

Model 926S

Chloride Analyser

Operator's Manual

Sherwood Scientific Limited
1 The Paddocks
Cherry Hinton Road
Cambridge
CB1 8DH
UK

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1

Introduction

1.1 Introduction

The M926S is a direct reading, digital chloride meter. It is designed for fast and accurate determinations of Chloride levels in clinical samples. Sample volume is 100µl. or 20µl. and results are displayed on a digital readout in mmol/l. (millimoles per litre) Chloride.

This manual presents complete instructions for setting up and using the M926S. A short time spent familiarising yourself with these instructions will be more than repaid in satisfactory operation.

The M926S is intended for use by persons knowledgeable in safe laboratory practices. If the M926S is not used in accordance with these instructions for the protection provided by the equipment may be impaired.

A Service Manual is available as an optional extra, for use by appropriately qualified technical personnel. Please refer to Section 10.2.

1.2 Summary of the Test

The M926S is used for the determination of chloride ions. It is an instrumental analogue of "Argentimetry", the traditional titrimetric methods using Silver Nitrate reagent. Like these classical methods it relies on the chemical formation of the very insoluble salt, Silver Chloride. The importance of chloride determination has been realised for well over a century, with many variations and changes being made to the techniques in order to improve the detectability and selectivity. Research into the analysis of chloride was conducted by Gay-Lussac (1832), Levol (1853), Mohr (1856) and Volhard (1874) and their findings have proven to be the basis of the methods that are still in common use today.

1.3 Reagents

The following solutions are recommended for use with the M926S. Ordering information is given in Section 10.2.

NOTE All reagents contain preservatives where required.

Standard Solution is 100mmol/l Chloride as Sodium Chloride.

Combined Acid Buffer Solution is a support electrolyte consisting of a mixture of Acetic and Nitric acids which maintains the correct pH for the complete cycle of titrations, and a colloid to hold precipitated silver chloride in suspension.

WARNING Acid Buffer is an irritant – avoid contact with skin. Wash exposed areas with water.

Dilution

No dilution is required for Sherwood Scientific reagents.

Storage

Solutions should be stored away from direct sunlight in a cool place, preferably with an ambient temperature below 25°C (77°C). Do not use solutions after the expiration date shown on the bottle. Do not return decanted contents to the original bottle. Caps of standard solution bottles must be done up firmly to prevent evaporation.

Purification

No purification or treatment is required when using Sherwood Scientific reagents.

Instability

Never leave bottles of Standard Solution uncapped as prolonged exposure to the atmosphere will affect the solution's concentration.

2

Installation

2.1 Electrical Supply

The M926S operates at low voltage (12 Volts d.c.). The universal mains adapter supplied with the M926S comes with a range of plugs to suit most a.c. supplies around the world. The a.c. supply can be in the range 100 – 240V, 50 – 60Hz.

2.2 Unpacking

Upon receipt, the M926S should be removed from its carton and inspected for damage. Contact your Sherwood Scientific representative if any items are missing or damaged.

1. Lift out the accessory tray.
2. Lift the instrument out of the polythene cover on to a bench.
3. Check the instrument and all the items in the carton for signs of damage. Check items received against the following list and notify your Sherwood Scientific representative if any discrepancies are discovered.

IMPORTANT Quantities shown in the following list are those supplied with a new instrument. DO NOT re-order from this list; instead refer to Section 10 of this manual.

| <u>Part No.</u> | <u>Description</u> | <u>Quantity</u> |
|-----------------|--|-----------------|
| 001 53 313 | Universal mains adapter | 1 |
| 001 09 006 | USB lead, A(M) – B(M), 1.8m | 1 |
| 001 56 202 | Chloride Standard Solution, 100mmol/l Cl, 1 x100ml | 1 bottle |
| 001 56 205 | Silver Electrode Polish | 1 vial |
| 001 56 208 | Combined Acid Buffer Solution, 1 x 500ml | 1 bottle |
| 925 11 002 | 1 x Cathode, 2 x Detector Electrode, set of 3 | 1 set |
| 925 11 003 | Anodes, pack of 3 | 1 pack |
| 926 11 001 | Beaker, plastic, graduated at 14ml, Sherwood | 2 |
| 925 14 001 | Stirrer | 1 |
| 926 00 109 | Chloride Meter 926S Clinical | 1 |
| 926 09 051 | Lead, M926 to Printer/Computer | 1 |
| 926 91 017 | Operators Manual M926S | 1 |

2.3 Assembly

1. Fit the two shorter, sleeved electrodes into the two rear positions on the underside of the electrode head, Item 3, Figure 2.1. Ensure both electrodes are pushed firmly into their sockets behind the protective rubber boots.

