit due to poor packaging, Sienco will charge you for repairs.

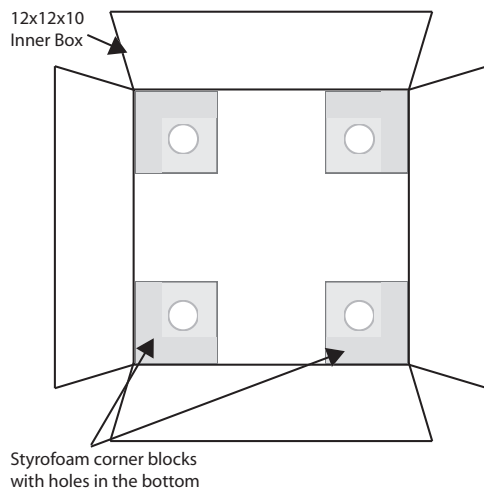
To prepare instrument for shipping, remove any cuvettes, probes or other supplies from the warming holes, cuvette holder and probe mount hub. With the head closed, place a large piece of packaging tape from the back of the instrument across the head and down the front of the instrument as shown below to prevent the head from moving during shipping.



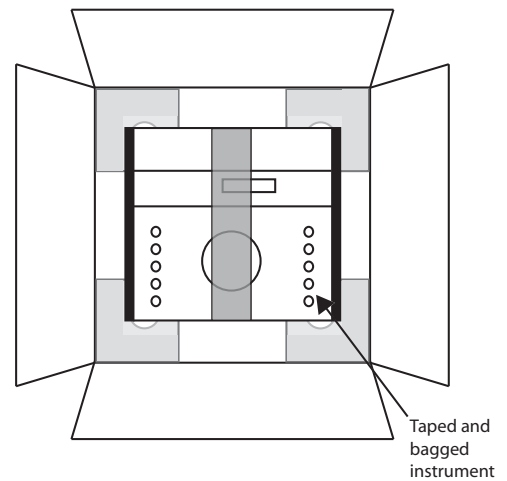
Place the instrument (without power cord) in a large, clean plastic bag and secure with a rubber band.

Arrange the four styrofoam corner blocks with the holes in the center in the bottom corners of the 12x12x10 box that your instrument came in. Place the instrument on these blocks as shown below.

Top View



Placement of Styrofoam Corner Blocks

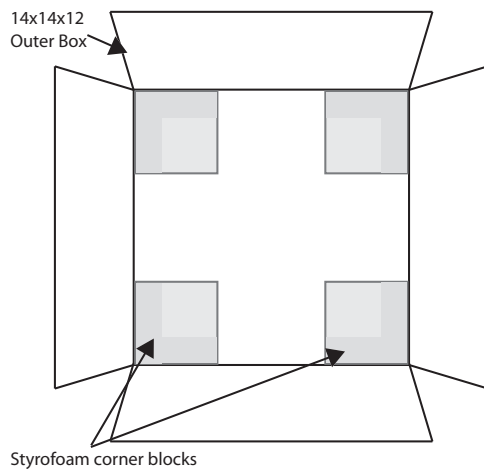


Placement of Bagged Instrument in Inner Box

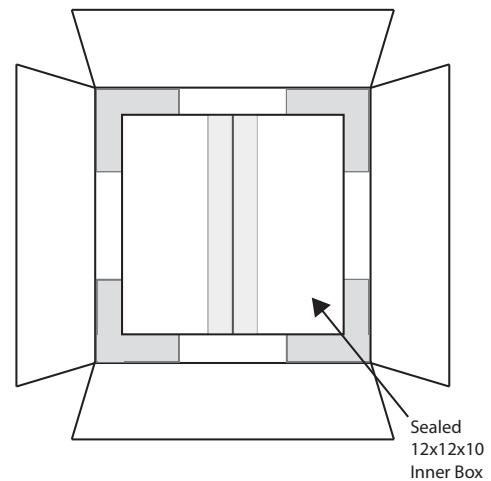
Fill out the decontamination form and place it on top of the packaged instrument. Place the remaining corner blocks on top of the instrument. Seal the box with packaging tape.

