XC-A10

Automated ESR Analyzer

Operation Manual

Contents

Chapter 1. General

XC-A10 automated Erythrocyte Sedimentation Rate (ESR) analyzer is a fast and easy-to-use instrument controlled by micro-computer system.

The analyzer can measure 10 tubes simultaneously, monitoring the change of the erythrocyte sedimentation rate during the whole testing process. The measurement of each sample is independent. The result is in mm/1h, it will be displayed on LCD screen directly and printed out by internal printer. The sedimentation curve of 3 minute interval can be printed out also.

Scope of application: erythrocyte sedimentation rate analysis

Features:

1. Utilizing of Micro-processor technology, fully controlled by computer programs.
2. Measure time: 30 min (correspond to Westergren 1 hour result)
3. The ESR results under temperature of 15°C～32°C can be automatically compensated to 18°C
4. The throughput is up to 20 samples per hour
5. Results can be displayed on LCD screen and printed out by

internal printer

6. Standard RS-232 interface, can be connected to external computer for remote communication and data process

Chapter 2. System Structure

The analyzer consists of the main unit (including the socket for 10 tubes), analysis system, display, operating component, internal printer and ESR tubes.

Front panel

1) ESR tube socket: to hold the sample tubes

2) LCD: to display temperature, ESR tube status, result, etc.

Chapter 3. Installation

1. Unpacking and inspecting

Carefully open the carton when you receive the goods, inspect the instrument to make sure it is in good condition, then check the accessories against the packing list. Notify the supplier immediately if you find anything damaged or missing. Handle the glass ESR tubes carefully.

2. Environment requirements:

To ensure the instrument under optimum working status, it must be installed according to the following requirements:

1) The environment should be clean and as free as possible from the dust
2) The instrument should be installed on a stable and solid platform that is free of mechanical vibration and away from vibration source
3) Do not place the instrument in direct sunlight.
4) Ambient temperature: 15^{o} C~32^{o} C, humidity: less than 85%.
5) The instrument should be away from the strong electrical interference

3. Installation

Pay attention to the following points when you install the instrument:

1) The power adapter of the instrument is a three-core socket, the grounding terminal must be well connected to ground to ensure

safety and reliable operation.

2) The instrument must be placed horizontal to ensure that ESR tube vertical after it been inserted into the hole. Meanwhile the instrument should be placed stably, reliably and anti-vibrant. After then, turn on the power, the instrument will run self-test and system setting automatically.

Chapter 4. Operation

1. Reading principle

Monitor 30 tubes simultaneously by the measuring board that consists of infrared photocell. The vertical measuring interval is 0.16mm (i.e. the resolution of the instrument), and the measuring cycle is 3 minutes. When the tube inserted, the analyzer automatically starts the measurement. The time for the first reading is set as “0 min”, and the blood level in the tube is been detected. The acceptable range for the blood height setting is 50mm～64mm (starting from the bottom of the ESR tube), the recommended height is 55mm (the corresponding volume is 1.6ml, i.e. 0.32ml anticoagulant and 1.28ml whole blood). The operating mode is 30 min if measures the tube for 10 times, and 60 min if measures the tube for 20 times. For the details of measuring and calculating principles, please refer to “Chapter 5 - Measuring Principle”

2. Sample Preparation

It requires 1.28ml whole blood for each sample. The blood can be directly injected into the ESR tube which contains 0.32ml anticoagulant. This is to ensure proper volume of the blood in the ESR tube. There are two indicating lines on the ESR tube. Inject the blood into the tube until the level is between the two lines, then seal the tube tightly with a rubber cover, slowly reverse the tube for at least 5 times to mix the anticoagulant

and whole blood completely.

Note: Air bubbles should be excluded from the anti-coagulated blood.

3. Label

Every ESR tube has a label. The label should be attached on the tube flatly, otherwise the tube may be not able to insert into the hole or can not reach the bottom and cause wrong measuring result. The correct label position on the ESR tube is shown as figure 4-1. There are two indicating lines on the label. The distance between the two lines is 9mm, the position is shown as H in figure 4-1. The recommended position of the blood height (M) is 55mm (corresponding to 1.6ml, i.e. 0.32ml anticoagulant and 1.28ml whole blood). The blood level should reach between two indicator lines, thus the analyzer can detect the blood level correctly.

