

Streck

- ESR-Auto Plus®
- ESR-657 Mixer



Operator's Manual

Welcome to Streck!

Thank you for choosing the ESR-Auto Plus®, the most accurate, reliable and user-friendly automated sed-rate analyzer available today! Our dedicated employees are here to make your ESR-Auto Plus experience as simple as possible.

The following items are included with this manual for your convenience:

- **QUICK REFERENCE GUIDE** – a simple, condensed guide to the most common instrument functions.
- **PROCEDURE GUIDELINE** – a template to streamline the creation of your documentation.
- **SERVICES & SUPPORT BROCHURE** – an overview of the many FREE services to assist you.

TECHNICAL SERVICE DEPARTMENT 800-843-0912 (ext. 7510)



The ESR-Auto Plus is supported by a staff of experienced Medical Technologists who welcome the opportunity to assist you. Our on-site Technical Service representatives have immediate access to the ESR-Auto Plus, and they are an excellent resource to answer your product questions.

Streck Technical Service Representatives:

- Assist with implementation of the ESR-Auto Plus
- Provide technical support for the entire ESR product line
- Process ESR-Auto Plus correlation data

We want your relationship with our company to extend beyond being satisfied with our product. It is our privilege to serve you, and we are looking forward to your next call.

STANDARD WARRANTY

Streck warrants the ESR-Auto Plus, ESR-657 Mixer and ESR Barcode Scanner to be free from defects in workmanship and materials during normal use for a period of one year from the date of purchase. If any defects occur during the warranty period, contact Technical Service at 800-843-0912 x 7510. This warranty does not cover defects or malfunctions, which occur due to instrument abuse, improper maintenance or unauthorized repairs.

Manufactured For:

Streck
7002 S. 109 Street
Omaha, NE USA 68128
800-843-0912
402-333-1982

TABLE OF CONTENTS

1.	INTRODUCTION.....	1
1.1	ESR Components.....	1
1.2	Unpacking Instructions.....	1
1.3	Cable Connections.....	2
1.4	Disconnect Device.....	2
1.5	Repackaging Instructions.....	2
2.	SAMPLE PREPARATION.....	3
2.1	ESR-Vacuum Tubes.....	3
2.2	Sample Collection.....	3
2.3	Phlebotomy Guideline.....	4
2.4	Secondary Patient Labels.....	4
2.5	Proper Tube Insertion.....	5
2.6	ESR-657 Mixer.....	5
3.	RUNNING A SAMPLE.....	6
3.1	Installing Printer Paper.....	6
3.2	Starting a Sample.....	6
3.3	Reporting Results.....	6
3.4	Canceling a Sample.....	7
4.	MENU FUNCTIONS 1-5.....	7
4.1	Standby Menu.....	7
4.2	Menu 1: Search Sample.....	8
4.3	Menu 2: Check Position.....	8
4.4	Search Sample.....	8
4.5	Menu 3: Print Log File.....	9
4.6	Menu 4: Control Samples: Register, Run and Show Controls.....	9
4.7	Menu 5: Run Test Rack.....	12
5.	MENU FUNCTION 6: OPTIONS/USER CONFIGURATION MENU.....	13
5.1	Accessing Menu.....	13
5.2	Set Date and Time.....	13
5.3	Set ESR Method.....	14
5.4	Set Printouts.....	15
5.5	Print Set Up.....	16
5.6	Set Access Code.....	17
5.7	See System Info.....	17
6.	MENU FUNCTION 6: OPTIONS/SERVICE MENU.....	17
6.1	Accessing Menu.....	17
6.2	Set Language.....	18
6.3	Set Date and Time Style.....	18
6.4	User Configuration Code.....	19
6.5	Set IR Power.....	19
6.6	LCD Contrast.....	19
6.7	Set Alarms.....	19
6.8	Motor Settings.....	20
6.9	Printouts.....	20
6.10	Prediction.....	21
6.11	Registering Test Rack.....	21
6.12	Set Thermometer.....	22
6.13	Test Mode.....	22

6.14	Reading Test.....	22
6.15	Power Test.....	22
6.16	RAM Reset	22
7.	BACKGROUND OF THE ESR TEST	23
	THE ESR TEST	
7.1	The History	23
7.2	The Original 200mm System	23
7.3	The 100mm Vacuum System.....	24
7.4	BD Standard Scale vs. QuickMode Method	24
7.5	The ESR-Vacuum Tube	25
	THE SEDIMENTATION REACTION	
7.6	A Typical ESR Reaction.....	25
7.7	Temperature Correlation	26
7.8	Reproducibility	27
8.	TECHNICAL INFORMATION.....	28
8.1	Overview.....	28
8.2	Measuring Abnormal Samples with IR Light.....	28
8.3	Checking a Secondary Label.....	29
8.4	Fill Level.....	29
8.5	Barcode Input	29
8.6	COM PORT Communication.....	29
8.7	Preventive Maintenance	30
8.8	Cleaning Instructions	30
8.9	Technical Specifications ESR-Auto Plus.....	31
8.10	Technical Specifications ESR-657 Mixer	32
8.11	Environmental Conditions.....	32
8.12	Transportation Environment	32
8.13	Disclaimer	32
9.	SAFETY PRECAUTIONS	33
9.1	User Precautions	33
9.2	Electrical Equipment.....	33
9.3	Sample Analysis	33
9.4	Application of Secondary Labels	33
9.5	Removal of ESR-Vacuum Tubes	33
10.	TROUBLESHOOTING.....	34
10.1	Error Codes	34
10.2	Decoding Error and Status Codes.....	34
10.3	Troubleshooting Guide	35
11.	QUICK REFERENCE GUIDE	36
11.1	Standby Screen	36
11.2	Mix Tubes	36
11.3	Run Test Rack	36
11.4	Register New QC Lot.....	36
11.5	Run QC Sample.....	36
11.6	Run Patient Sample.....	37
11.7	Cancel Measurement.....	37
11.8	Predict Sample Result.....	37
11.9	Re-Register Test Rack.....	37
	ESR-AUTO PLUS QC / MAINTENANCE RECORD.....	38

1 INTRODUCTION

The ESR-Auto Plus® is designed to accurately and precisely measure the sedimentation rate of erythrocytes (red blood cells) in ESR-Vacuum Tubes. The results are recorded as millimeters (mm) per hour (Westergren method) by converting to the QuickMode method, a scientifically developed method for measuring ESR in only 30 minutes. The instrument compensates for temperatures above 26°C (77°F).

Results are automatically reported to an internal printer. The instrument may also be interfaced with a Laboratory Information System (LIS) or a computer. For easier and safer ID-Code handling, the instrument can be equipped with a barcode scanner.

The mixing process prior to evaluation of an ESR sample is critical. For this reason, the ESR-657 Mixer is available as an additional accessory. The ESR-657 Mixer slowly mixes the ESR samples through a full 360° rotation, which ensures complete mixing and more accurate results.

The ESR-Auto Plus and ESR-657 Mixer are IVD Medical Equipment.

1.1 ESR Components



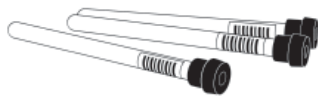
ESR-Auto Plus

The ESR-Auto Plus analyzer can process up to 20 samples per hour. Samples are read by infrared light using a measuring arm, which is controlled by a motor.



ESR-657 Mixer

The ESR-657 Mixer is specifically designed to mix ESR-Vacuum Tubes prior to evaluation. Its unique motion assures proper mixing of samples. The ESR-657 Mixer can hold up to 10 ESR-Vacuum Tubes.



ESR-Vacuum Tubes

ESR-Vacuum Tubes are available in 1.2ml and 2.0ml vacuum draw sizes and are designed specifically for use with the ESR-Auto Plus, ESR-100 and ESR-10 Manual Rack. High Altitude and Safety Coated 1.2ml tube configurations are also available.



ESR Barcode Scanner

Symbol barcode scanner, part # LS1902T-i000 or LS2208-SR20001g, connects to the ESR-Auto Plus using a COM port cable, part # 25-55591-20. It is compatible with most available barcodes: EAN, UPC, Codabar, Code 39, Code 93, Code 128, Interleaved 2 of 5, and several more. The barcode scanners are considered to be Class 1 lasers that emit Class 2 laser light.

1.2 Unpacking Instructions

Retain all packaging materials for shipping, moving or storing the instrument.

- Open the box and remove the top foam piece, which contains accessories such as the barcode scanner, power cables and paper.
- Carefully lift the instrument out of the bottom foam piece and remove the anti-static shipping bag.
- Remove the ESR-657 Mixer from the bottom foam piece.
- Install the ESR-Auto Plus and ESR-657 Mixer on a level, supported surface that is free from any vibrations.

Note: Vibrations will adversely affect ESR results.

1.3 Cable Connections

Attach the cables in the following order:

1. Connect the barcode scanner to the socket marked "barcode input". **Note: The barcode scanner has been pre-programmed. If you encounter any problems with the operation of the barcode scanner, contact Technical Service before making any changes to the settings.**
2. Connect the external printer cable or mainframe computer cable (LIS) to the socket marked "COM 1". **Note: COM PORT settings can be adjusted in the User Configuration Menu.**

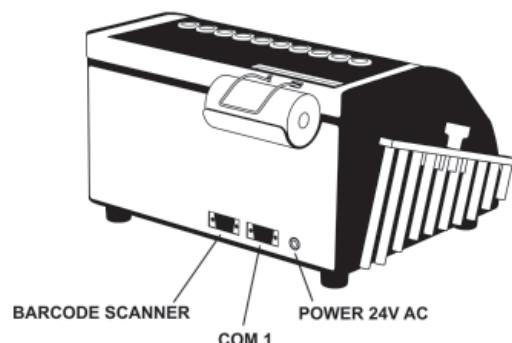
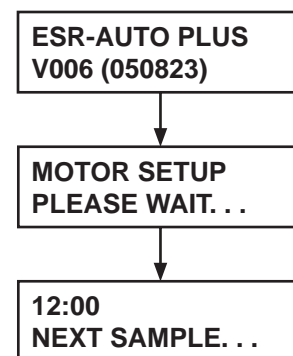


Figure 1: Rear view cable connections.

3. Connect a 24V AC power cable to the power socket on the back of the ESR-Auto Plus. **Note: The power cables for the ESR-Auto Plus and ESR-657 Mixer are interchangeable.**
4. Plug the power cable into the main power outlet and the instrument will automatically power up. The display will show the software version for about 5 seconds before motor initiation begins. **Note: It is recommended that the ESR-Auto Plus be plugged into a power surge protector for additional protection from power surges and fluctuations.**
5. If necessary, the instrument will automatically recalibrate and reset the motor. Once the initiation sequence and system check are complete, the internal scanner will move to the home position and the display will advance to standby mode.
6. The ESR-Auto Plus is ready to accept new samples when "Next Sample" appears on the display.
7. Connect a 24V AC power cable to the ESR-657 Mixer and turn the power switch to the "on" position. The mixer will rotate continuously when the power switch is in the "on" position.



1.4 Disconnect Device

To disconnect the instrument, unplug the power cable from the wall outlet. It is not necessary to routinely disconnect the instrument when it is not in use. **Note: Turn off the main power before removing or reinstalling any connectors on the ESR-Auto Plus.**

1.5 Repackaging Instructions

The ESR-Auto Plus contains delicate electrical components and needs to be properly packed in the approved foam inserts and carton before shipping. Please contact Streck Technical Service at 800-843-0912 x7510 with any questions or to obtain the correct packaging materials.

1. Unplug the instrument. Remove the paper, test rack, cables, and other accessories.
2. Wipe the outer surface of the instrument and test rack with an ethanol or isopropanol solution.
3. Place the bottom foam piece in the shipping carton. (See Figure 2a)

4. Insert the test rack into the ESR-Auto Plus and place the instrument inside the antistatic bag supplied with the approved packaging.
5. Place the instrument and mixer in the designated slot in the bottom foam piece. (See Figure 2b)
6. Place the top foam piece in the shipping carton with the flat side down. (See Figure 2c)
7. Place any accessories inside the top foam piece. (See Figure 2d)
8. Fill any extra space with packing material before closing the box.
9. Always ship the instruments and components as “FRAGILE”!



Figure 2a.



Figure 2b.



Figure 2c.

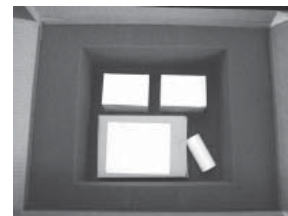


Figure 2d.

2 SAMPLE PREPARATION

2.1 ESR-Vacuum Tubes

The ESR-Auto Plus is intended for use with 1.2ml ESR-Vacuum Tubes. However, 2.0ml ESR-Vacuum Tubes may be used by selecting the alternate tube size in the User Configuration Menu. ESR-Vacuum Tubes are also available in High Altitude and Safety Coated 1.2ml configurations.

All Streck ESR-Vacuum Tubes preserve the integrity of the patient sample for up to 72 hours from the time of blood collection when transported or stored at 2-10° C, or up to 4 hours at 18-30° C.

2.2 Sample Collection

Patient samples may be drawn directly into an ESR-Vacuum Tube or into an EDTA vacuum tube. When using an EDTA tube, transfer the well-mixed patient sample into the ESR-Vacuum Tube. Fill the ESR-Vacuum Tube to the fill line. Do not remove the sodium citrate in the ESR-Vacuum Tube.