Arrange four styrofoam corner blocks in the bottom corners of the 14x14x12 outer box that your instrument came in. Place the 12x12x10 inner box inside of the outer box as shown below.

Top View



Placement of Styrofoam Corner Blocks



Placement of Inner Box Inside Outer Box

Place the four remaining corner blocks around the inner box and seal the outer box with packaging tape. Ship the package to the following address:

Sienco, Inc.
 Service Department
 7985 Vance Drive, Suite 104.
 Arvada, CO 80003 USA

Appendix

Warnings, Cautions, and Hazards



1: **WARNING:** As with any laboratory test result, diagnosis should not be based solely on the Sonoclot test result. The attending physician is responsible for interpreting the Sonoclot test result in conjunction with the patient's condition and other test results.



2: **WARNING:** To safeguard against electrical shock, only use a grounded electrical outlet.



3: **CAUTION:** Use of the Sonoclot Analyzer should be limited to properly trained laboratory personnel and/or other appropriate health care professionals.



4: **CAUTION:** Operator should read the Operator's Manual (this manual) before attempting to operate the Sonoclot Analyzer.



5: **CAUTION:** This analyzer should be checked at least once a year by a biomedical engineering department for compliance with applicable current leakage standards.



6: **HAZARD:** Human blood is a biohazardous material. The operator should wear appropriate protective gear when handling blood and/or test cuvettes containing blood samples. Biocontaminated materials should be handled and disposed of properly in accordance with hospital, local, state and federal regulations.



7: **WARNING:** To improve reliability, always avoid moving the transducer hub sideways when inserting or removing the probe. Push the probe on straight. Pull the probe off straight.



8: **CAUTION:** Do not place the Sonoclot Analyzer on counter tops where other vibrating instruments, such as centrifuges, are located. Mechanical vibration of the Sonoclot Analyzer may cause erratic results.



9: **CAUTION:** Do not drop the Sonoclot Analyzer. If the unit is dropped, contact your local Sienco service center.

References

1. Shibata T, Sasaki Y, Hattori K, et al. Sonoclot analysis in cardiac surgery in dialysis dependent patients. *Ann Thorac Surg.* 2004; 77(1): 220-05.
2. Shimokawa M, Kitaguchi K, Kawaguchi M, Sakamoto T, Kakimoto M, Furuya H. The influence of induced hypothermia for hemostatic function of temperature-adjusted measurements in rabbits. *Anesth Analg.* 2003; 96: 1209-13.
3. Liszka-Hackzell J J and Ekback G. Analysis of the information content in Sonoclot data and reconstruction of coagulation test variables. *Journal of Medical Systems.* 2002; 26(1): 1-8.
4. Furuhashi M, Ura N, Hasegawa K, et al. Sonoclot coagulation analysis: New bedside monitoring for determination of the appropriate heparin dose during haemodialysis. *Nephrol Dial Transplant.* 2002; 17(8): 1457-62.
5. Bindi ML, Biancofiore GD, Consani G, et al. Blood coagulation monitoring during liver transplantation: Sonoclot Analysis and laboratory tests. *Minerva Anesthesiol.* 2001; 67(5): 359-69.
6. Kamada Y, Yamakage M, Niiya T, et al. Celite-activated viscometer Sonoclot can measure the suppressive effect of tranexamic acid on hyperfibrinolysis in cardiac surgery. *J. Anesth.* 2001; 15(1): 17-21.
7. Waters JH, Anthony DG, Gottlieb A, Sprung J. Bleeding in a patient receiving platelet aggregation inhibitors. *Anesth Analg.* 2001; 93(4): 878-82.
8. Pivalizza EG, Pivalizza PJ, Kee S, Gottschalk LI, Szmuk P, Abramson DC. Sonoclot analysis in healthy children. *Anesth Analg.* 2001; 92(4): 904-6.
9. Santucci RA, Erlich J, Labriola J, et al. Measurement of tissue factor activity in whole blood. *Thromb Haemost.* 2000; 83(3): 445-54.
10. Konrad C, Markl T, Schuepfer G, Schmeck J, Gerber H. *In-Vitro* effects of different medium molecular hydroxyethyl starch solutions and lactated Ringer's solution on coagulation using Sonoclot. *Anesth Analg.* 2000; 90(2): 274-9.
11. Kjeliberg U, Hellgren M. Sonoclot Signature during normal pregnancy. *Intensive Care Med.* 2000; 26(2): 206-11
12. Brazil EV, Coats TJ. Sonoclot coagulation analysis of *in-vitro* haemodilution with resuscitation solutions. *J R Soc Med.* 2000; 83(10): 507-10.
13. Ekback G, Carlsson O, Schott U. Sonoclot coagulation analysis: a study of test variability. *J Cardiothorac Vasc Anesth.* 1999; 13(4): 393-7.
14. McKenzie ME, Gurbel PA, Levine DJ, Serebruany VL. Clinical utility of available methods for determining platelet function. *Cardiology.* 1999; 92(4): 240-7.
15. Konrad C, Markl T, Schuepfer G, Gerber H, Tschopp M. The effects of *in-vitro* hemodilution with gelatin, hydroxethyle starch, and lactated Ringer's solution on markers of coagulation: an analysis using Sonoclot. *Anesth Analg.* 1999; 88(3):483-8