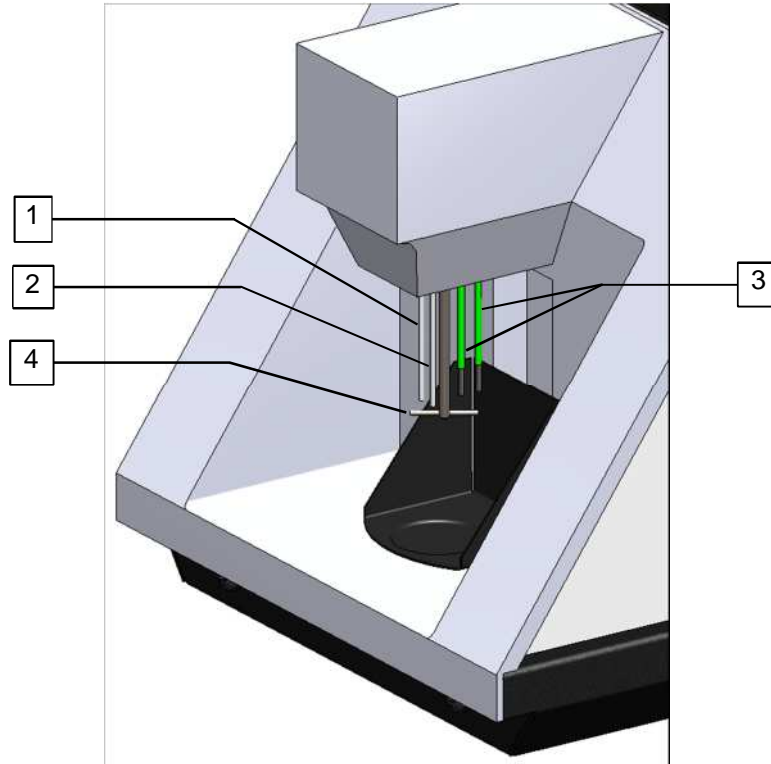


Figure 2.1 Electrode Head

1. Cathode, 2. Anode, 3. Detector electrodes, 4. Stirrer.
2. Insert the stirrer through the stirrer hole and push it firmly into its coupling, as shown in Figure 2.1, Item 4.
3. Insert the cathode (un-sleeved, short electrode) through the left-hand hole and push it firmly into its socket, as shown in Figure 2.1, Item 1.
4. Fit an anode (70mm long electrode) through the remaining hole into its socket.
5. Check that the three shorter electrodes are all fully inserted and then adjust the position of the anode so that all four electrodes are the same length.
6. Position the M926S so that there is clear access to the on/off switch (Item 1, Figure 5.2, p.12).
7. The universal mains adapter supplied with the M926S comes with a range of plugs to suit most a.c. supplies around the world. Choose and fit the one that suits your local electricity supply.
8. Refer to Section 5 of this manual for detailed operating instructions.

3

Principles of Operation

3.1 Description

An accurately measured volume of sample (100µl. or 20µl. set by the 'select' button on the front panel) is added to an acid buffer. The M926S automatically titrates chloride ions by passing a known constant current between two silver electrodes which provides a constant generation of silver ions. These silver ions combine with the chloride in the sample to form silver chloride, which is held in suspension by the colloid stabiliser. During the titration period the digital readout is updated approximately every 0.3 seconds. During these periods the number of silver ions introduced into the sample combine with one unit measurement of chloride. When all the chloride has been precipitated as silver chloride, free silver ions begin to appear and the solution conductivity changes. This change is detected by the detector electrodes and the readout is stopped, displaying the results directly in millimoles per litre of Chloride. Another sample may now be added to the same acid buffer and the cycle repeated. The digital display is held until starting another cycle, when it is automatically reset to zero.

NOTES

1. The M926S uses an absolute method of operation and is calibrated at the factory. Recalibration should only be necessary after changing internal electronic components.

4 Performance Characteristics and Specifications

4.1 Range

10 to 299mmol/l Chloride.