ESR-Vacuum Tubes are similar to ordinary vacuum blood collection tubes. The tube contains liquid anticoagulant and must be thoroughly mixed with the blood sample immediately after the tube has filled. Failure to mix the sample completely and immediately may result in the formation of microscopic blood clots/aggregates that could alter results.

Proper collection and preparation of the ESR sample is critical to obtain accurate results. Inaccurate results are most often a result of improper sample handling.

CAUTION: Handle all biological samples and blood collection sharps according to your standard laboratory procedures. Seek medical attention in the case of exposure to biological specimens. Transmission of infectious diseases may occur.

Follow the CLSI Approved Standard “Procedures for the Collection of Diagnostic Blood Specimens by Venipuncture”, CLSI Document H03 (formerly NCCLS Document H3).

2.3 Phlebotomy Guideline

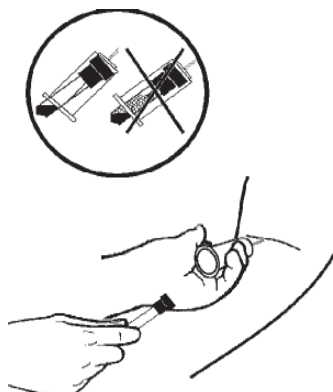


Figure 3: Venipuncture



Figure 4: Mixing

1. Insert the ESR-Vacuum tube into the plastic holder. Hold the tube so the cap is flush against the needle holder as the sample is collected.
2. Angle the tube so the blood stream hits the tube wall before mixing with the citrate solution to minimize the formation of bubbles.
3. Watch for an air bubble to rise in the sample as the tube fills to indicate the draw is complete and remove the tube immediately.
4. The ideal fill level and acceptable fill range are indicated on the tube.
 - 1.2ml ESR-Vacuum Tubes: 60mm \pm 5mm
 - 2.0ml ESR-Vacuum Tubes: 100mm \pm 8mm
5. It is especially important to mix Streck ESR-Vacuum Tubes thoroughly by inverting them 8-10 times due to their smaller tube diameter and draw volumes (1.2ml and 2.0ml) compared to an EDTA tube.
6. Prior to analysis, thoroughly mix the sample again. Rotating the tubes on the ESR-657 Mixer for three minutes is adequate.
7. Samples can be maintained from the time of blood collection for up to 72 hours prior to analysis when transported and stored at 2-10° C, or up to 4 hours at 18-30° C.
8. Refer to the ESR-Vacuum Tube Instructions For Use (IFU) for more details.

The mixing procedure is very important! If the citrate is not properly mixed with the blood, clots/aggregates may form and cause results to appear higher than they actually are.

2.4 Secondary Patient Labels

The ESR-Auto Plus reads the sample using infrared light. This light is very strong and can read through one layer of most commonly used labels. **Note: Caution must be taken when applying additional labels to ESR-Vacuum Tubes if the sample is scanned within the label area.**

1.2ml Tubes

The 1.2ml ESR-Vacuum Tube is the primary tube used in ESR-Auto Plus.

- a. The ideal fill level of the 1.2ml tube is 60mm \pm 5mm from the bottom of the tube. The ideal fill level and range are printed on the tube label. The fill range can extend to as much as \pm 9mm from the fill line without compromising the integrity of the sample.
- b. Additional labels should be applied as close to the cap as possible.

Note: Leave a space of at least 5mm between the blood level in the tube and any additional labels to ensure accurate reading of the sample. (Refer to Figure 5.)

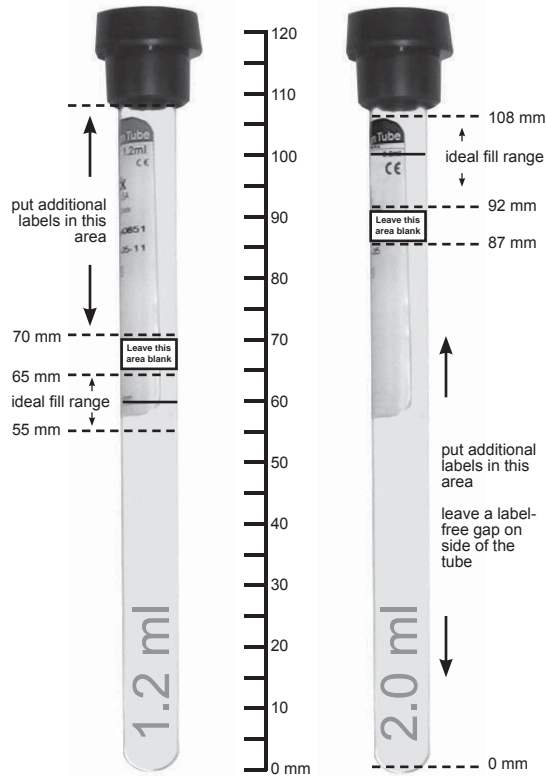


Figure 5: 1.2ml and 2.0ml label placement

2.0ml Tubes

The 2.0ml ESR-Vacuum Tube can be used in the ESR-Auto Plus as long as the tube is inserted in the ESR-Auto Plus correctly and additional labels are applied correctly.

- Do not place additional labels on top of the fill level printed on the top of the original label.
- Place additional labels facing the same direction as the original label, creating a label-free gap on one side of the tube.

Note: This gap is critical to allow accurate measurement of the level of blood in the tube.

2.5 Proper Tube Insertion

Insert the tube in ESR-Auto Plus with the label facing forward, leaving the label-free side at the rear to ensure accurate reading of the sample.

2.6 ESR-657 Mixer

The ESR-657 Mixer is an optional accessory designed to accompany the ESR-Auto Plus. The automated mixer holds up to 10 ESR-Vacuum Tubes at one time.

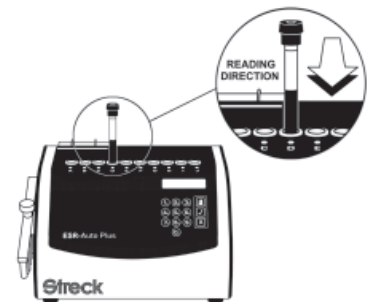


Figure 7: Tube reading direction

Note: Mix all samples thoroughly prior to analysis.

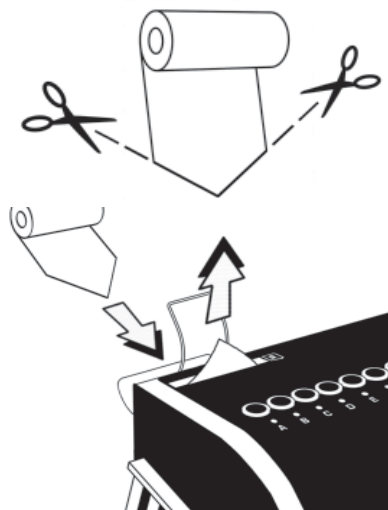


- Place the mixer on a level surface.
- Gently snap ESR-Vacuum Tube samples into the slots on the mixer.
- Locate the power switch on the top of the mixer to turn the unit "on".
- The ESR-657 Mixer rotates the samples during the mixing process.
- Leave the samples to mix for a few minutes before analyzing.

Figure 8: ESR-657 Mixer

3 RUNNING A SAMPLE

3.1 Installing Printer Paper



Installing Paper

Before installing the paper, remove any residual glue or tape sealing the new roll, and then cut it in the shape of an arrowhead to facilitate loading the paper in the printer.

Insert the paper in the gap at the back of the printer and push the paper through the feeding mechanism. Once the point is visible, use the paper feed button on the keypad to advance the paper until the full width is visible.

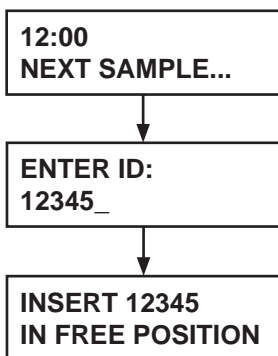
Removing Paper

Cut paper close to roll. Advance the paper forward through the printer using the paper feed button.

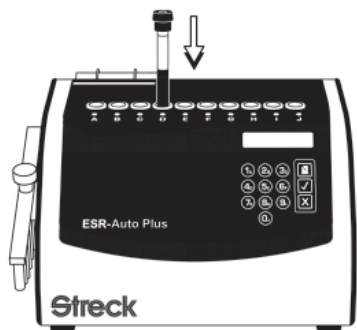
CAUTION: Do not remove the paper by pulling the roll out backwards. Damage may occur.

Figure 9: Loading paper in the internal printer

3.2 Starting a Sample



- The ESR-Auto Plus is ready to accept a sample when the “Next Sample” standby mode appears in the display window. Scan the patient barcode with a barcode scanner, or enter the sample ID code manually on the keypad.
- An ID code may contain up to 10 digits. When manually entering an ID code, press “X” to delete incorrect digits and “√” to confirm the code. The instrument will automatically add the “√” signal when using a barcode scanner.
- After the barcode is scanned or the ID code is entered, insert the well-mixed, room temperature sample in any free position as indicated by a green light. The position light will turn red and the ESR-Auto Plus will initiate testing.



NOTE: It is very important that the sample is properly mixed and at room temperature before analyzing. A well sedimented sample may require several minutes of mixing.

Note: Alpha numeric characters A-J and 0-9 can be entered manually using the keypad. Letters greater than J can only be entered using the barcode scanner.

Figure 10: Starting a Sample

3.3 Reporting Results

After measurement is complete, the ESR-Auto Plus automatically prints results on the internal printer and the COM PORT. The COM PORT and desired printer can be configured in the software. Refer to the User Configuration Menu.

Two different printout styles are available; Ticket style (default) and Log File style. Log File printout is used when results are sent to a computer using the COM PORT. The Log File style error message is binary coded. Refer to Section 10 to decode binary error messages.

```

***** ESR RESULT *****
MM-DD-YY 12:00 PO:A ER:0000 ST:0353

PATIENT NAME: _____
PATIENT ID: 12345

ESR: 1 MM WESTERGREN (QM PAED TUBE)
ALARMS:
- LOW FILL LEVEL
    
```

Figure 11a: Ticket Style Printout

```

ID      ESR PO ER ST  DATE  TIME
1234567890 53 A 0 353 030101 08.45
12345      61 B 0 353 030101 08.50
    
```

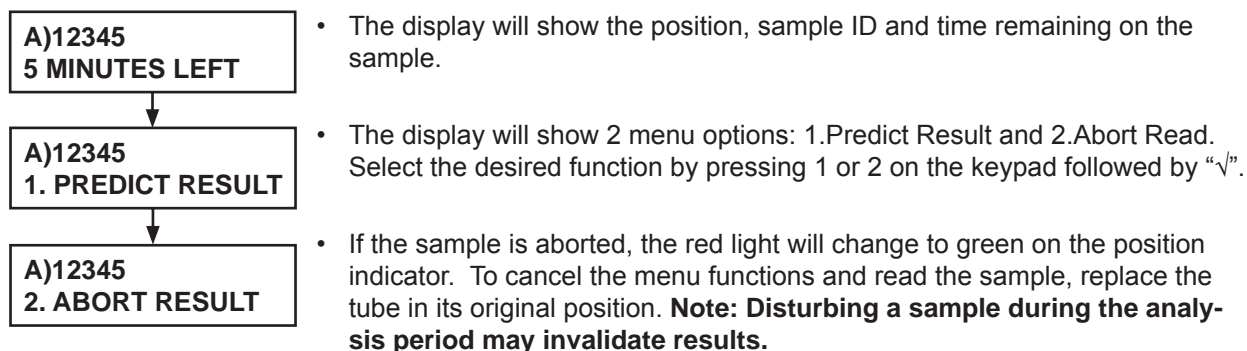
Figure 11b: Log File Printout

Patient Name	Blank line for manually writing patient name on the ticket printout.
Patient ID	The ID number entered (or scanned) for the sample.
PO	Lane position in ESR-Auto Plus where the sample was measured.
ER	Binary error code. Refer to Section 9 for decoding.
ST	Binary sample status code. Refer to Section 9 for decoding.
QM PAED/QM	The ESR-Auto Plus uses one of the two different methods dependent on set-up and tube size for calculating the Westergren value. NOTE: QM PAED = 1.2ml tube

Figure 11c: Information included on ESR-Auto Plus Printout

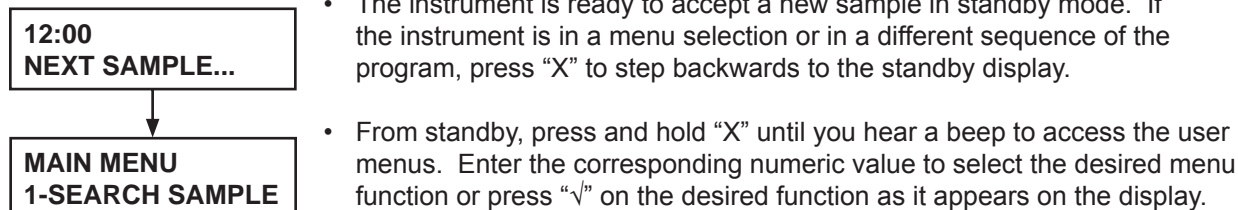
3.4 Canceling a Sample:

To cancel a sample, remove it from the slot.