16. Pivalizza EG, Koch SM, Mehlhorn U, Berry JM, Bull JMC. The effects of intentional hyperthermia on the Thromboelastograph and the Sonoclot Analyzer. *Int. J. Hyperthermia.* 1999; 15(3): 217-23.
17. Miyashita T, KuroM. Evaluation of platelet function by Sonoclot analysis compared with other hemostatic variables in cardiac surgery. *Anesth Analg.* 1998; 87(6): 1228-33.
18. Pivalizza EG, Abramson DC, Harvey A. Perioperative hypercoagulability in uremic patients: a viscoelastic study. *J Clin Anesth* 1997; 9(6): 442-5.
19. Pivalizza EG, Pivalizza PJ, Weavind LM. Perioperative throboelastography and Sonoclot analysis in morbidly obese patients. *Can J Anesth.* 1997; 44(9): 942-5.
20. Nuttall GA, Oliver WC, Ereth MH, Santrach PJ. Coagulation tests predict bleeding after cardiopulmonary bypass. *J Cardiothorac Vasc Anesth.* 1997; 11(7): 815-23.
21. Lyew MA, Spaulding WC. Template for rapid analysis of the Sonoclot Signature. *J Clin Monit* 1997; 13(4): 273-7.
22. Horlocker TT, Schroeder DR. Effect of age, gender, and platelet count on Sonoclot coagulation analysis in patients undergoing orthopedic operations. *Mayo Clinic Proc.* 1997, 72(3): 214-219.
23. Amerikhosravi A, Biggerstaff JP, Warnes G, Francis DA, Francis J. Determination of tumor cell procoagulant activity by Sonoclot analysis in whole blood. *Thromb Res.* 1996; 84(5): 323-32.
24. Yang Y-C, Tsai S-K, Ng K-O, Keung L-K, Hseu S-S, Lee T-Y. Evaluation of the hemostatic clot formation of newborns by Sonoclot Coagulation Analyzer. *Chin Med J.* 1995; 56(2): 115-9.
25. Schött U, Björsell-Östling E. Sonoclot coagulation analysis and plasma exchange in a case of meningococcal septicaemia. *Can J Anaesth.* 1995; 42(1): 64-8.
26. Hett DA, Walker D, Pilkington SN, Smith DC. Sonoclot analysis. *Br J Anaesth.* 1995; 75(6): 771-6.
27. Francis JL, Francis DA, Gunathilagan GJ. Assessment of hypercoagulability in patients with cancer using the Sonoclot Analyzer and Thromboelastography. *Thromb Res.* 1994; 74(4): 335-46.
28. Wasson AW, Stubblefield PG. Use of a coagulation analyzer in managing disseminated intravascular coagulation after midtrimester pregnancy termination - a case report. *J Reprod Med.* 1994; 39(10): 835-7.
29. Steer PL, Krantz HB. Thromboelastography and Sonoclot analysis in the healthy patient. *J. Clin Anesth.* 1993; 5(5): 419-24.
30. Chapin JW, Becker JL, Hurlbert BJ, Newland MC, Cuka DJ, Wood RP, Shaw BW Jr. Comparison of Thrombelastograph and Sonoclot Coagulation Analyzer for assessing coagulation status during orthotopic liver transplantation. *Transplant Proc.* 1989; 21(3): 3539.