4.2 Accuracy

Results will be within ± 2 mmol/l. (at the 100mmol/l. level) of the values obtained by standard wet-chemical methods after allowing for pipetting errors.

4.3 Linearity

Results will be within ± 1 mmol/l in the range 10 to 299mmol/l. or $\pm 1\%$ concentration value whichever is the greater.

4.4 Reproducibility

The values obtained from 20 consecutive titrations of a nominal 100mmol/l. solution will give a coefficient of variance of $\leq 1.5\%$.

4.5 Stability

The calibration level (mean of five titrations of a standard solution) will change by less than ± 2 Least Significant Digits over the life of any silver anode.

4.6 Response Time

A stable reading will be displayed within 26 seconds of pressing the 'titrate' button, at a concentration level of 100mmol/l.

4.7 Measurement Capacity

Twenty samples at 100 μ l. or 20 μ l. sample volume, per reagent change.

4.8 Samples

Type

Chloride in solution, having low ionic strength, neutral pH and free of silver halides, silver reactive constituents (other than chloride), solid matter and high levels of dissolved solids.

Presentation

By pipette directly into the beaker of Sherwood Scientific Combined Acid Buffer.

Volume

100 μ l. or 20 μ l. – user selectable.

Performance Characteristics and Specifications

continued

4.9 Readout

Measurement results are shown in characters 15mm. high on a 2.75" 60 dpi backlit LCD screen. Separate areas of the display are reserved for measurement units and instrument status information.

4.10 Warm Up

Five minutes warm up is required to meet the stated specification.

4.11 Environmental Conditions

Operation

| | |
|---------------------------|--------------------------------|
| Temperature range | +10°C to +35°C |
| Maximum relative humidity | 85% at +35°C (non condensin g) |

Transportation

| | |
|---------------------------|-----------------|
| Temperature range | -40°C to + 45°C |
| Maximum relative humidity | 95% at +45°C |

Compliance with the stated specification will be unaffected by a change in ambient temperature up to 4°C per hour, provided the operating temperature range is not exceeded.

Installation Category

Installation category 1.

4.12 Power requirements

Mains adapter Input

100V – 240V ~, 50Hz – 60Hz, 0.6A

Mains adapter Output

12V ⎓ 1.25A

4.13 Size

| | |
|--------|---------------|
| Width | 200mm (7") |
| Depth | 250mm (9.8") |
| Height | 315mm (12.4") |

4.14 Weight

1.9kg (4.2lbs)

5

Operating Instructions

5.1 Controls and Indicators

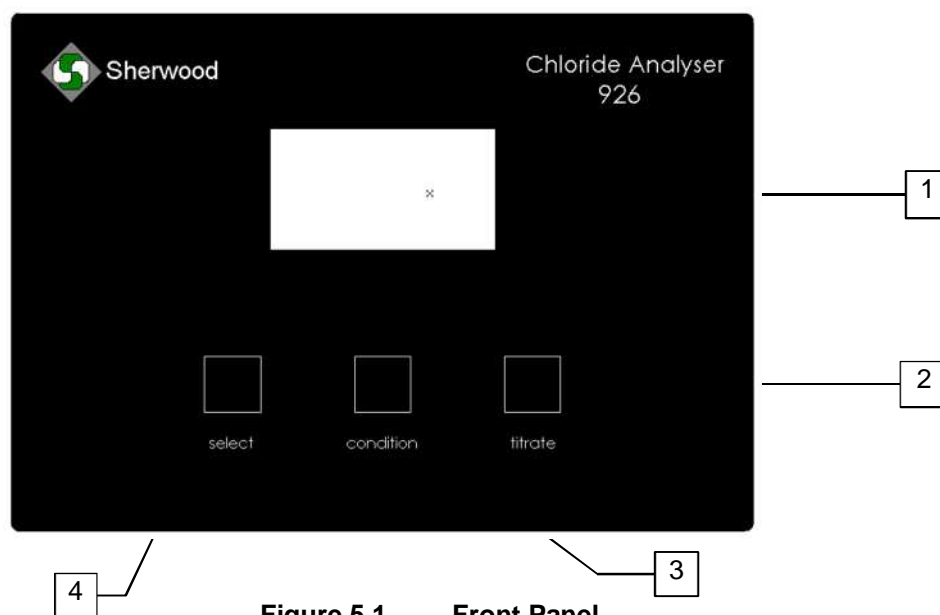


Figure 5.1 Front Panel

1. Display screen, 2. 'titrate' button, 3. 'condition' button, 4. 'select' button.

'condition'

Pressing this button initiates a conditioning cycle. The purpose of the conditioning cycle is to titrate out any Chloride present in the buffer or beaker, so that the subsequent titration is accurate. The conditioning cycle must be run each time the M926S is switched on and each time the buffer is changed, usually when *'Change Buffer And Condition/ Condition Required'* is displayed.