4 MENU FUNCTIONS 1-5

4.1 Standby Menu

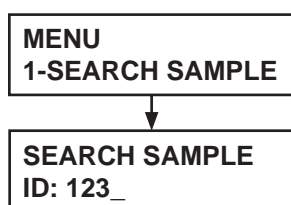


The available user menus will scroll on the display:

- 1 - SEARCH SAMPLE
- 2 - CHECK POSITION
- 3 - PRINT LOG FILE
- 4 - CONTROL SAMPLES
- 5 - RUN TEST RACK
- 6 - OPTIONS

4.2 Menu 1: Search Sample

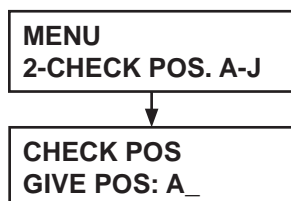
The ESR-Auto Plus stores up to 100 records. After the first 100 samples are recorded, additional results are stored on a first in, first out basis. The ESR-Auto Plus searches all samples currently in process for an ID match before searching the sample log internal memory.



- Select Menu Function 1 to search for a sample result by sample ID.
- Enter the sample ID code using the keyboard or barcode scanner. Partial ID codes can be used. For example, to search for ID code 12345, enter 123 to return all ID codes starting with 123. A blank entry will return all samples. Press and hold the number keys to display the corresponding letters A-J. Use the log file search function for patient ID numbers that begin with a letter greater than J.

4.3 Menu 2: Check Position

Sample results may also be retrieved using the position where the sample was run. The results will print on the internal printer and enabled COM PORT.

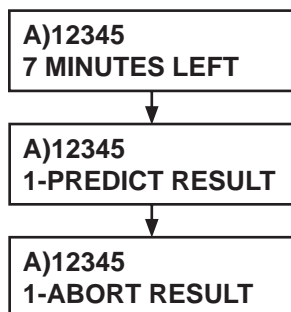


- Select Menu Function 2 to search for a sample result by position.
- Enter the position A-J as listed on the ESR-Auto Plus and press “√”.

4.4 Search Sample

Search Sample and Check Position sample results are displayed in the same manner. Samples can have two different status options: In progress, or Completed.

Sample in Progress



- If the sample is currently in process, the display will show the position of the sample, the sample ID and the time remaining until the sample is complete. After a few seconds, the second row of the display will show menu options.
- 1-PREDICT RESULT will predict the sample result.
- 2-ABORT RESULT will cancel the measurement of the sample. Press “X” to continue to the next sample fitting the search criteria.

NOTE: Correlation to Westergren will decrease the earlier a sample is predicted. It is not recommended to predict a sample more than 15 minutes early. The predicted result should always be confirmed when the final result is available.

Completed Sample

A)12345 (1/5) 030101 09:00 [OK]	<ul style="list-style-type: none"> If the sample is complete and results are available, the display will show position, sample ID, number of samples that fit the search criteria and the date/time for the most recently analyzed sample that fits the search criteria.
↓	
A)12345 (1/5) ESR 110 ER1024	<ul style="list-style-type: none"> Press “X” to view the next matching sample, or “√” to view details of the current sample. The second row will show the result and any error code.
↓	
A)12345 (1/5) REPRINT [OK]	<ul style="list-style-type: none"> When prompted, press “√” to reprint, or “X” to view sample. To end the Search sequence, press and hold “X” for one second.

4.5 Menu 3: Print Log File

The ESR-Auto Plus will store all sample results to a maximum of 100 records. Storage of samples results continues on a first in, first out basis after the first 100 samples are recorded.

MENU 3-PRINT LOG FILE	<ul style="list-style-type: none"> Select Menu Function 3 to print all sample results stored in memory. The Log File header will repeat after every 50 samples.
--------------------------	--

```

***** ESR-AUTO PLUS LOG FILE *****
030101 15:00

  ID     ESR  PO  ER  ST  DATE   TIME
1234563456  53  A  12  449 030101 18.00
1234586754   1  C   0  449 030101 18.01
1234456734 123  E   8  449 030101 18.01
1234567987   4  F   0  449 030101 18.05
1234567345  18  H  21  449 030101 18.05
1234567555  57  J   0  449 030101 18.25
1234532756  65  I   0  449 030101 18.25
*
    
```

Figure 12: Log File Printout

4.6 Menu 4: Control Samples

The Control Sample Menu Function is designed to monitor commercially available bi-level quality control samples. The Control Sample Menu Function accepts two levels of control. Control samples are analyzed, compared to the registered assay value and stored in a control sample database.

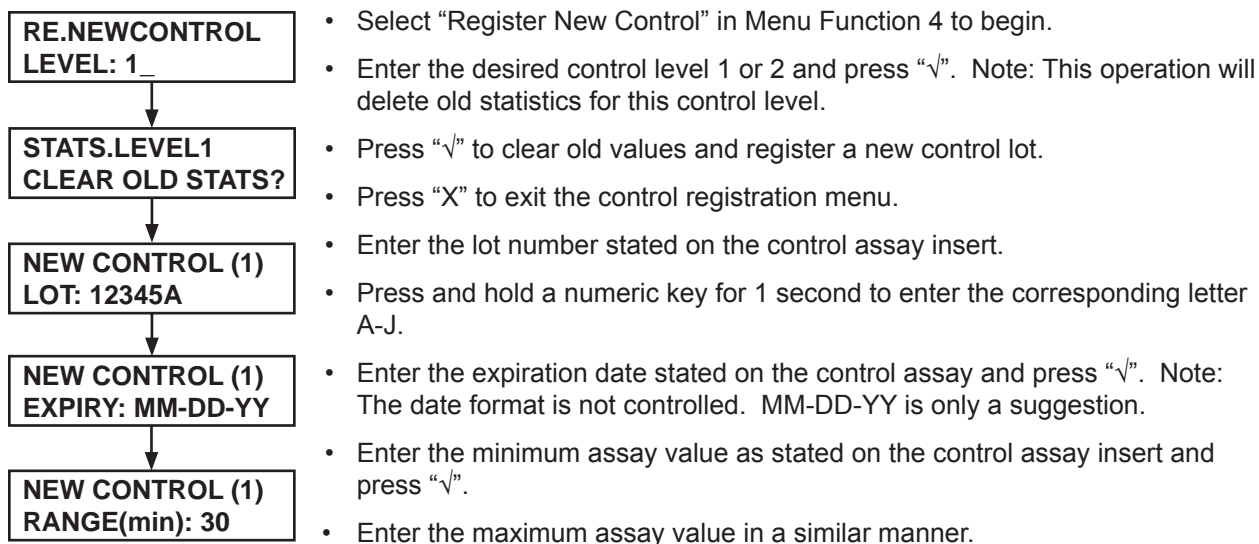
NOTE: Streck recommends running 2 levels of ESR-Chex controls daily to ensure the accuracy of the instrument.

The Quality Control Menu contains 3 options:

MENU 4-CONTR.SAMPLES	<ul style="list-style-type: none"> REGISTER NEW CONTROL, RUN CONTROL, SHOW CONTROL Press “√” when the desired menu function is displayed.
-------------------------	---

4.6.1 Register New Control

Register the lot number and assay ranges before using a new lot of control material. Registering a new level of control lot will delete all data collected for the previous control lot of that level.



```

***** ESR CONTROL REPORT *****
030101 08:00

ASSAY VALUES
  LOT NO      : 12345A
  LEVEL       : 1
  EXPIRY DATE : 10-06-04
  EXP. RANGE  : 30-40
  
```

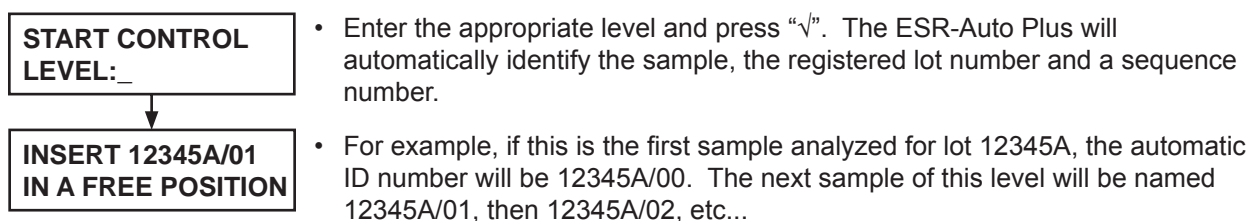
Note:

- A report of the assay values will then be printed. Press "√" to accept the data. The new lot is now registered and ready to use.
- ESR-Auto Plus stores up to 100 samples of control data per level. If 100 samples are exceeded, the oldest value will be deleted.

Figure 13: Control Report

4.6.2 Run Control

Once a control lot has been registered, select "Run Control" in Menu Function 4 to run a control sample.



1. Transfer the well-mixed control into the ESR-Vacuum Tube.
2. Fill to the fill line specified on the tube label and mix thoroughly.
3. Insert the room temperature control sample into any free position.
4. The ESR-Auto Plus will automatically start measuring the sample.

The control sample printout is similar to a ticket style patient sample printout. If the result is outside the expected range an alarm message will be reported.

```

**** CONTROL SAMPLE LEVEL 1 RESULT ****
030101 08:00 PO:A ER:2146 ST:0353

LOT#/SEQ : 23445A/00

ESR: 42 MM WESTERGREN(QM PAED TUBE*)

ALARMS:
-OUTSIDE CONTROL REF (20-40)

```

Figure 14: Control Results

Note:

- QM Paed Tube = 1.2ml ESR-Vacuum Tube
 - ER is the error code reported on a control sample. The “base” error codes for control samples are L1 control = 2048; L2 control = 4096. The reported error code (ER) - “base” error code = actual error. Refer to section 10, Troubleshooting, for complete list of error codes.
- | | |
|------------------------------|------------------------------|
| L1 Example: | L2 Example: |
| 3072 - 2048 = 1024, overfill | 5120 - 4096 = 1024, overfill |
| 2048 - 2048 = 0, no error | 4096 - 4096 = 0, no error |
| 2052 - 2048 = 4, low fill | 4100 - 4096 = 4, low fill |

4.6.3 Show Control

Control samples are stored in a control log file, which holds up to 100 samples per level. The ESR-Auto Plus can generate statistical reports or display control information on the LCD from the stored data. Select “Show Control” in Menu Function 4 to access the following options: SHORT REPORT, LONG REPORT OR SHOW ON LCD.

1. Short Report

```

SHORT REPORT
LEVEL:_

```

- The Short Report will generate a statistical report for the specified level. Select level 1 or 2 and press “√” to start the printout.

2. Long Report

```

LONG REPORT
LEVEL:_

```

- The Long Report will generate a statistical report and the complete log file for the specified level. Select level 1 or 2 and press “√” to start the printout.

3. Show on LCD

Control information can be viewed manually on the LCD and individual runs may be deleted.

```

SHOWVALUES
LEVEL: 1_

```

- Select level 1 or 2 and press “√” to view.
- The LCD will show the lane position, lot/sequence #, ESR result and associated error code for the most recent sample of that level.

```

E)12345A/10
ESR: 36 ERR:4224

```

- After a few seconds, two options will scroll on the display.
- 1 - Reprint ticket for this sample.

```

E)12345A/10
1.REPRINT

```

- 2 - Delete this sample record.
- Press “1” to print or “2” to delete the current record.

```

E)12345A/10
2.DELETE

```

- Press “X” to advance to the next sample.
- Press and hold “X” for 1 second to exit the sequence.

```

***** ESR CONTROL REPORT *****
030101 08:00

ASSAY VALUES
  LOT NO      : 12345A
  LEVEL       : 1
  EXPIRY DATE : 10-06-04
  EXP. RANGE  : 30-40

STATISTICS
  POP. SIZE   : 10
  AVERAGE    : 36
  HIGHEST     : 42
  LOWEST      : 34
  SD          : 2.0
  CV%         : 5.5

```

Figure 15: Short Report

```

***** ESR CONTROL REPORT *****
030101 08:00

ASSAY VALUES
  LOT NO      : 12345A
  LEVEL       : 1
  EXPIRY DATE : 10-06-04
  EXP. RANGE  : 30-40

STATISTICS
  POP. SIZE   : 10
  AVERAGE    : 36
  HIGHEST     : 42
  LOWEST      : 34
  SD          : 2.0
  CV%         : 5.5

LOT#/SEQ  ESR  ERR  PO  DATE  TIME
123454A/10 38  4224  E  030331 12:00
123454A/09 34  4224  B  030330 12:00
123454A/08 36  4224  C  030329 12:00
123454A/07 39  4224  G  030328 12:00
123454A/06 39  4224  D  030327 12:00
123454A/05 39  4224  A  030326 12:00
123454A/04 39  4224  D  030325 12:00
123454A/03 34  4224  A  030324 12:00
123454A/02 39  4224  D  030323 12:00
123454A/01 42  4224  D  030322 12:00

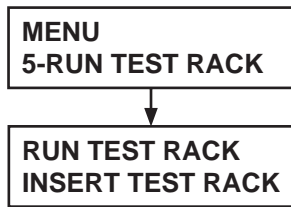
```

Figure 16: Long Report

4.7 Menu 5: Run Test Rack

The ESR-Auto Plus uses a special test rack to verify the proper function of each lane and test the accuracy of results throughout the reportable range. The test rack is designed to simulate ESR levels. The instrument scans the test rack and compares the readings to the reference values stored in memory.

Note: Streck recommends running the test rack at the beginning of each day that the ESR-Auto Plus is in use.



- To run the test rack, select Menu 5 - Run Test Rack.
- The display will prompt you to insert the test rack. Insert the test rack and press “√” to start the procedure.

After the reading is complete, the results will report on the internal printer.