31. Tuman KJ, Spiess BD, McCarthy RJ, Ivankovich AD. Comparison of viscoelastic measures of coagulation after cardiopulmonary bypass. *Anesth Analg.* 1989; 69(1): 69-75.
32. Stern MP, DeVos-Doyle K, Viguera MG, Lajos TZ. Evaluation of post-cardiopulmonary bypass Sonoclot Signatures in patients taking nonsteroidal anti-inflammatory drugs. *J Cardiothorac Anesth.* 1989; 3(6): 730-3.
33. Shenaq SA, Saleem A. Viscoelastic measurement of clot formation: the Sonoclot. In: Ellison N, Jobes DR, eds. *Effective Hemostasis in Cardiac Surgery.* Philadelphia, PA: Harcourt Brace Jovanovich, Inc.; 1988: 183-93.
34. Newland MC, Chapin JW, Hurlbert BJ, Kennedy EM, Newland JR. Thrombelastograph and Sonoclot Signature monitoring of changes in blood coagulation following cardiopulmonary bypass. *Anesthesiology.* 1987; 67(3A); A199.
35. Blifeld C, Courtney JT, Gross JR. Assessment of neonatal platelet function using a viscoelastic technique. *Ann Clin Lab Sci.* 1986; 16(5): 373-9.
36. Barnard RJ, Hall JA. Effects of diet and exercise on blood pressure and viscosity in hypertensive patients. *J Cardiac Rehabilitation.* 1985; 5: 185.
37. Schreiber WE, Schmer G. Fibrinogen seattle II: Defective Release of Fibrinopeptide A in a Slow Clotting Fibrinogen". *Thromb Res.* 1985; 37(1): 45.
38. Schreiber WE, Schmer G. Application of mechanical impedance measurements to the study of dysfibrinogens. *J Lab Clin Med.* 1984; 104(4): 494-500.
39. Saleem A, Blifeld C, Saleh SA, et al. Viscoelastic measurement of clot formation: a new test of platelet function. *Ann Clin Lab Sci.* 1983; 13(2): 115-24.
40. Gordon SG, Gilbert LC, Lewis BJ. Analysis of procoagulant activity of intact cells from tissue culture. *Thromb Res.* 1982; 26(5): 379-87.
41. Sugiura K, Ikeda Y, Ono F, Watanabe K, Ando Y. Detection of hypercoagulability by the measurement of the dynamic loss modulus of clotting blood. *Thromb Res.* 1982; 27(2): 161-6.
42. Saleem A. Bleeding problems after cardiovascular surgery. *Am J Med Tech.* 1982; 48(5): 388. Abstract.
43. Abbasi S, Johnson L. A micro heparin assay for sick preterm infants. The Society for Pediatric Research, 1982: 16-273A, Abstract 1166.
44. Abbasi S, Johnson L. Microviscosity measurement using a mechanical impedance technique. The Society for Pediatric Research, 1982: 16-197A, Abstract 711.
45. Hamstra R, Ens G. *Hypercoagulation.* Monograph published by Colorado Coagulation Consultants, Denver, CO., January, 1982.
46. Kurica K, Holmes J, Peck S, Cox B, Brantigan C, Wenzel W. Hypercoagulation and the predictability of thromboembolic phenomena in total hip and total knee surgery. *Thrombosis and Haemostasis.* 1981; 46(1): 17, Abstract 0039.