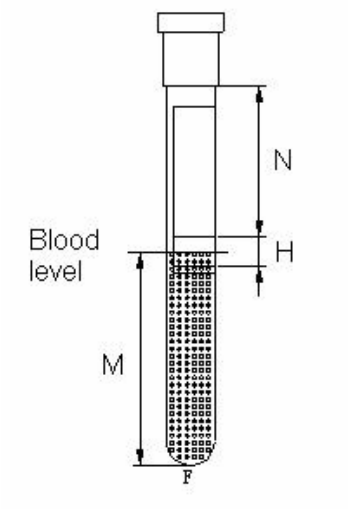

Figure 4-1

Note: the injected blood and coagulant should not exceed the range of H. In figure 4-1, the maximum value of M is 64mm and the

minimum is 50mm. This is the effective blood height.

4. Sample mixing

The sample must be fully mixed before measuring. The method is indicated in “Section 2: Sample preparation”, or you can use the rotated mixer or special mixer.

5. Sample Insert

The sample should be inserted into the analyzer immediately after mixing. Therefore, it is suggested to mix the sample near the analyzer. The sample tube can be inserted into the analyzer at any time. Symbol “---” indicates the position is free to use. After the tube inserted, the corresponding position will show “+” (as position #03 in figure 4-2). When the measurement finish, the result will be displayed on the screen (as position #04 in figure 4-2). Symbol “XXX” indicates the measurement of that position has been cancelled by the operator (as position #05 in figure 4-2).

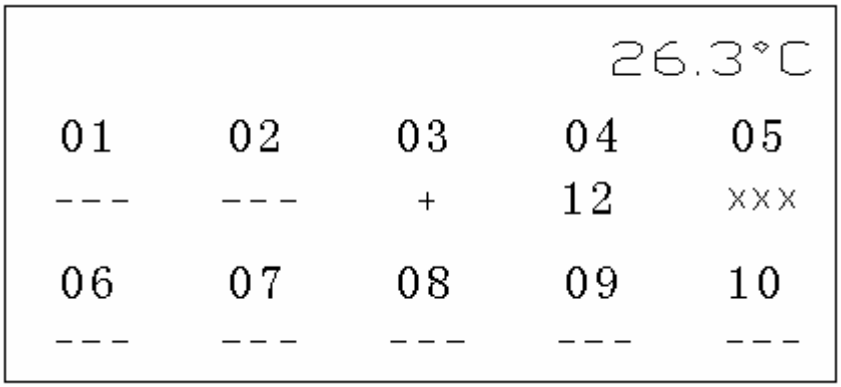

Figure 4-2

6. Sample Remove

Do NOT pull out ESR tube during testing.

If you pull out the tube during testing, the analyzer will give out “beep” sound and the test will be cancelled. Then after one measuring cycle, the status of the corresponding position will change from “+” to “---”. When the test finish, the result will be displayed on the corresponding position (as position #04 in figure 4-2). Remove the sample tube, then the status of the corresponding position changes to “---”. It indicates the position is free and new sample can be inserted for testing.

7. Interface

Turn on the power, the instrument will run self-test, after a few seconds, the screen will display:

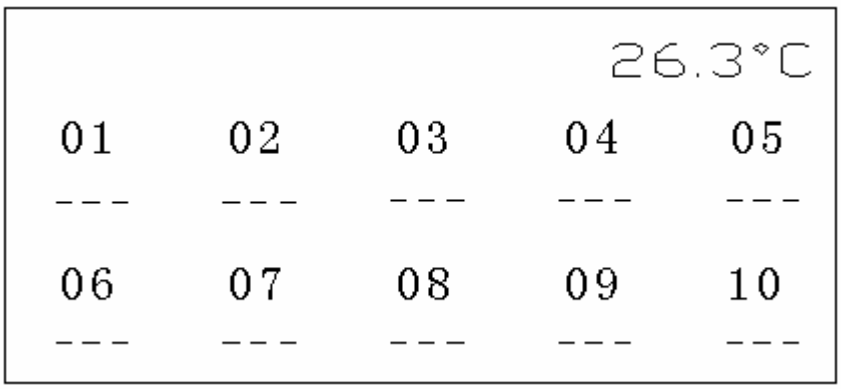

Figure 4-3

If the self-test failed, the screen will display “ERR1”, and the instrument will halt.