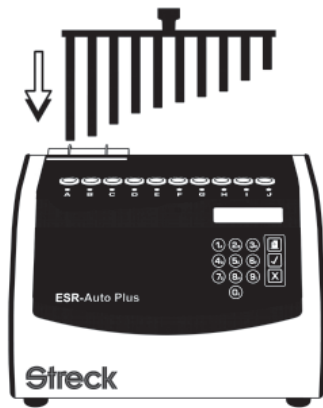


Figure 17: ESR-Auto Plus Test rack

A ± 2 mm range is acceptable. If the readings are outside the acceptable range compared to the expected values, the instrument will alert that the test failed and ask if you want to retry.

Press “√” to retry or “X” to exit.

If the test rack fails a second time, re-register the test rack. See the Quick Reference Guide at the end of this manual for instructions.

```

    ***** TEST RACK *****
    DATE 03/01/01 12:00
    SERIAL No: 504-0000
    HARDWARE INIT DATE 00/01/01
    SOFTWARE VER:
    ESR-AUTO PLUS
    VER(0001)
    SAMPLE COUNTER:
    HARDWARE INIT DATE 00/01/01

    TECHNICAL SETUP:
    MOTOR SPEED :12 SEC/R
    V-OFFSET :28 DEG
    REF-CYCLE :2600
    LP-OFFSET :160DATE
    IR POWER :51%

    TEST RACK LEVELS: (REAL mm)
    READ VALUE EXPECTED VALUE
    POS MM MM
    A 7.7mm 7.7mm
    B 12.3mm 12.3mm
    C 23.6mm 23.6mm
    D 33.7mm 33.7mm
    E 38.5mm 38.5mm
    F 43.1mm 43.1mm
    G 47.7mm 47.7mm
    H 52.1mm 52.1mm
    I 61.3mm 61.3mm
    J 70.8mm 70.8mm

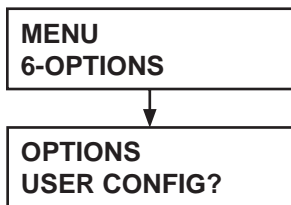
    TEST OK
  
```

Figure 18: Test Rack Report

5 MENU FUNCTION 6: OPTIONS - USER CONFIGURATION MENU

5.1 Accessing Menu

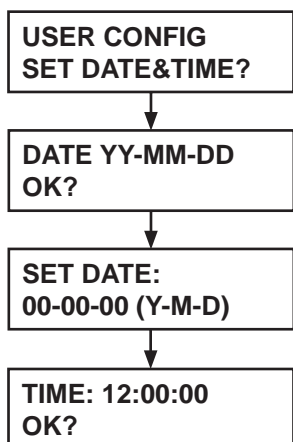
The two sections of the Options menu are the User Configuration Menu and the Service Menu. Both sections can be protected by an access code to prevent changing settings by mistake. See Section 6.4 for instructions on how to set or view an access code.



- From standby, press and hold “X” to access the user menus.
- Enter “6” to select the options menu.
- Press “√” to access the User Configuration Menu.

5.2 Set Date and Time

The instrument has an internal realtime clock with battery backup. Date and time will be maintained when the instrument power is turned off. To set the date or time, press “√” when prompted.



Date

- Press “√” if the date is correct, or “X” if the date is incorrect.
- To change the date, use the numeric keypad to change the blinking digit.
- Press “√” to step forward and “X” to step backward.
- Press “√” after the last digit to proceed to the time setting.

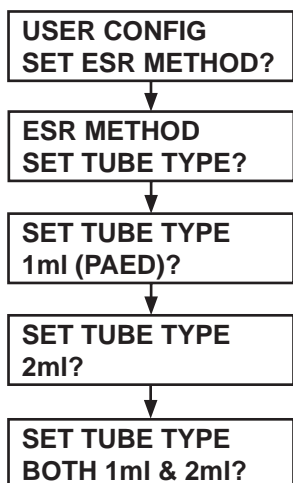
Time

- Press “√” if the time is correct, or “X” if the time is incorrect.
- Change the time in a similar manner to the date adjustment.

NOTE: Date and time format can be changed to display different international standards. See Option 6 - Service Menu to change date and time formats.

5.3 Set ESR Method

The ESR-Auto Plus measures samples according to the QuickMode method, a scientifically developed method for measuring the ESR in only 30 minutes. ESR-Auto Plus can read 1.2ml, 2.0ml or both 1ml & 2ml ESR-Vacuum Tubes.



Set Tube Type

- Press “√” to set tube type, or “X” to advance to the next menu selection.
- Press “√” to select 1.2ml tubes, or “X” to advance to the next tube type.
- Press “√” to select 2.0ml tubes, or “X” to advance to the next tube type.
- Press “√” to select both 1.2ml & 2.0ml tubes, or “X” to return to the 1.2ml prompt.

Note: If both tube sizes are enabled, the instrument will read tubes filled more than 70mm as 2.0ml tubes and all others as 1.2ml tubes.

Set Calibration

QuickMode results correspond to the original 200mm Westergren ESR. Since there are many different 200mm pipettes that produce slightly different results, QuickMode results can be calibrated.

At the time of delivery, the calibration factor will be set to +0%. Please contact Streck Technical Service before adjusting the calibration factor.

Note: The standard calibration menu option will only be available if 2.0ml tubes are enabled in Set Tube Type.

ESR METHOD
SET CALIBR.?

- Press “√” to adjust calibration, or “X” to advance to the next menu selection.

STD CALIBR.:
+0_% (0-99)

- Enter 0 on the numeric keypad.
- Press “√” to accept the standard calibration values (if applicable) and proceed to the next menu selection.

PAED CALIBR.:
+0_% (0-99)

- 1.2ml & 2.0ml tubes have separate menu entries. Enter 0 on the numeric keypad.
- Press “√” to accept the 1.2ml calibration values and proceed to the next menu selection.

ESR METHOD
SET MEAS. TIME?

Set Measuring Time

- Press “√” to adjust test time.
- Enter the desired test time on the numeric keypad.
- Press “√” to advance to the next menu selection.

MEASURING TIME
MINUTES: 30_

5.4 Set Printouts

The ESR-Auto Plus has several settings affecting the printout of results.

USER CONFIG
SET PRINTOUTS?

- Press “√” to access the printout settings.

PRINTOUTS
AUTO PRINT?

Auto Print

Results will print automatically when auto print is enabled. If auto print is turned off, each printout must be selected manually using the reprint function.

- Press “√” to enable the autoprint function, or “X” to turn it off.

PRINTOUTS
TICKET STYLE?

Ticket Print v. Log Style

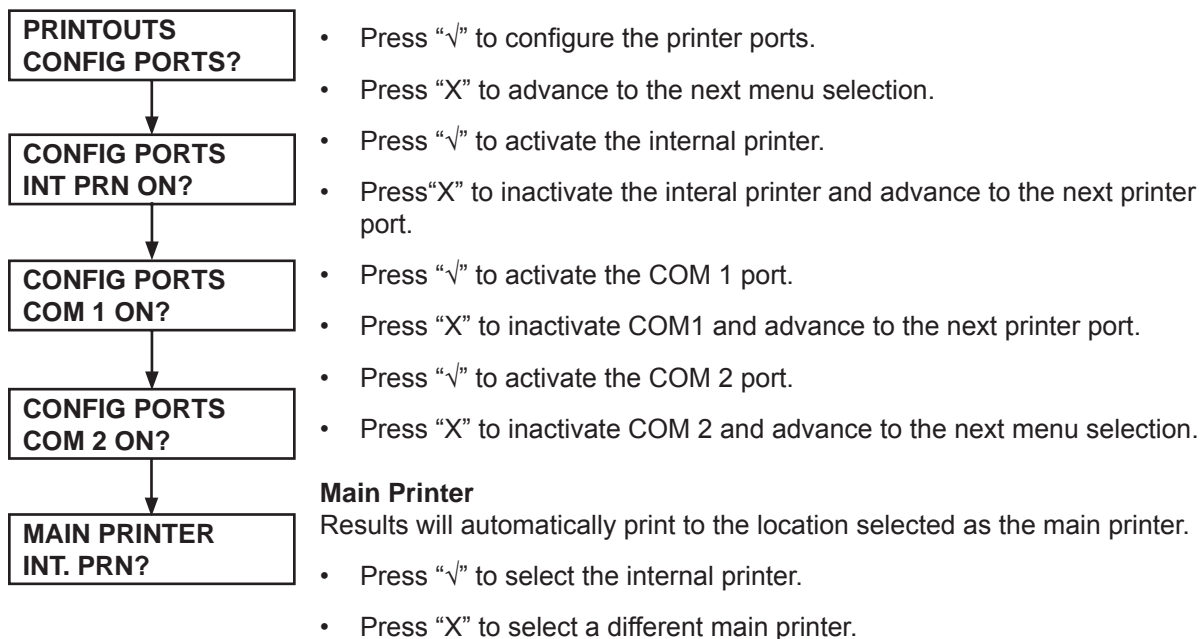
The ESR-Auto Plus can print results on the internal printer in Ticket Style or Log Style printout.

- Press “√” to select Ticket Style printout, or “X” to select Log Style printout.

Configure Ports

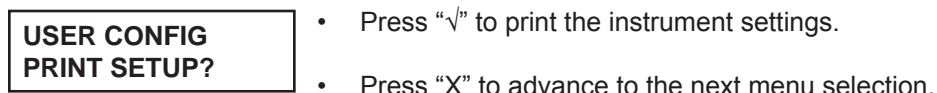
ESR-Auto Plus can transmit results to the internal printer and/or an external COM PORT. The COM PORT is used for connection to an external printer or LIS computer system. The print setup must be set to Log Style to transmit results to an LIS.

Note: More than one port can be activated at the same time.



5.5 Print Set Up

The system settings can be printed. Once your system is configured as desired, we recommend keeping a printout of the settings for reference.



<pre> ***** ESR-AUTO PLUS SETUP ***** 12-31-2008 14:43 SAMPLE COUNTER: 30 SERIAL No: 504-0000 HARDWARE INIT DATE 08/23/05 SOFTWARE VER: ESR-Auto Plus V0006 (050823) INT PRINTER: 1 (0=NON, 1=TXT, 2=GRAPHIC) LANGUAGE:ENGLISH TUBE MODEL IN USE: 1ml PAEDIATRIC TUBE METHOD IN USE: QUICK MODE (CAL.=+0%) PAED MODE (CAL.=+0%) ALARM&TRIG POINTS: 1ml pd LOW FILL : 510 1ml pd LOW FILL : 690 NO SAMPLE TRIG : 200 PAED LEVEL TRIG : 1200 </pre>	<pre> (PRINT SETUP CONTINUED) RTC SETUP: DATE STYLE:4 TIME STYLE:1 PRINTOUT&COM PORTS SETTING: INTERN PRN:ON COM1:ON COM2:OFF DEFAULT PRN:1 AUTO PRINT:YES PRINT STYLE: 1 TECHNICAL SETUP: IR POWER:51% IR STANDBY POWER:14% PREDICTION FROM 15 MINUTES TEMPERATURE COMPENSATION ON. CALIBRATION= 0 CELSIUS MOTOR SETUP: MOTOR SPEED :12 SEC/R V-OFFSET :28 DEG REF-CYCLE :2600 ACC. VAR. :25 LP-OFFSET :180 </pre>
--	--

Figure 19: ESR-Auto Plus set up example. Each instrument is set individually.

5.6 Set Access Code

An access code can be assigned to control access to the User Configuration Menu. The access code can be any number from 1 to 30,000. If the code is set to 0, the function is switched "off".

```

USER CONFIG
SET ACCESS CODE?

```

- Press "√" to set an access code.

5.7 See System Info

The ESR-Auto Plus start up date, total number of samples run and instrument serial number can be viewed on the display.

```

USER CONFIG
SEE SYS INFO?

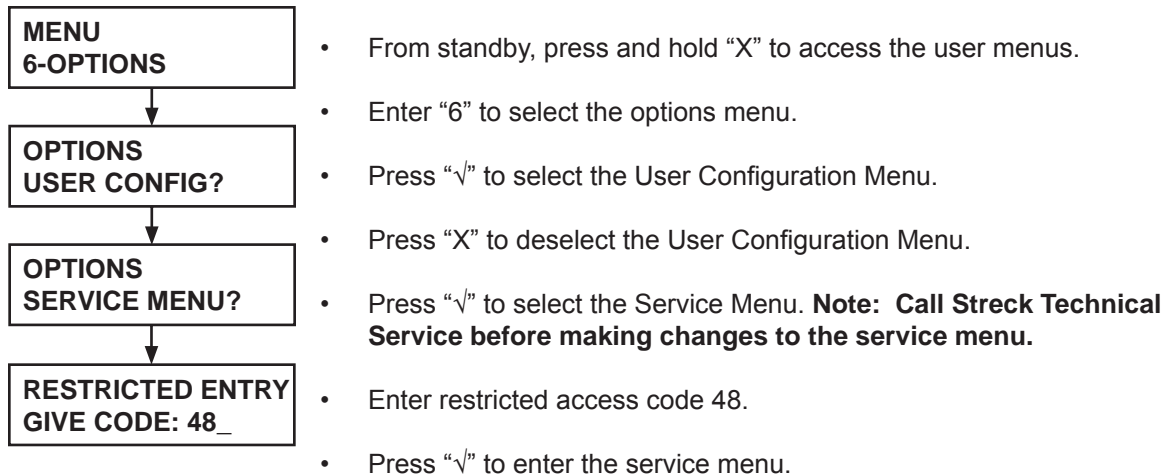
```

- Press "√" to scroll through system information.
- Press "X" to exit User Configuration Menu.