47. Saleem A, Yawn DH, Saleh SA, Crawford ES. Clot impedance as an indicator platelet dysfunction following cardiopulmonary bypass. *Thrombosis and Haemostasis*. 1981; 45(1): 143, Abstract 0442.
48. Hamstra R, Ens G. "Hypercoagulation". Tech Talk, 3 (2): 1, 1979.
49. Peck, S.: "Evaluation on the In-Vitro Detection of the Hypercoagulable State Using the Thrombin Generation Test and Plasma Clot Impedance Test". *Thrombosis and Haemostasis*, 42 (27): 764, 1979.
50. Newlin, F, Ens, G., Leppke, L. and Hamstra, R.: "Heparin Control with the SONOCLOT". *American Journal of Medical Technology*, 44: 508, 1978.
51. Hamstra, R., Ens, G. and Simons, S.: "The SONOCLOT: A New Thrombokinetic Coagulation Instrument". *Thrombosis and Haemostasis*, 38 (1): 282, 1977. Abstract.
52. Ens G, Hamstra R. ReAct Test recalcification of activated whole blood using the SONOCLOT". *Thrombosis and Haemostasis*. 1977; 38(1): 282, Abstract.
53. von Kaulla K, Ostendorf P, von Kaulla E. The impedance machine: a new bedside coagulation recording device. *J Med*. 1975; 6(1): 73.
54. von Kaulla K, Simons S. Changes in mechanical impedance: a new principle for measuring and recording various parameters of blood coagulation. *Federation Proceedings*. 1972; 31: 247, Abstract.
55. von Kaulla E, von Kaulla K, Simons S. Veraenderungen Mechanischer Impedanz, Ein Neues Prinzip Fuer Electromechanische Registrierung Von Unterschiedlicher Gerinnungsparametern Einschliesslich Uebergerinnbarkeit. *Herzinfarkt und Blutgerinnung*, R. Marx and H.A. Thies eds; *Thrombos. Diathes. et Haemorrh. Suppl.*, 52, 111:1972.

Warranty

The Sonoclot Coagulation & Platelet Function Analyzer includes a two year, return-to-factory Warranty. The Warranty guarantees that the Sonoclot Analyzer conforms to Sienco's current specifications for the product and is free of defects in the material and workmanship.

The Warranty covers and is limited to the replacement or repair of defective parts and components of the Sonoclot Analyzer system. This Warranty does not apply to any product which is used in any manner or subjected to any condition not consistent with its intended purpose or accepted industry practice. The Warranty shall be voided if the Sonoclot Analyzer is modified in any way without prior written approval by Sienco, or is repaired in any manner so as to adversely affect its operation or reliability by persons other than Sienco or its agents.

Claims under this Warranty shall be submitted in writing to Sienco within a reasonable time. The claim shall state the nature and details of the instrument defect and the serial number of the instrument. The statement of claim must accompany the defective product submitted for repair or replacement.

Defective products returned to Sienco shall be decontaminated and properly and adequately packaged and sent to Sienco's plant where the products were manufactured, and shall be shipped prepaid. Such products shall, at Sienco's election, be either repaired, replaced or returned collect.

Decontamination Form

Sonoclot Analyzer Decontamination and Shipping Instructions

This form must be filled out and returned with the Sonoclot Analyzer when shipping the instrument to Sienco for any reason, or a \$75.00 Biohazard Decontamination Charge will be assessed.

We require you to thoroughly clean and decontaminate the Sonoclot Analyzer per guidelines followed by your institution. Here are some tips to follow when decontaminating the Sonoclot Analyzer:

Place a clean probe on the probe adapter to protect the sensing mechanism while cleaning. **Do not spray any cleaning solvent up into the head since fluid will damage the sensor.**

Decontaminate all surfaces of the instrument using a product certified by your institution.

Remove and discard all probes and cuvettes before packing the instrument.

Institution: _____ Dept.: _____

Decontaminated by: _____ Phone: _____

Decontaminate Used: _____ Date: _____

Contact Person: _____ Phone: _____

Sonoclot Analyzer Serial Number: _____

We will call with an estimated cost for repairs before any work is done. Please make sure to include a contact name and phone number.

Ship the Sonoclot Analyzer to:

Sienco, Inc.
Attn.: Service Manager
7985 Vance Drive, Suite 104
Arvada, CO 80003 USA

If you have any questions, please contact:

Service Manager
800/432-1624
303/420-1148