'titrate'

Pressing this button initiates a titration cycle. During a titration the stirrer operates for approximately 5 seconds before the readout is set to zero. The Chloride is then titrated out of the solution while the readout is incremented. When all the chloride is titrated the readout is stopped and held. The *'titrate'* button is inoperative at switch on and when *'Change Buffer And Condition/ Condition Required'* is displayed, usually after the allowed maximum number of consecutive samples (20) have been titrated. In each case this ensures that a condition cycle is carried out first. This prevents an erroneous result on the first titration due to chloride being present in the buffer or beaker.

'select'

The *'select'* button on the M926S allows the user to choose the volume of sample to be measured – 100µl. or 20µl. - and shown on the display screen. The M926S measures in units of mmol/l Chloride.

5.2 Rear Panel Components

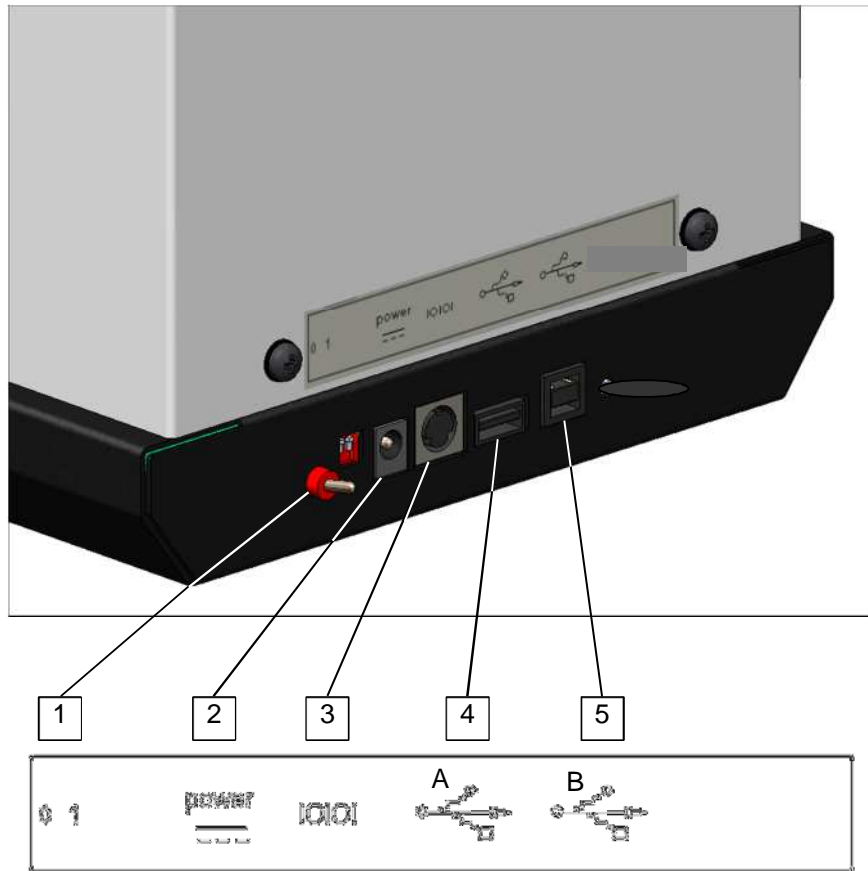


Figure 5.2 Rear Panel and Label detail

- 1. Power switch** On/Off toggle switch that switches the d.c. supply from the mains adapter to the instrument. 0 for Off, 1 for On.
- 2. Power** Input socket for d.c. lead from mains adapter to the instrument.
- 3. RS232 socket** Input connector for Serial Cable (926 09 051).
- 4. USB A socket** To accept a memory stick for firmware upgrades.
- 5. USB B socket** Connector for USB Cable (001 09 006) as an alternative for connecting to computers that do not have an RS232 serial comms. Port.