6 MENU FUNCTION 6: OPTIONS - SERVICE MENU

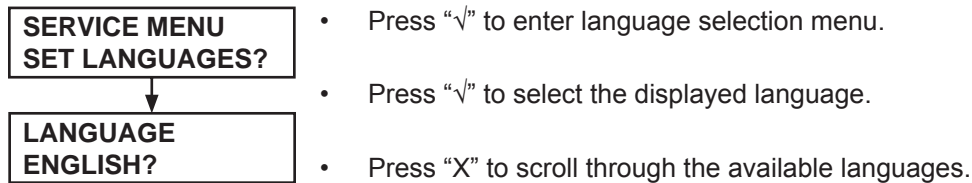
6.1 Accessing Menu

The ESR-Auto Plus has many adjustable features. Most of these features are accessed through the service menu, but these operations should be used with great caution. If used incorrectly, the accuracy of results may be affected.



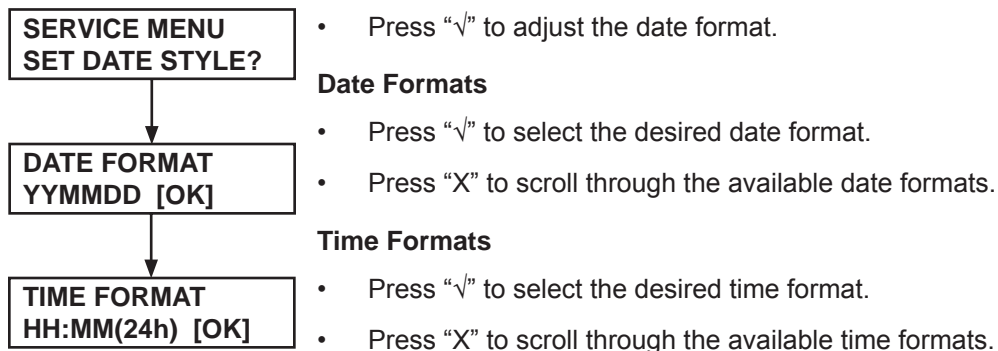
6.2 Set Language (not available in all software)

There may be multiple languages available in the software.



6.3 Set Date and Time Style

There are a number of different date and time display formats available.

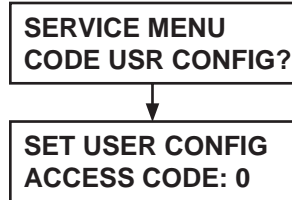


Date Formats	Example	Time Formats	Example
YYMMDD	080125	HH:MM (24h)	18:50
YYYY-MM-DD	2008-01-25	H:MMp (12h)	6:50p
YY-MM-DD	08-01-25		
MMDDYY	012508		
MM-DD-YYYY	01-25-2008		
MM-DD-YY	01-25-08		

Figure 20: ESR-Auto Plus time and date formats.

6.4 User Configuration Code

If the user configuration code is forgotten, it can be displayed and reset through the service menu.



- Press “√” to view and reset the user configuration access code.

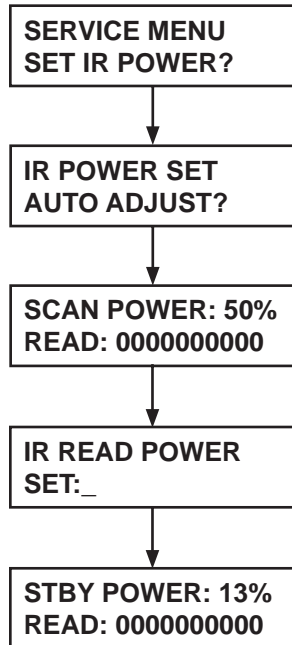
The code will be displayed and can be reset to any number from 1 to 30,000. If the code is set to 0, the function is switched off.

- Press “√” to set an access code, or “X” to advance to the next menu selection.

6.5 Set IR Power

IR Scan Power

The power of the IR diodes can be adjusted in the service menu. Certain label types require increased IR diode strength. For maximum diode life, do not increase the power more than is necessary to read through the labels.



- Press “√” to adjust IR power.
- Press “√” to auto adjust IR power.
- Press “X” to adjust it manually.

The top row shows the current IR power of 50%. The bottom row shows a 0 or 1 for each position in the reading arm. The display will change from 0 to 1 if anything blocks the light path, such as blood or a secondary label. Insert an empty tube with the desired label into any position to determine whether the label blocks the light, or the light is powerful enough to penetrate the label.

- Enter the new value on the keypad to change the IR power.
- Press “√” to accept the displayed value.

IR Standby Power

The IR standby power is the power used in the home position to detect sample insertion or removal. The IR standby power can also be adjusted. Power should be selected so that the original label interrupts the IR beam, indicating that the position is busy. The default setting is 13%.

6.6 LCD Contrast

The contrast of the LCD display can be adjusted from 0-100 (100=lightest).



- Press “√” to adjust the LCD contrast.

6.7 Set Alarms

Trigger levels for different alarms are automatically set to the default when new software is installed or a new tube type is selected.



- Press “√” to enter the alarms menu.

Some alarm levels can be manually adjusted. After a RAM reset, verify that alarm values match the fill level alarms listed below in figure 21. Adjust the values manually if needed.

	1.2ml tubes	2.0ml tubes	Both tubes
Low Fill Level	510	890	510
No Sample	200	200	200
Overfill Level	690	1080	1080
PAED* Trigger	1200	0	690

Figure 21: Fill Level Alarms. * PAED Trigger = 1.2ml Tube

6.8 Motor Settings

The ESR-Auto Plus uses a synchronous motor (circular motion) to measure the ESR. The ESR is measured as time, converted to degrees, then algebraically converted to vertical millimeters. A few required motor-dependent factors are automatically calculated during software installation and should never be changed.

SERVICE MENU MOTOR SETTINGS?

- Press “√” to adjust the motor settings.

When a sample is measured, the angles of the detected levels are calculated based on their portion of a full cycle of the motor, called the Cycle Time (CT). To verify that each cycle is identical, the CT of each scan is compared to the Reference Cycle Cycle (REF CYCLE) value stored in RAM.

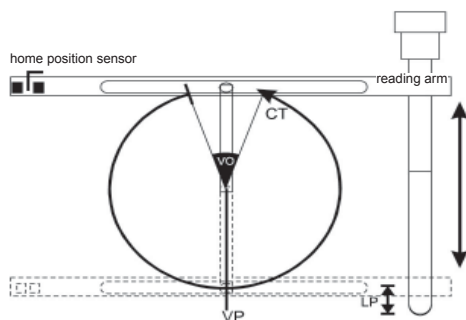


Figure 22: Scanning Device

In order to scan the tubes properly, the system must identify the Vertical Position (VP). The VP is the location where the actual scanning starts and is dependent on the length of the home position sensor. The system must also know the Vertical Offset (VO), which is the angle of the measuring cycle spent in the home position.

ESR-Auto Plus does not scan the entire tube. To obtain readings and alarms equivalent with the actual blood level in the tube, the Lower Position Offset (LP) can also be adjusted. The LP is expressed as mm*10.

6.9 Printouts

ESR-Auto Plus printouts can be adjusted in the service menu.

SERVICE MENU PRINTOUTS?

- Press “√” to access the printouts menu.
- Press “√” to set the internal print type.

PRINTOUTS INT PRN TYPE: _

The main printer port is the location where items print, e.g. small messages, error warnings, and test rack printouts.

PRINTOUTS MAIN PORT? 1

- Select 1=internal, 2= COM1 or 3=both, to designate which printer port will be used as the main printer. When connecting the ESR-Auto Plus to an LIS, select Main port=3.

PRINTOUTS ENABLED PORTS: 7

The COM PORTS can be enabled or disabled from this menu.

- Select 1=internal, 2=COM1 or 7= All enabled (default), to enable the desired COM PORTS. When connecting the ESR-Auto Plus to an LIS, select enabled ports=7.

6.10 Prediction

Prediction is only allowed after a specified amount of time. The earlier the prediction is done, the lower the accuracy of the result. It is not recommended to predict sample results until at least 15 minutes have elapsed.

**SERVICE MENU
SET PREDICTION?**

- Press “√” to adjust prediction time.
- Enter the desired prediction time in minutes.

6.11 Registering Test Rack

The ESR-Auto Plus test rack is designed to simulate ESR levels. Each test rack is unique and its reference values must be registered in the ESR-Auto Plus where it will be used.

**SERVICE MENU
REG TEST RACK?**

- Press “√” to register the test rack.
- Insert the test rack and press “√” to begin the registration process. The instrument will scan the test rack twice and print the results.

↓
**NEW TEST RACK
INSERT RACK [OK]**

- Press “√” to store the new reference values or “X” to decline the new values.

```
***** NEW TEST RACK REGISTRATION*****
DATE 03/01/01 12:00
SERIAL No: 504-0000
HARDWARE INIT DATE 00/01/01
SOFTWARE VER:
  ESR-AUTO PLUS
  VER(0001)

TECHNICAL SETUP:
  MOTOR SPEED :      12 SEC/R
  V-OFFSET     :      28 DEG
  REF-CYCLE    :      2600
  LP-OFFSET    :      160DATE
  IR POWER     :      51%

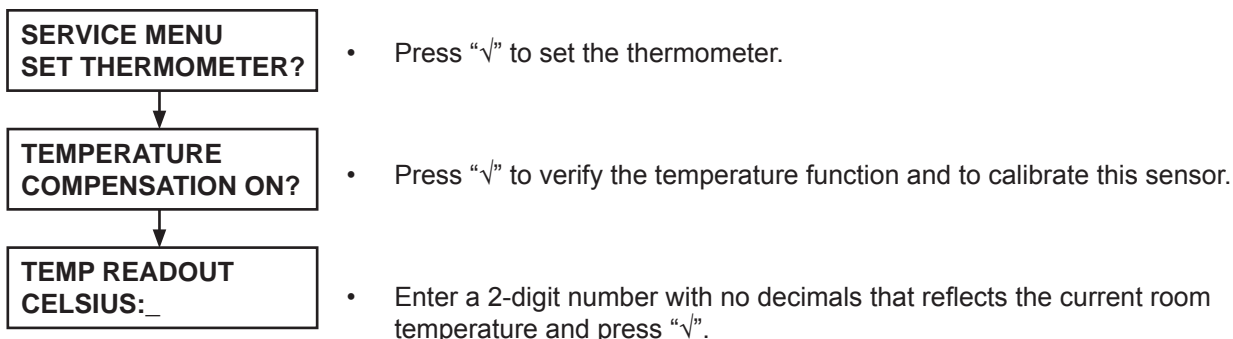
TEST RACK LEVELS:
  1ST READ      2ND READ
POS  MM         MM
A    63.4       63.3
B    55.4       55.4
C    43.1       42.9
D    37.9       37.7
E    30.4       30.5
F    25.7       25.7
G    20.0       20.0
H    10.0       10.2
I     6.2        5.9
J     0.0        0.0

TEST RACK REGISTRATION OK
```

Figure 23: Test Rack Registration Printout

6.12 Set Thermometer

The ESR-Auto Plus has an internal temperature sensor to determine the compensation factor used on reported results. The temperature compensation feature should be turned “on”.

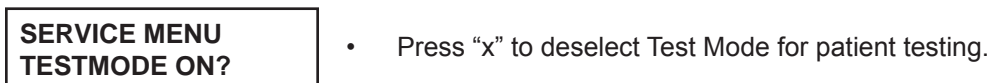


Room temperature can significantly affect the sedimentation reaction, which can lead to incorrect values in the readings. The ESR-Auto Plus software makes an automatic temperature compensation to prevent these errors. The instrument measures the ambient temperature and automatically changes the scale at temperatures above 26° C. This function is carefully calibrated before delivery. A small thermometer icon will appear in the display when the temperature compensation function is in effect due to elevated ambient temperature. Results obtained when the temperature icon is present are valid.

6.13 Test Mode

The ESR-Auto Plus can be set to Test Mode for servicing and testing various instrument functions. The measuring time in Test Mode is approximately 5 minutes. ESR results obtained in Test Mode are NOT clinically significant.

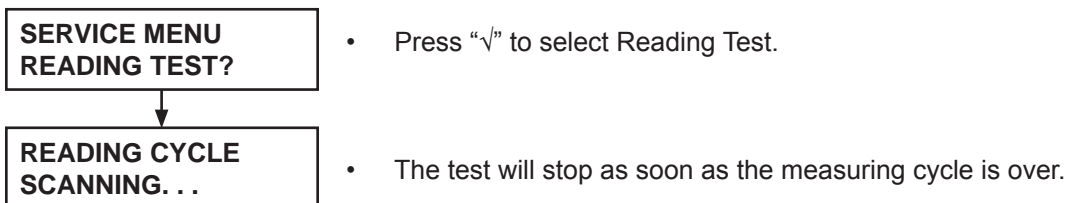
Note: Test mode must be turned off when running patient samples.



6.14 Reading Test

This function is designed to test the accuracy of the reading device. The system continuously scans all 10 positions and reports the readout as mm*10.

Note: Reading test must be turned off when running patient samples.



6.15 Power Test

This function is designed to test the power of the unit.