8. Operation

8.1 Turn on the power, the instrument runs self-test automatically.

8.2 After warming up for 15 minutes, insert the sample tubes into the socket and start the testing. The result will be printed out automatically once the test finish.

8.3 Power off the instrument when all tests finished.

Chapter 5. Measuring Principle

1. Measuring Method

The principle of data reading is shown in Figure 5-1. The moving area of the infrared optical coupler (TX-RX) is C, L is the bottom position, H is the top position.

During the movement of the infrared optical coupler (TX-RX) from bottom (L) to top (H), if the infrared light can not reach the receiver, then it means the infrared light is obstructed by high density red blood cells. Once the infrared light can go through ESR tube and reach the receiver, the receiver will send signal to the computer to calculate the distance to the bottom.

L1: the height of the blood in the ESR tube at 0 min.

L2: the height of the blood in the ESR tube at 30 min.

L3: the height of the blood in the ESR tube at 60 min.

K: the height of the blood in the ESR tube when the optical coupler moves to the bottom. It is decided by the system itself and setting in the computer.

Each time adding 1.6ml anti-coagulated whole blood into ESR tube, the height of the blood will be slightly changed due to the difference of the ESR tube. To compensate this difference, the instrument will take into account of the initial height in a certain range and the sedimentation

percentage.

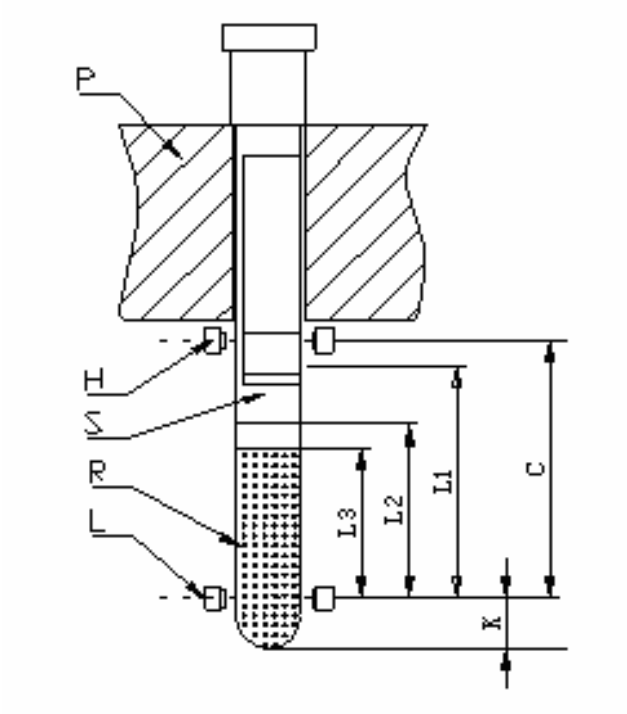

Figure 5-1

P: ESR tube socket.

H: The highest position of the optical coupler (TX-RX).

L: The lowest position of the optical coupler (TX-RX)

R: Red blood cells

S: Blood Serum

C: Measuring range

K: The distance from the bottom of ESR tube to position “L”.

L1: Initial height (at 0 min)

L2: The height of red blood cell at 30 min.

2. Calculation

The calculation of 30 min Sedimentation percentage is as formula (1)

$$\%S30' = 100(L1-L2)/(L1+K) \qquad (1)$$

After summarizing abundant testing results from plenty of hospitals and labs，formula (2) is to convert sedimentation percentage at 30 min to Westergren 1h result.

$$Y = aX + b \qquad (2)$$

Y: Westergren result

X: Sedimentation percentage

a, b: constant

Westergren 1h result is calculated from (a1, b1) and %S30'.

3. Compensate to Westergren result at 18° C

The calculated ESR result at different temperatures are automatically compensated to the standard Westergren ESR result at 18° C by interpolation method. The range of temperature compensation is 15° C～32° C. If the temperature is lower than 15° C, the result will be considered as at 15° C and be compensated accordingly. If the temperature is higher than 32° C, the result will be considered as at 32° C and be compensated accordingly.