5.3 Operation

1. Connect power, switch on and allow 5 minutes for the M926S to warm-up.
2. Fill a plastic beaker, supplied, to the mark with combined acid buffer, place the beaker on the platform and raise the platform until it locates in the up position.
3. Set the sample volume to 100 μ l or 20 μ l using the 'select' button.
4. Pipette the chosen volume of 100mmol/l standard solution into the beaker.
5. Press the 'condition' button and wait for the condition cycle to complete.
6. Pipette the chosen volume of sample into the beaker and press the 'titrate' button.
7. When the stirrer stops, note the reading on the display.
8. Repeat paragraphs 5 and 6 for further samples.

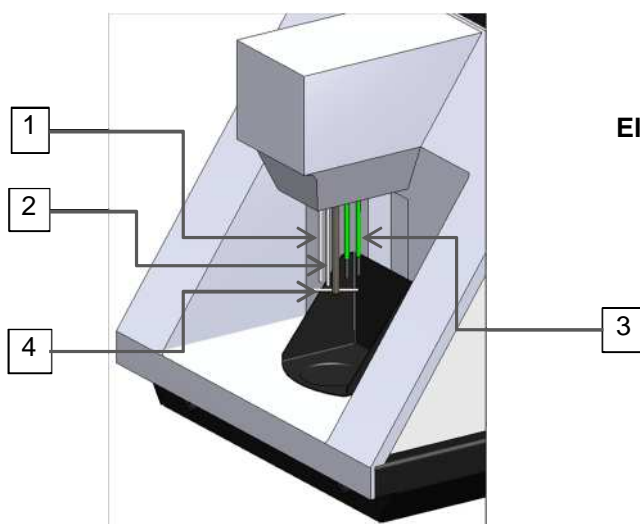


Figure 5.3
Electrodes and Electrode Head

1. Cathode
2. Anode
3. Detector electrodes
4. Stirrer

9. At the end of the 18th titration, the message 'Condition in 2' will appear on the screen. If only two further samples are to be run, return to paragraph 5. However, if more than two samples are to be run, continue with paragraph 10. 'Condition in 1' will be shown after the 19th titration.

IMPORTANT When the 20th titration is complete any further sample added will be lost. "Change Buffer And Condition/ Condition Required" will be displayed on the screen and the 'titrate' button will have no effect. Go to paragraph 10 below.

10. If "Change Buffer And Condition/ Condition Required" is displayed, continue with paragraph 10.
11. Lower beaker and empty out contents. Rinse with deionised water and dry with clean tissue.
12. If necessary, adjust the vertical position of the anode, Item 2, Figure 5.3, so that it is the same length as the other electrodes.
13. If more samples are to be titrated return to paragraph 2 near the top of this page.
14. When determinations are complete, remove the beaker and dry the electrodes and stirrer by blotting with a clean tissue.

5.4 RS232 Output and Printing

The M926S has an RS232 output that enables results to be sent to external printers, such as the Portable Printer (473 56 903), or other devices with serial inputs.

1. A Serial Cable (926 09 051) is provided if you wish to use an external device. The small, round end of the cable fits into the socket on the rear of the M926S (Item 3, Figure 5.2, page 12) and the other end into the serial input socket of the external device - a printer or a computer serial interface.
2. Adjust the serial comms. settings of the external device to 9600 8-N-1.
3. Direct printing from the M926S Clinical.

Switch on the external device then switch on the M926S. After the initialisation sequence the software version (e.g. v0.24) and serial number (e.g. 16555) are shown on the display screen for approximately 5 seconds. The printer will print:-

```
926 Chloride Meter
Serial Number: 16555

Software Version: 0.24
```

4. Perform measurements as described in Section 5.3, page 13. After each titration the printer will print the screen value as: -

```
Sample 001 = 100 mmol/l
Sample 002 = 102 mmol/l
Sample 003 = 101 mmol/l
```

During and after the conditioning cycle there is no signal to the printer as conditioning can be necessary during the measurement run of samples. The sample number sequence is thus uninterrupted.

The number sequence on a printer can be reset to '001' only by switching off the M926S and reconditioning.