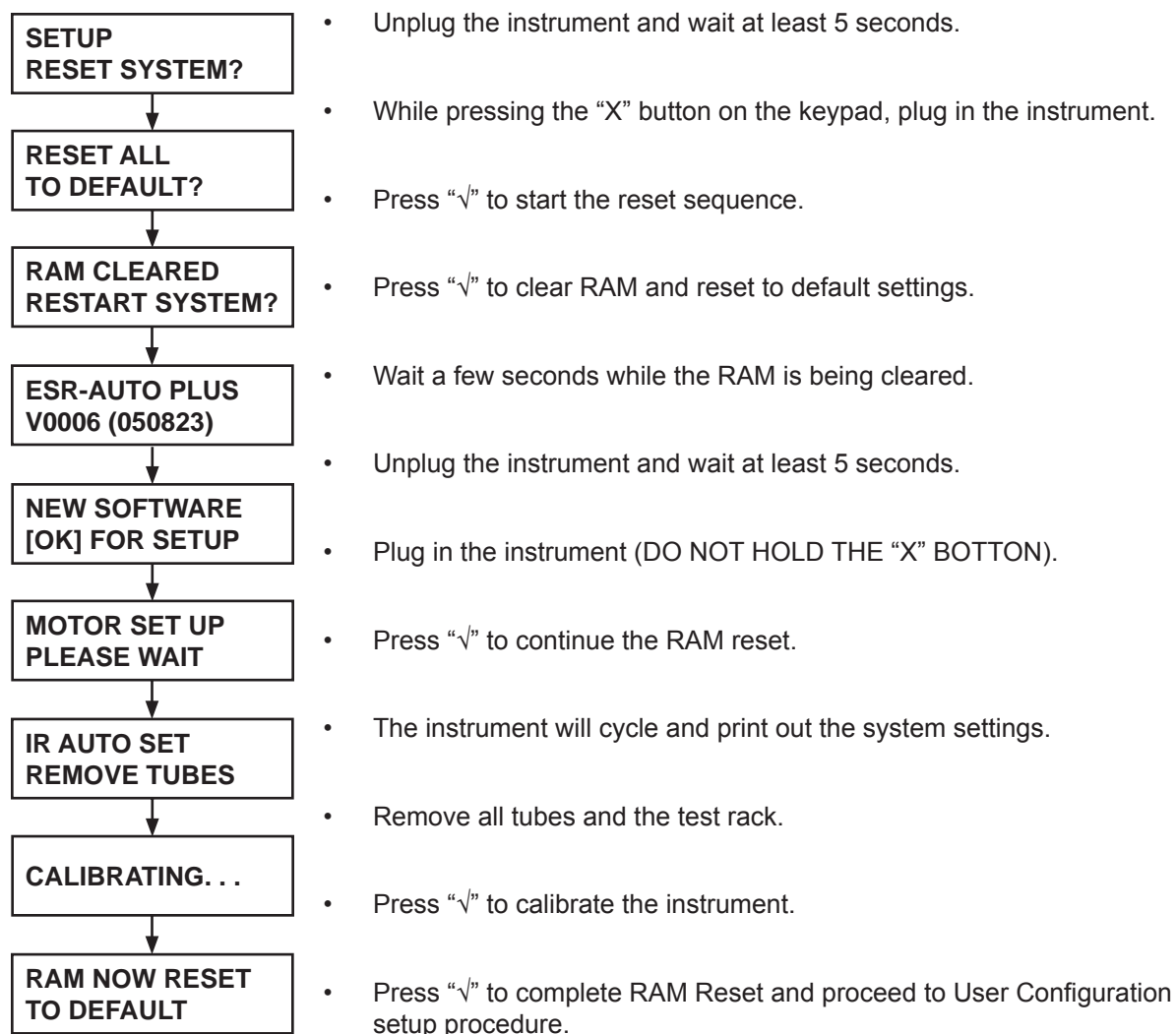
Note: Power test must be turned off when running patient samples.



6.16 RAM Reset

Operators can perform a RAM Reset during start up to reset the instrument to its default factory settings.

NOTE: RAM Reset will erase all customized settings, QC and patient data. If possible, print the instrument setup, patient log file, and QC data before performing a RAM Reset.



7 BACKGROUND OF THE ESR TEST

THE ESR TEST

7.1 The History

Clinicians have long observed that the settling rate of erythrocytes in anticoagulated blood is affected by disease. Initially, the sed-rate test was used as a pregnancy test, but was later unsatisfactory for that purpose. Instead, ESR gained its reputation in the battle against infections, particularly tuberculosis. Its use and importance as a marker of inflammation was highly enhanced by the standardized procedure established by Westergren, a Swedish physician. His method is still considered “the gold standard.”

7.2 The Original 200mm System

The original Westergren method requires a 300mm long pipette of certain dimensions, filled to 200mm with a well-mixed solution consisting of 75% blood and 25% 0.25mmol citrate solution as an anticoagulant. The pipette is placed in an absolutely vertical position, protected from vibrations, temperature changes and sunshine. The sedimentation length of the red blood cells is measured at 60 minutes ± 1 minute and expressed in mm/hr.

Appropriate reference intervals for ESR:

Healthy	0-20 mm/hr
Infectious	20-60 mm/hr

If the ESR is measured again after the second hour, it is referred to as the "Extended ESR." The Extended ESR provides an indication of influence from high hematocrit (HCT). Hematocrit is the volume of red blood cells as a percent of the total sample volume. A sample with an HCT of 70 means that 70% of the sample volume is RBC's. An Extended ESR result is expressed as a fractional parameter. For example 10/15 or 40/40, which means 10mm during the first hour and another 5 during the second, or 40 during the first hour and none during the second.

In a sample with a high HCT and a high ESR, the reaction will stop when all the red cells are packed in the bottom of the tube and the result will appear lower than it actually is.

This problem is more common in the new 100mm tubes than in the original 200mm tubes. As a result, the standardization organization ICSH* discourages the use of the Extended ESR.

* ICSH, *International Council for Standards in Hematology*

7.3 The 100mm Vacuum System

The risk associated with hepatitis virus and HIV infected blood has forced the attention to automatic blood sampling and processing systems. To reduce hazards, evacuated blood collection systems of different designs were introduced into the market during the 1980's.

7.4 BD Standard Scale v. QuickMode Method

In 1985, the Swedish nurse Barbro Hjalmarsson persuaded Becton Dickinson, the largest tube manufacturer in the world at that time, to promote her evacuated blood collection tube. The tube was manufactured in accordance with the BD vacuum tube standards and consisted of a 120mm evacuated tube, pre-filled with an adequate volume of anticoagulant. The diameter of this tube was larger than a Westergren tube, and the system required a conversion scale to produce results compatible with the reference method. The vacuum tube collected 100mm of blood and is often referred to as the 100mm ESR.

Due to the nature of the sedimentation reaction, a non-linear scale is used to convert results obtained with the 100mm tube method to an equivalent result from the 200mm tube method. BD developed the 100mm tube scale, which became the standard conversion scale for 100mm ESR tubes.

The long ESR test time of 60 minutes prompted researchers to develop alternative methods to reduce the measuring time of the ESR test. Most early methods violated fundamental ESR principles described by ICSH* and produced unreliable results. Early methods include holding tubes at different angles, changing angles during the reaction, and centrifuging samples, among others. The "Rapid-ESR" is an example of an early system where an ordinary 200mm ESR tube is placed at a 45° angle to produce a faster sedimentation reaction. The method does increase the speed of RBC sedimentation, but is inaccurate in the higher range.

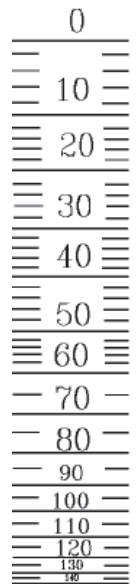


Figure 24: The 100mm standard conversion scale.

The ESR-Auto Plus used the QuickMode method to accelerate ESR measurement. QuickMode is faster than the "Rapid ESR" method described above and has better correlation to the reference method than the standard scale! QuickMode uses a special mathematical formula to convert the accelerated results.

7.5 The ESR-Vacuum Tube

In parallel with Hjalmarsson's developments, another Swedish ESR tube was developed. This one was similar to the long Westergren pipette with a narrow bore, but with vacuum and the appropriate amount of pre-filled anticoagulant.

A special reagent was developed and added to the citrate to make the anticoagulant and blood mix easily. The reagent reduced the surface tension in the sample, but did not affect the sedimentation reaction. It also helps reduce the formation of blood foam, which is a common occurrence when drawing ESR samples. This tube later became the ESR-Vacuum Tube in 1996.

THE SEDIMENTATION REACTION

7.6 A Typical ESR Reaction

Although ESR has been measured for a long time, little is known about its biological background. In order to understand the advantages of the ESR-Auto Plus and the 30-minute method, it is important to understand the course of development of ESR.

Sedimentation is not as basic as people tend to believe. A number of factors affect the sample during its reaction. These factors can be a disadvantage since they can make ESR quite unspecific; however, they also make ESR a wide screening marker for disease. The reaction contains several phases, which affect the end result in various ways. Generally, the reaction can be divided into three basic phases: Aggregation, Sedimentation and Packing.

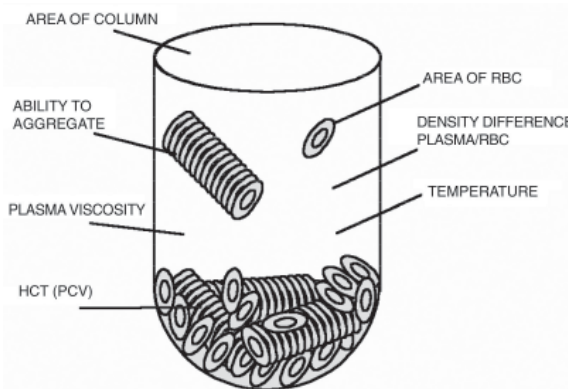


Figure 25: Before the ESR reaction has come to a stop, a number of factors have participated and affected the result.

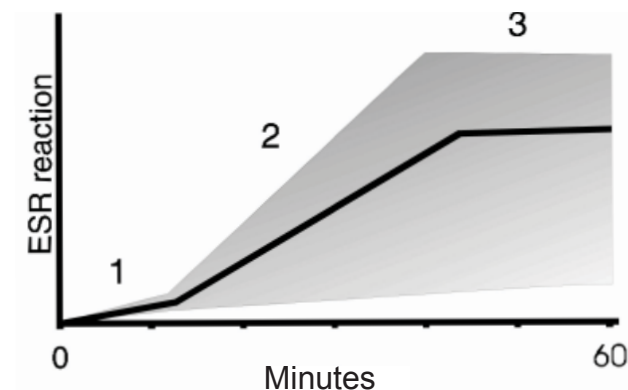


Figure 26: The ESR reaction can be divided into three phases: 1. Aggregation, 2. Sedimentation, and 3. Packing.

Aggregation

The Aggregation Phase occurs during the first 5 to 10 minutes of the reaction. The red blood cells aggregate and sink to the bottom of the tube since red blood cells are denser than plasma. The reaction during this time is not known to correlate to any disease state. Almost no sedimentation of the red cells occurs during this phase. However, the degree of aggregated cells will determine the sedimentation rate during the second phase.

Sedimentation

Sedimentation of red blood cells occurs during the Sedimentation Phase. The sedimentation rate is often linear during the major part of this phase.

Packing

As sedimented red blood cells reach a certain density, sedimentation will decrease and come to an end. This is the Packing Phase where the blood divides into distinct layers of red blood cells, white blood cells and plasma.

Samples reach the Packing Phase at widely different times depending on the sedimentation rate and the relative volume of red blood cells. In some samples, packing may be

complete in 30 minutes. In others, packing may take more than 60 minutes. A two-point measurement with the 200mm reference method, where the first point is reported during the first hour and the second point after the second hour, is often used as an indication that the Packing Phase is complete.

Differences in results between the 200mm and 100mm ESR methods are often observed during the Packing Phase. Some samples will reach the Packing Phase in 100mm tubes, while those same samples may not reach the Packing Phase in 200mm tubes. Therefore, a two-point measurement is not normally considered necessary in 100mm tubes. Excluding samples with an extremely low ESR, most samples will reach the Packing Phase within the first hour.

This Packing Phase phenomenon is what makes ESR-Auto Plus and QuickMode unique. In QuickMode, samples are read after 30 minutes and results are converted to 60-minute Westergren values. As seen in the following graph, the ESR-Auto Plus demonstrated excellent correlation to the manual method.