The recommended operation temperature is 15° C～32° C。

Manual Compensation table

18° C Compensation value	15° C Test Result	18° C Test Result	20° C Test Result	25° C Test Result	30° C Test Result
5	4	5	5	6	8
10	9	10	10	12	16
20	18	20	21	25	31
30	27	30	31	37	45
40	36	40	42	49	58
50	46	50	52	60	71
60	55	60	62	71	82
70	63	70	72	82	93
80	72	80	82	93	104
90	81	90	93	103	114
100	90	100	103	114	125

4. ESR curve.

ESR curve is retrieved from the sedimentation percentage results that obtained every 3 minutes. 30min ESR curve is shown as figure 5-2.

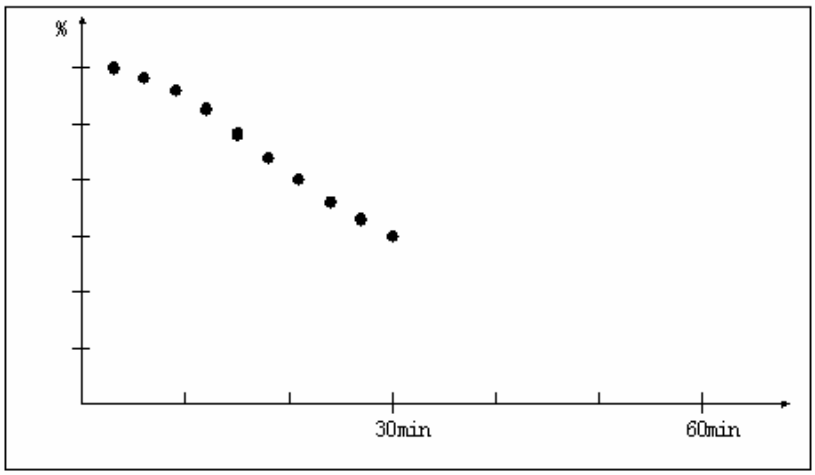

Figure 5-2 30min ESR curve

5. Print out result

Once the test finished, the printer will automatically print out the ESR result (mm/1h) and curve.

The printing format is as below:

ESR curve (as shown in figure 5-2)

Serial No. 001	*Serial No. 001*
POS: 01	*ESR tube position: 01*
TEMP：REF.TO18C	*Compensated result refer to 18ºC*
Result: 33mm/1h	*The result of sedimentation rate is 33mm / hour (Westergren)*

Chapter 6. Specifications

Area of Application: Erythrocyte sedimentation rate analysis

Measuring time: 30 minutes

Throughput: up to 20 samples per hour

Reading channel: 10

Loading capability: Max 10 samples at a time

Loading pattern: random

Analysis result: in Westergren ESR value (mm/1h)

Temperature compensation: refer to 18^{o} C automatically.

Measuring principle: Infrared barrier

Reading resolution: 0.2mm

Reproducibility: <3% or ±2mm/1h

Result resolution: 1mm/1h

Blood level range: 50mm～64mm

Display: LCD screen with backlight

Interface: RS-232 serial port

Print: internal thermal recorder (optional)

Power supply: AC 100V-230V, 50/60Hz±1 Hz

Power: 50W

Dimension (LxWxH): 320 x 260 x 158 mm

Net Weight: 5kg

Operation conditions:

Temperature: 15^{o} C～32^{o} C

Humidity: ≤85%

Chapter 7. Maintenance

1. No specific maintenance required. Keep the operation environment dry and clean. Keep the ESR tube hole away from the dust, otherwise it will affect the performance of the optical coupler (TX-RX) and make it unstable. Handle the glass ESR tube very carefully to avoid broken. Avoid direct sunlight to the instrument.

2. Do not clean the instrument surface with wet cloth or corrosive liquid. Prevent the liquid from flowing into the ESR tube holes, otherwise it will the damage the instrument.

Chapter 8. Troubleshooting

1. Insert the ESR tube, after one measuring cycle, the screen shows a symbol like position #05 in figure 4-2

Cause: The blood level in ESR tube exceeds the measuring range, or nontransparent material is inside the hole.

2. The motor doesn't stop during testing and gives out abnormal noise.

Cause: The optical coupler on the measuring board is malfunction.

3. The position shows "+" but no tube inserted.

Cause: The optical coupler on the measuring board is malfunction, or seriously contaminated by dust or oil.

4. Self-test failed, the screen shows "ERR1", the instrument halts.

Cause: The optical coupler on the measuring board is malfunction

5. No display on the screen after power on.

a) Check the power supply.

b) Check the fuse. If broken, replace with a new one.