5.5 USB B Output

The M926S also has USB B port that enables results to be sent to computers that do not have an RS232 serial comms. port. A USB cable (001 09 006) is provided. The squarer end fits into the socket on the rear of the M926S (Item 5, Figure 5.2, page 12). On the PC in Device Manager under Ports (COM & LPT) the M926S will typically appear as - *926 Series Chloride Analyser (COM7)*.

A PC utilities communications programme such as HyperTerminal is required to establish a connection with the M926S and receive data from it. Making a connection requires knowledge of which COM port (7 in the example above) the M926S is on and the settings **9600 8-N-1**.

6

Operating Precautions and Hazards

6.1 Operating Precautions

1. The electrodes may go black during use; this will not affect the performance. Only if the M926S will not measure a Standard or sample will it be necessary to clean the electrodes.
2. The M926S requires a warm up period of five minutes to meet the stated specification.
3. Reproducibly accurate results are dependent on reproducible pipetting from sample to sample and from aqueous standard to sample. If the M926S calibration is checked with an aqueous standard and reproducibly low results are obtained, hold up in the pipette should be suspected and a rinse out technique employed.
4. Always dispense standard solution into a small beaker or cup. Do not take standard solution directly from the bottle with a pipette, as the standard could become contaminated. Never pour standard solution back into the bottle once it has been dispensed. Ensure that only genuine Sherwood Scientific reagents and supplies are used with the M926S. Do not use solutions after the expiry date shown on the bottle.
5. Samples should have low ionic strength, neutral pH and be free of sulphide, sulphhydryl silver halides, silver reactive substances (other than chloride), solid matter and high levels of dissolved solids.
6. Do not leave the electrodes immersed in reagents when the instrument is not in use.
7. Use only the beakers supplied with the M926S.
8. It is recommended laboratory practice to wear gloves when handling samples. Gloves will also afford protection against the Combined Acid Buffer and against accidental static damage to the electrodes.

6.2 Hazards

1. All electrical equipment is potentially hazardous. Never remove covers from the M926S without first ensuring that it is isolated from the a.c. supply.
2. Do not move the M926S when there is a beaker containing Combined Acid Buffer in position on the sample platform.

7

Quality Control

7.1 General

The M926S Chloride Analyser has been designed to provide fast and accurate determinations of Chloride in clinical solutions.

The latest Sherwood Scientific technology has been incorporated into the M926S to ensure the validity of the final results. However, the results can be affected by factors other than instrument malfunction, such as sample handling and storage. Sherwood Scientific recommend therefore that a Quality Control programme is set up to monitor instrument and operator performance. Because the needs of each laboratory are different, due to size of workload, number of hours worked, statutory regulations, etc., no attempt has been made to formulate a rigid programme. Instead, in Section 7.2 there are a number of suggestions that will be helpful in specifying a procedure to suit your particular requirements.

The following references are recommended for further information on Quality Control.

BS600:2000 A guide to the application of statistical methods to quality and
 standardisation
 ISBN 058033227 6

Westgard, J.O., Clinical Chemistry 54:612, 2008.

IMPORTANT If you report your results to a Quality Control Scheme ensure that they are informed of the change in method, i.e. Sherwood Scientific 926S Chloride Analyser.

7.2 Quality Control Checks

The following notes are designed to assist you in formulating a Quality Control programme.

1. Include a Quality Control as specified in your Quality Control Scheme or at least once per sample run, once per day or every 40 samples.
2. Check abnormally high and low values daily.
3. Routinely include aqueous Standards that contain chloride concentrations that are different to the Standard concentration used for calibrating the M926S.
4. Ensure day-to-day variations do not exceed acceptable values.
5. Reproducibility should be checked on 20 replicate samples on a routine basis.

8

Maintenance

8.1 General

The M926S has been designed to reduce the need for regular maintenance to an absolute minimum. The maintenance required is detailed in Section 8.2, Daily. Refer to Section 10 for ordering information and catalogue numbers of parts used for daily maintenance, which are listed under *Equipment Required*.

8.2 Daily

Equipment Required

Disinfectant Solution

electrode polish

1 x anode

1 x cathode

2 x detector electrodes.

1. Check that all four electrodes are straight and parallel and the anode is the same level as the other electrodes. If necessary, refer to Section 8.3 to clean, adjust or replace the electrodes.
2. Check that the stirrer is present and is fitted firmly into its coupling.
3. Wipe down the sample area with disinfectant solution.