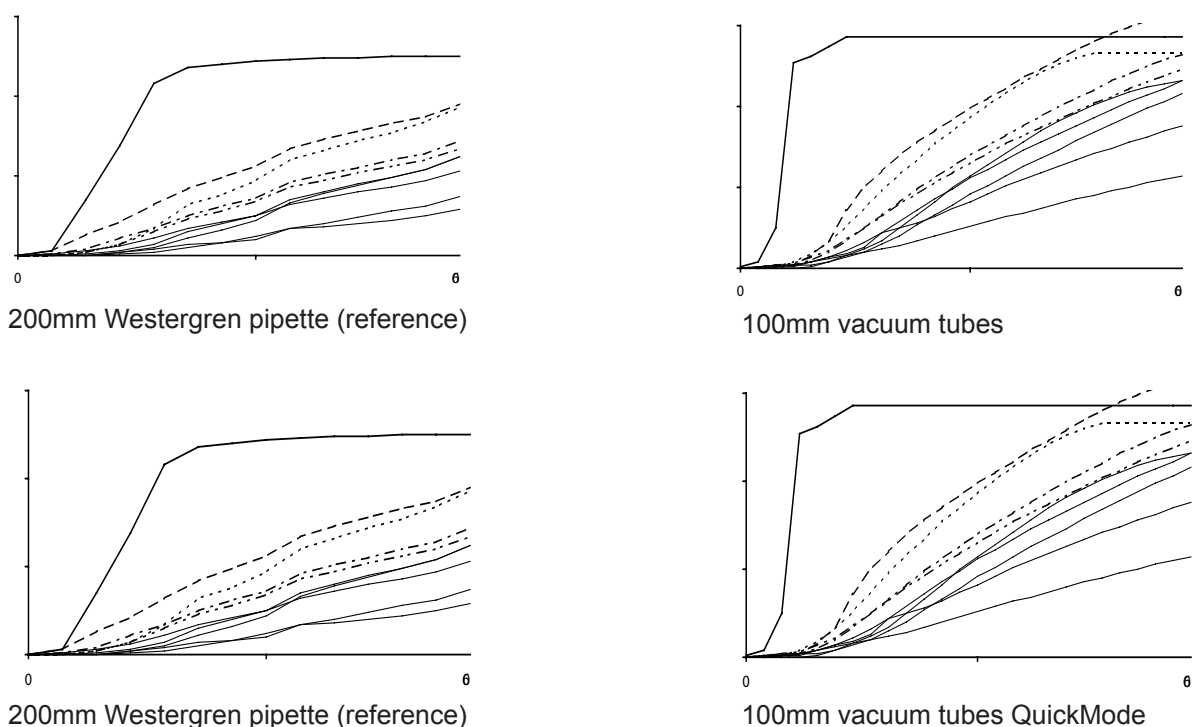


Figure 27: Samples measured in both 100mm tubes and the 200mm reference method. **Note:** In the top two graphs, the correlation during the reaction is quite similar; however, the end results are very different between the two methods. This difference occurs because samples enter the Packing Phase at different times. In the lower two graphs, the QuickMode method yields a much better correlation to the reference method.

7.7 Temperature Correlation

Ambient temperature affects the ESR result. In a warmer room, the ESR reaction increases considerably. The ESR test should be performed at 20°C. Since this is impossible in some laboratories, a conversion scale was developed with the 100mm system.

Both scales are programmed in the ESR-Auto Plus and a temperature sensor mounted internally decides which scale to use. This sensor switches at temperatures above 26°C. When using QuickMode, which is a mathematical method (not scaled), a standard 10% is deducted from the result at temperatures above 26°C.

The normal 60-minute scales have been further developed into additional scales below 20°C and above 27°C. The effect of temperature is not the same in all samples and it is difficult to get an exact correlation factor. The diagram below shows the effect of temperature.

In some samples, the influence of temperature is nearly non-existent. In others, it is considerable, which makes a general compensation impossible.

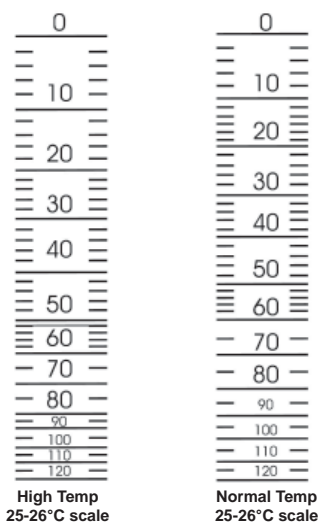


Figure 28: The standard scales for temperature compensation

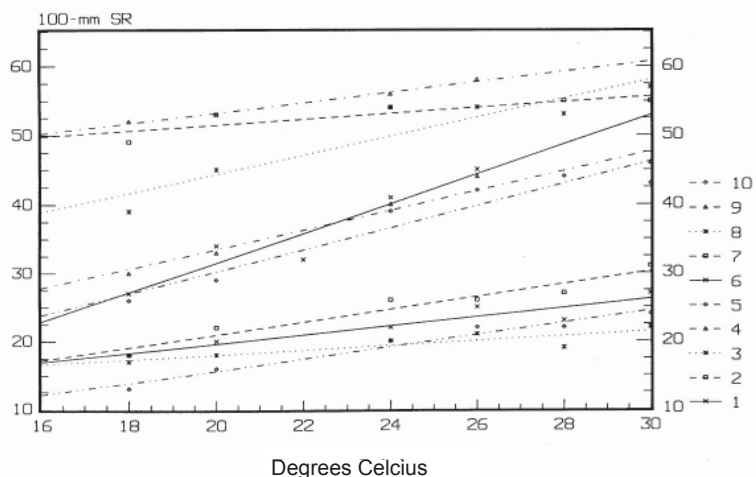


Figure 29: The real temperature effect in a few samples.

7.8 Reproducibility

It is often discussed how long a sample can be stored before measurement, and how many times an ESR result can be reproduced. In the study below, tubes were continuously measured (1 reading per 70 minutes) during the first 10 hours after collection and then stored in the refrigerator overnight for measurement again the following morning.

The graph does not show any difficulty recovering values for normal results. However, samples with an elevated ESR result commonly display a difference of about 10%. In the graph below, the sample with the most difference varies from 43 to 47 mm (=9%).

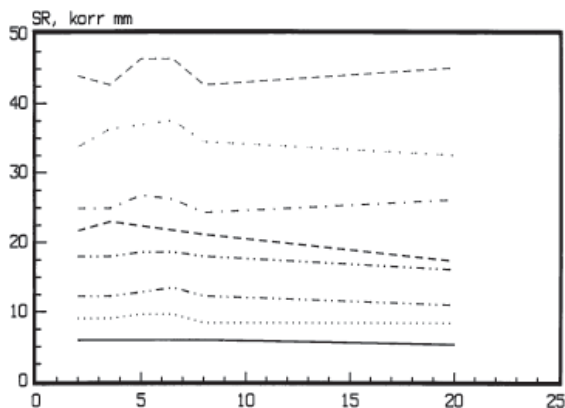


Figure 30: The reproducibility for a few samples.

It is important to include other factors in this discussion. These samples were carefully mixed at time of venipuncture. Once the samples reached room temperature, they were mixed an additional 10 minutes using ESR-657 Mixer. If these two steps were not carefully performed, the variation in a reproducibility test, such as the one below, would be greater.

It is necessary to have a mixer similar to the ESR-657 Mixer when mixing ESR tubes. A normal "roller" mixer is often not good enough.

8 TECHNICAL INFORMATION

8.1 Overview

Automated ESR testing analyzes samples in a similar manner to manual ESR testing. The instrument collects readings at two different timepoints; the first is an initial timepoint to register the initial fill level in the tube, the second after a specified period of time to register the level of RBC sedimentation. These values are then converted to a standard ESR result in mm/hr.

The ESR-Auto Plus uses the QuickMode method, which reads the RBC sedimentation level after 30 minutes and mathematically converts it to an equivalent Westergren result in mm/hr.

The ESR-Auto Plus scans the RBC level twice during each reading; once as the reading arm lowers and once on the way up. If the system detects a difference between the two scans, it will ignore the readings and rescan the sample.

8.2 Measuring Abnormal Samples with IR Light

The ESR-Auto Plus reads samples by scanning the tube with infrared light (IR). One side of the measuring arm consists of IR-diodes and the other has IR sensors. **Note: The clinical significance of an ESR result obtained from an abnormal sample should be determined by the clinician ordering the test.**

Hemolyzed Samples

The IR light is powerful and can transmit through plasma, lipid samples and most hemolyzed samples. However, results from hemolyzed samples can cause confusion. In manual testing, it can be very difficult to see the RBC / plasma interface in a sample that is only partly hemolyzed. Therefore, these samples may be reported as "normal."

The ESR-Auto Plus can detect hemolysis to a level of ≤ 3.0 g/dL free hemoglobin due to the strength of the IR light. Try to reproduce the test result manually by holding the hemolyzed sample against a strong light. Re-run the sample on the ESR-Auto Plus and verify the automated result.

Icteric Samples

The ESR-Auto Plus indicates no appreciable shift in ESR recovery at bilirubin concentrations up to 20.2 mg/dL. Infrared detection is not impeded.

Low Hemoglobin Concentration

The ESR-Auto Plus can read samples with hemoglobin concentrations ≥ 3.0 g/dL. Hemoglobin concentrations < 3.0 g/dL are incompatible with the ESR-Auto Plus. The ESR-Auto Plus identifies ESR recovery failures as " > 120 mm/hr" or sample "not recognized."

Lipemic Samples

The ESR-Auto Plus is unable to read severely lipemic samples. The readability limit of lipemic samples has not been quantified. The ESR-Auto Plus detects the cellular/plasma interface when reporting the ESR result. That interface is disguised in severely lipemic samples.

8.3 Checking a Secondary Label

The ESR-Auto Plus can normally read through one layer of a normal paper-label. However, any proposed labelling system should be checked first. The IR power and the sensitivity can be adjusted to read through thicker labels. To check label type interference:

- a. Take a few empty tubes and place the secondary label as close to the cap as possible.
- b. Place the tubes in an open position with the labels facing forward, leaving any label-free area in the scanning light-path of the ESR-Auto Plus.
- c. If the instrument reports zero (0) on any result, then the label was detected by the IR reader and it will interfere with the ESR test.

8.4 Fill Level

1.2ml ESR-Vacuum Tubes are evacuated to draw at least a 60mm blood column. ESR-Vacuum Tubes will remain within the stated fill level limits through the expiration date. The fill level, expiration date and lot number are printed on the label of each tube.

8.5 Barcode Input

The barcode input is a COM PORT located on the back of ESR-Auto Plus. Sample ID's can contain any alphanumeric character and have a maximum length of 16 characters. No special start or stop characters are required. Non-printable or control characters are removed. The barcode reader is a scanning model and is available from your Streck representative. The barcode scanners are considered to be Class 1 lasers that emit Class 2 laser light.

Accepted codes (Symbol LS1902T-i000, LS2208-SR20001):

EAN, UPC, Codabar, Code 39, Code 93, Code 128, Interleaved 2 of 5, and more. The barcode reader has several adjustable parameters. Please refer to separate manual.

Port specification:

Type	COM PORT Female HP 9p D SUB
Baud Rate	9600
Data Bits	8
Parity	None
Flow Control	None

Pin assignments:

1	nc	2	RX-Data from barcode reader
3	nc	4	+5 V for reader C TS
5	nc	6	nc
7	Ground	8	nc
9	+5V, 0.1 A max		

8.6 COM PORT Communication

The results can asynchronously be transmitted to the host computer via the COM PORTS located on the back of the ESR-Auto Plus. This is a unidirectional transmission of data. The data consists of ASCII characters and is the same data that is sent to the printer. At the end of the each line, a "LF" is sent (Hex 0D 0A). After the last line 2 sets of "LF" are sent to feed paper up.

The printout can be configured from the software. The COM PORTS can be switched "on" or "off."

Port specifications:

Baud Rate	9600
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None

Pin assignments:

1	nc	2	TX (Transmit)
3	RX (Read)	4	nc
5	GND	6	nc
7	nc	8	nc
9	nc		

8.7 Preventive Maintenance

Internal Printer:

Regularly check that the printer head on the internal printer is free from dust and remains from old printer paper.

8.8 Cleaning Instructions

Regularly clean the instrument. Use a damp, soft cloth or paper. The covers can also be carefully cleaned with ethanol or isopropanol. "Canned Air" should not be used to blow dust away from the printer. Damage to the print head may occur.

CAUTION: The main power must be turned "off" before cleaning with any liquids. Do not remove the ESR-Auto Plus cover during cleaning.