8.3 Electrode Cleaning and Replacement

Equipment Required

Electrode polish, soft cloth, 1 x cathode, 1 x anode and 2 x detector electrode.

1. Remove the four electrodes by withdrawing them downwards from the electrode head.

NOTE that the anode (Item 2, Figure 8.1) is longer than the other three electrodes.

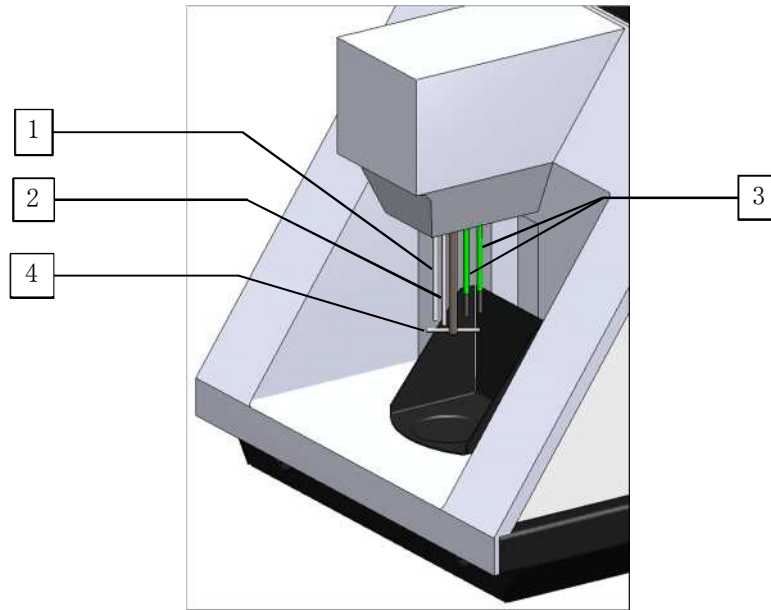


Figure 8.1 Electrodes and Electrode Head

1. Cathode, 2. Anode, 3. Detector electrodes, 4. Stirrer.

2. If the length of the anode is less than 57mm discard it and fit a replacement.
3. Place a little Electrode Polish on a soft cloth and gently rub the exposed parts of the electrodes until they are clean and bright.
4. Refit the electrodes; ensure that with the cathode and detector electrodes fully inserted, the anode is adjusted to the same length.
5. Place a beaker of deionised water on the sample lift and immerse the electrodes.
6. Carry out three condition cycles.
7. Remove the beaker and wipe the electrodes with a clean soft cloth.
8. Carefully inspect the electrodes to ensure that they are clean. If they are not repeat paragraphs 1 to 7. If they are still not clean, fit replacements, ensuring that they are fully inserted.
9. Check that all the electrodes are straight and parallel, adjusting as necessary.

9

Troubleshooting

9.1 Display not illuminated

Check that the instrument is connected to a working a.c. supply and that the power switch is in the 'On' position.

If the fault persists contact your Sherwood Scientific distributor.

9.2 On-screen messages

These self-explanatory alerts may appear at the top of the display screen.

| | |
|---|--|
| Change Buffer / And Condition Condition Required | Shown at start-up and after twenty consecutive samples have been titrated. |
| Add Sample / Press Titrate Condition in 2 | Shown after the 18 th consecutive titration. |
| Add Sample / Press Titrate Condition in 1 | Shown after the 19 th consecutive titration. |
| Out of Solution / Check Buffer Condition Required | Shown if electrodes are not in liquid. |
| Reading 299+ / Check Sample Condition Required | 299mmol/l has been exceeded. Check sample dilution and that pipette is dispensing correctly. |
| Condition cycle timed out Refer to Operator Manual | Conditioning took too long. Too much Chloride in beaker. Stirrer not present or not turning. |

9.3 Condition or titrate cycle inoperative

Check the beaker contains Chloride; add 100µl. of standard solution if necessary.

Clean or replace the electrodes, refer to Section 8.3.

Make sure that the cathode electrode is fully inserted into its socket.

If the fault persists contact your Sherwood Scientific distributor.

9.4 Reproducibly high or low results

Try using a fresh bottle of standard solution and another pipette.

Check that carry over in the pipetting is avoided by using a rinse out technique for each sample.

If the fault persists contact your Sherwood Scientific distributor.

9.5 Non-reproducible results

The M926S requires a five minute warm up to meet the stated specification.

Try another pipette. (Ensure the pipette is reproducible to 0.5% Standard Deviation).

Clean or replace the electrodes, refer to Section 8.3.

Use a fresh bottle of Combined Acid Buffer.

If the fault persists contact your Sherwood Scientific distributor.

10

Spares and Accessories

10.1 Ordering Information

When ordering spares or accessories for the M926S please give the following information to your Sherwood Scientific representative: -

Serial number
Catalogue number of part (Cat. No.)
Description
Quantity required

This will ensure that your order is dealt with quickly and efficiently.

The number shown in the third column (Quantity) is the quantity of items that are supplied against the stated catalogue number. If the quantity is greater than one then only multiples of that quantity can be supplied.

10.2 Spares and Accessories

| <u>Cat. No.</u> | <u>Description</u> | <u>Quantity</u> |
|-----------------|---|-----------------|
| 001 56 208 | Chloride Analyser Combined Acid Buffer, 1 x 500ml | 1 bottle |
| 001 56 202 | Chloride Analyser Standard, 100mmol/l Cl, 6 x 100ml | 1 pack |
| 001 56 205 | Silver Electrode Polish, 25g | 1 vial |
| 473 56 903 | Printer Assembly, Universal | 1 |
| 473 59 700 | Printer consumables kit | 1 pack |
| 925 11 002 | 1 x cathode and 2 x detector electrode, set of 3 | 1 set |
| 925 11 003 | Anodes, pack of 3 | 1 pack |
| 926 11 001 | Beaker, plastic, graduated at 14ml, Sherwood | 1 |
| 925 14 001 | Stirrer, 20mm | 1 |
| 926 89 001 | Service manual | 1 |
| 001 53 313 | Universal Mains adapter | 1 |

11

Sherwood Scientific Limited Product Warranty Statement

Warranty Term: 12 Months

Sherwood Scientific Ltd (Sherwood) warrants, subject to the conditions itemised within this document, through either Sherwood personnel or personnel of its authorised distributors, to repair or replace free of all charges, including labour, any part of this product which fails within the warranty time specified above, appertaining to this particular product. Such failure must have occurred because of a defect in material or workmanship and not have occurred as a result of operation of the product other than in accordance with procedures described in the instructions furnished with this product.

Conditions and specific exceptions that apply to the above statement are as follows:

1. End-user warranty time commences on the date of the delivery of product to end-user premises.
2. '*Free of all charges*' statement applies only in areas recognised by Sherwood as being serviced either directly by its own personnel, or indirectly through personnel of an authorised distributor. Products purchased outside these areas requiring service during the warranty period will incur charges relative to the travel/transit costs involved. However, products purchased in such areas will be serviced during the warranty period free of all charges providing they are returned, carriage paid, to either Sherwood or by pre-arrangement to an authorised Sherwood distributor.
3. All maintenance (other than operator maintenance as described in the instructions), repairs or modifications have been made by Sherwood or Sherwood authorised personnel.
4. This product has where applicable been operated using Sherwood specified supplies and reagents.
5. Sherwood reserves the right to make any changes in the design or construction of future products of this type at any time, without incurring any obligation to make any changes whatsoever to this particular product.
6. Reagents, supplies, consumables, accessories and user maintenance items are not included in this warranty.

Product Warranty Statement (continued)

7. Repairs or replacement of any part failing due to abnormal conditions including the following, are excluded from this warranty:
- a. Flood, lightning, earthquake, tornado, hurricane, or any other natural or man-made disaster.
 - b. Fire, bombing, armed conflict, malicious mischief or sprinkler damage.
 - c. Physical abuse, misuse, sabotage or electrical surge.
 - d. Damage incurred in moving the product to another location.

User agrees to permit Sherwood personnel or personnel of its authorised distributor to make changes in the product which do not affect results obtained, but do improve product reliability.

Representations and warranties purporting to be on behalf of Sherwood made by any person, including distributors and representatives of Sherwood, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitations of the liability of Sherwood as set forth above), shall not be binding upon Sherwood unless reduced to writing and approved by an officer of Sherwood Scientific Ltd.

Except for the obligations specifically set forth in this warranty statement, in no event shall Sherwood be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort or any other legal theory and whether advised of the possibility of such damages.

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Sherwood Scientific Ltd
1 The Paddocks
Cherry Hinton Road
Cambridge
CB1 8DH
England