8.9 Technical Specifications ESR-Auto Plus

Electrical Specifications	The ESR-Auto Plus is provided in two electrical configurations as noted below.			
US / 120V input	US Adaptor with UL approval (Model: MW48-2401000A) UL/CUL plug-in AC/AC Adaptor Input: 120V~60Hz Output is 6 foot cord + male 3.5 x 14mm			
International / 230V input	International Adaptor with IEC 320 connector (Model: AP7974) CE approval wall mount AC/AC Adaptor Input: 230V~ 50Hz Output is 6 foot cord + male 3.5 x 14mm dc plug			
Power Cables European U.K. Australian	International adaptor listed above should be used with one of the following power cables. Part number: 519.1000.0004 Part number: 519.1000.0003 Part number: 519.1000.0001			
Current consumption	Max. 33W			
Voltage Current consumption	24V AC 50/60 Hz, Single Phase. (For connection to 120V or 230V mains: Order with dedicated power transformer.) Max. 850 mA			
Reading method	Infrared light, wavelength 950 nm. Values converted according to time consumed between bottom position and triggering point following trigonometric calculations.			
Capacity	In "QuickMode" (30 min): 20 samples / hour			
Preparation of tubes	Immediately after venipuncture: 6-8 complete inversions of tube. Before insertion in ESR-Auto Plus, minimum 10 complete inversions or 3 minutes in ESR-657 Mixer.			
Alarm limits		1.2ml tube	2.0ml tube	both tubes
	Low Fill Level	510	890	510
	No Sample	200	200	200
	Over Fill Level	690	1080	1080
	PAED Trig	1200	0	690
Analytical range	0 - 120 mm/hr			
Serial port	COM PORT. See "Technical Information" for details.			
Barcode specification	COM PORT. See "Technical Information" for details.			
External printer cable	Null Modem Cable, 2 meters, 9 pin male to 9 pin male.			
Sound pressure level	Less than 55 dB at the highest sound pressure level.			
Working environment Temperature range Relative humidity	5°C to 40°C Max. 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.			
Storing environment Temperature range Relative humidity	0°C to 40°C Max. 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.			
Ventilation requirements	Not specified, but one must be aware that the ESR reaction increases with higher temperature.			
Dimensions	272mm (width) x 224mm (depth) x 160mm (height)			
Weight	8 pounds (3.6 kg)			

8.10 Technical Specifications ESR-657 Mixer

Electrical Specifications	The ESR-657 Mixer is provided in four electrical configurations as noted below.
US / 120V input	US Adaptor with UL approval (Model: MW48-2401000A) UL/CUL plug-in AC/AC Adaptor Input: 120V~60Hz Output is 6 foot cord + male 3.5 x 14mm
International / 230V input	International Adaptor with IEC 320 connection (Model: AP7974) CE approval wall mount AC/AC Adaptor Input: 230V~ 50Hz Output is 6 foot cord + male 3.5 x 14mm dc plug
Power Cables European U.K. Australian	International adaptor listed above should be used with one of the following power cables. Part number: 519.1000.0004 Part number: 519.1000.0003 Part number: 519.1000.0001
Current consumption	Max. 29VA
Sound pressure level	Less than 55 dB at the highest sound pressure level.
Working environment Temperature range Relative humidity	5°C to 40°C Max. 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.
Storing environment Temperature range Relative humidity	5°C to 40°C Max. 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.
Ventilation requirements	Not specified.
Dimensions	180mm (width) x 90mm (depth) x 125mm (height)
Weight	1.8 pounds (0.79 kg)

8.11 Environmental Conditions

ESR-Auto Plus is designed to be safe under the following conditions:

- a. Indoor use
- b. Altitude up to 2,000 meters
- c. Temperature 5°C to 40°C
- d. Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
- e. Main supply voltage fluctuations not to exceed +10% of the nominal voltage
- f. Transient over voltages according to installation category II
- g. Pollution degree 1 in accordance with IEC664

8.12 Transportation Environment

Temperature Range: -40°C to 55°C

Pressure Range: 68-100kPa.

8.13 Disclaimer

If ESR-Auto Plus or ESR-657 Mixer is used in ways other than specified in this manual, the protection provided by the equipment may be impaired. Streck cannot take any responsibility for injuries or accidents that might occur as a consequence of this.

9 SAFETY PRECAUTIONS

9.1 User Precautions

All ESR-Auto Plus operators should follow Universal Precautions for handling potentially infectious materials analyzed in this instrument. Seek immediate medical attention in the case of exposure to biological specimens.

9.2 Electrical Equipment

The power supply of all electrical equipment is a potential source of danger. To avoid the risk of electrical shock and/or damage to the instrument, operators should not open the covers of live electrical parts of the instrument. As a precaution, the instrument should be disconnected from the power supply before removing or reinstalling any connectors on the instrument. In addition, we recommend plugging the ESR-Auto Plus into a power surge protector for additional protection from power surges and fluctuations. Only authorized Streck service personnel may open the instrument to perform maintenance or repair. Contact Streck Technical Service at 800-843-0912 for assistance.

9.3 Sample Analysis

The operator should consider all biological samples as potentially infectious. The operator should observe Universal Precautions and follow established laboratory safety regulations when handling all biological samples and blood collection sharps. Wipe up any specimen spilled on the instrument immediately and disinfect the contaminated surface with a 0.5% sodium hypochlorite solution.

Biological fluids and liquid waste should not be disposed in general waste, but should be disposed with infectious medical waste. Compliance with waste disposal regulations is the responsibility of the operator.

9.4 Application of Secondary Labels

Caution must be taken when applying additional patient labels to ESR-Vacuum Tubes. Excessive label thickness, wrinkling or flagging may increase the outer diameter of the tube enough to wedge it in the instrument. If the operator experiences resistance when inserting a tube containing a secondary label, they should remove the tube before it is fully inserted and remove the additional label before proceeding.

9.5 Removal of ESR-Vacuum Tubes

The operator should easily be able to remove an ESR-Vacuum Tube from the ESR-Auto Plus at the conclusion of the test by grasping the stopper with their fingertips. Caution must be taken to lift the tube straight out of the instrument until the entire tube clears the top surface of the instrument. There is a greater risk of the stopper dislodging from a tightly fit or wedged tube, which could make tube removal difficult.

In the event that an ESR-Vacuum Tube becomes lodged or broken inside the instrument, the operator should not attempt to remove the tube. The operator should seal the affected tube channel with tape, place the instrument in a biohazard bag and contact Streck Technical Service at 800-843-0912 for instructions on how to return the instrument to Streck for repair and decontamination.

10 TROUBLESHOOTING

10.1 Error Codes

Error codes are printed in text on the ticket style printout and binary code on the log style printout and LCD display. The binary values, error codes and explanations are listed below.

Binary Value	Error Code	Cause / Remedy
1024	Sample overfilled	Max. fill level: Paed tube=69mm, 2.0ml tube=115mm. Do not overfill.
512	Sample manually aborted	Appears when a sample is aborted before end of measuring time.
256	Timing error	The timing of an ESR reading was wrong by more than 30 seconds.
128	Test mode enabled-Result invalid	Disable test mode in service menu to read ESR samples.
64	Not reported	N/A
32	High temperature warning	The temperature of the lab is more than 26°C.
16	No ID code	The sample was started without entering an ID code.
8	Out of range	The ESR value is outside of the instrument's scanning range.
4	Low fill level	Min fill level: Paed tube=51mm, 2.0ml tube=89mm. Check draw level.
2	No sample found	Sample started and removed without aborting, or fill level is < 20mm.
1	PAED tube overfill	Max. fill level: Paed tube=69mm. Do not overfill.

10.2 Decoding Error and Status Codes

To decode an alarm error code or status code, identify the largest value on the binary value table equal to or smaller than code reported. Subtract that value from the error code reported. Continue the same process until you reach 0. Each binary value subtracted from the original number represents an error message that applies to the sample.

Binary Value	Error Code	Status Code
1024	Sample overfilled/ Label Interference	No code
512	Sample manually aborted	Reprint sample
256	Timing error	This is a PAED tube (1.2ml)
128	Test mode enabled-Result invalid	Motor check "on"
64	Not reported	Auto print "on"
32	High temperature warning	Temperature compensation "on"
16	No ID code	No code
8	Out of range	No code
4	Low fill level	No code
2	No sample found	No code
1	PAED tube overfill	QuickMode enabled

Example:

Reported Error Code = 1048.

The largest binary value \leq 1048 is 1024 (sample overfilled): $1048 - 1024 = 24$.

The largest binary value \leq 24 is 16 (no ID code): $24 - 16 = 8$.

The largest binary value \leq 8 is 8 (out of range): $8 - 8 = 0$

Therefore, the error codes associated with the binary value 1048 are: 1024 = Sample overfilled, 16 = No ID code, and 8 = Out of range.

10.3 Troubleshooting Guide

Miscellaneous errors and conditions are summarized below.

Problem	Possible Cause(s)	Corrective Action
Incorrect values	Samples not mixed properly. Incorrect instrument settings.	Re-mix samples as described in operator manual. Verify that any additional labels are placed correctly on the tube. If incorrect values persist, print System Setup and call Streck Technical Services.
Test rack verification fails	Read values differ more than 2mm from the stored reference values.	Repeat test rack verification. Re-register test rack in Service Menu.
Low fill/overflow alarm	Alarm limits are incorrect. Instrument set to read wrong tube type.	Choose correct tube type in User Configuration menu. Verify alarm limits in Service menu.
Printer malfunction	Printer paper empty. Printer port not activated in the set up.	Load paper. Activate correct printer port. (See User Configuration and Service menus.)
Motor malfunction	Motor broken, Motor driver broken, or Motor connector loose	Call Streck Technical Services.
Alarm for sample removed immediately after starting	Incorrect label placement. Sample removed and needs to be canceled.	Verify that any additional labels are placed correctly on the tube. Abort sample and re-run if necessary.
Barcode scanner does not read the barcode	Barcode type not activated in scanner. Scanner not properly connected to unit.	Connect scanner with screws. Activate barcode in the scanner – refer to scanner programming guide. Verify that barcode scanner is tightly screwed into the correct port on the back of the unit. Verify that the port is activated in the User Configuration Menu.

Note: Contact Streck Technical Services for assistance with any of the problems listed above, or if any other system malfunctions are observed.

11 QUICK REFERENCE GUIDE

11.1 Standby Screen

The standby screen indicates that the ESR-Auto Plus is ready to run a patient sample. The ESR-Auto Plus is in standby mode when "NEXT SAMPLE..." appears in the display. For any other operation, such as looking up a result, predicting a sample currently in process, printing a result, running a control or changing instrument settings, press and hold the red 'X' button for one second to access the Main Menu.

11.2 Mix Tubes

1. Transfer patient sample from an EDTA tube or collect sample directly into an ESR-Vacuum Tube.
Note: Do not remove anticoagulant from ESR-Auto Plus tube before transfer.
2. For direct draw, invert the ESR-Vacuum Tube 8 to 10 times manually after blood collection.
Note: It is very important to mix the tube thoroughly.
3. Allow sample to reach room temperature before analysis.
4. Place the room temperature tube on the ESR-657 Mixer for at least 3 minutes to thoroughly resuspend sample.
5. When thoroughly mixed, load sample in the ESR-Auto Plus.

11.3 Run Test Rack

1. From standby, press the red "X" button.
2. Select number 5-Run Test Rack.
3. Insert the test rack and press the green " $\sqrt{}$ " button.
4. Instrument will scan the test rack and generate a printout.
5. If the printout reads "TEST OK", proceed with QC controls.
6. If test rack reads "FAILED", refer to section 10.8 Re-Register Test Rack.

11.4 Register New Lot of QC

Note: Registering a new lot will clear all existing QC data. Print existing QC data before registering a new lot.

1. From standby, press the red "X" button.
2. Select number 4-QC Menu.
3. Select number 3-Reg New Control.
4. Enter level and press the green " $\sqrt{}$ " button.
5. Press the green " $\sqrt{}$ " button to clear old stats.
6. Enter lot, expiration date and min/max ranges.
7. New values will automatically print.
8. Press the green " $\sqrt{}$ " button to accept or the red "X" button to reject values.

11.5 Run QC Sample

Note: Register controls before running a QC sample.

1. From standby, press the red "X" button.
2. Select number 4-QC Menu.

3. Select number 1-Run Controls.
4. Select either Level 1 or 2.
5. Instrument reads: "Insert in a Free Position."
6. Insert QC sample in any open position, and the light will change from green to red.
7. In 30 minutes, the result will automatically print and the light will return to green.

11.6 Run Patient Sample

1. From standby, either enter patient ID on the keypad and press the green " $\sqrt{}$ " button, or scan the patient barcode with the ESR Barcode Scanner.
2. Instrument reads: "Enter - (patient ID) in a free position"
3. Insert patient sample in any open position, and the light will change from green to red.
4. In 30 minutes, the result will automatically print and the light will return to green.

11.7 Cancel Measurement

1. To cancel a tube, remove it from its position.
2. Press the green " $\sqrt{}$ " button to abort or the red "X" button if removed by accident.

11.8 Predict Sample Result

1. From standby, press the red "X" button.
2. Press 1 to search sample by ID or 2 to search by position.
3. Enter the ID or position number and the instrument will give an alarm sound and remaining time will appear on display.
4. After a few seconds, the second row will display 1 Predict Sample and 2 Abort Sample. Choose either 1 or 2, or press and hold the red "X" button to end search sequence.

11.9 Re-Register Test Rack

1. Unplug the instrument. Wait at least 5 seconds and plug in the instrument.
2. Instrument reads: "Initiating Motor..."
3. Instrument reads: "Next Sample..." Press the Red "X" button. Enter "6."
4. Instrument reads: "User Config." Press the red "X" button.
5. Instrument reads: "Service Menu." Press the green " $\sqrt{}$ " button.
6. Instrument reads: "Give Code." Enter "48." Press the green " $\sqrt{}$ " button. Press the red "X" button until the instrument reads "Reg Test Rack?"
7. Instrument reads: "Reg Test Rack?" Press the green " $\sqrt{}$ " button.
8. Instrument reads: "Sure?" Press the green " $\sqrt{}$ " button. The instrument will scan twice and print results. The printout should read "TEST RACK REGISTRATION OK."
9. Instrument reads: "Set Thermometer?" Press the red "X" button.
10. Instrument reads: "Test Mode On?" Press the red "X" button.
11. Instrument reads: "Reading Test?" Press the red "X" button.
12. Instrument reads: "Power Test?" Press the red "X" button.
13. Instrument reads: "Next Sample..."

The instrument is ready to run samples.

ESR-AUTO PLUS QC / MAINTENANCE RECORD

MONTH _____ YEAR _____

DAY	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Controls 1st Shift																															
Controls 2nd Shift																															
Controls 3rd Shift																															
Test Rack Passed																															

WEEK	1	2	3	4	5
Printerhead free of dust and old paper.					
Instrument cleaned with a soft cloth.					



7002 S. 109 Street Omaha, NE 68128 U.S.A.
+1 402-333-1982 www.streck.com

October 2008

320440-5