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C2

November, 1996

**MF-9064**

**INSTRUCTION MANUAL**

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Cell Stand

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Bioanalytical  
Systems, Inc  
2701 Kent Avenue  
West Lafayette  
Indiana 47906

#### MANUFACTURER'S NOTE

This instrument, either wholly or in part, is manufactured for research purposes only. Use for medical diagnosis is not intended, implied or recommended by the manufacturer. Use for this purpose and accountability for the same rests entirely with the user.

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## **Section 1 - INTRODUCTION**

Finite current electrochemistry used for analytical purposes has progressed dramatically over the last decade. There have been a number of reasons for this progress: ease of use and improved reliability. The use of solid electrodes has also been a significant part of this trend. The BAS C2 Cell Stand is specifically designed to conveniently use the variety of solid electrodes and cell accessories available from BAS.

The C2 Cell Stand interfaces directly with BAS 100 series Electrochemical Analyzers and BAS Voltammographs. The cell is enclosed in a Faraday Cage to minimize electrical interference. A built-in gas control allows purging or blanketing of the sample prior to or during analysis. A separate gas line is provided to sparge the "next sample" while analyzing the present sample, thus increasing productivity. The magnetic stirrer allows for controlled agitation of the sample for experiments requiring convective mass transport of electrolyte or analyte to the electrode surface. The cell arm with detachable cell top allows easy removal and replacement of the cell vial as well as easy access to the electrodes for rinsing, cleaning, or replacement.

The C2 Cell Stand is part of an Electrochemical Accessories Package. The package also includes a voltammetry cell, reference electrodes (silver/silver chloride), working electrodes (glassy carbon and platinum), an electrode polishing kit, and connecting tubing.

**FEATURES**

- “Quick-connect” input gas line connector.
- Manual or Remote on-off control of gas purge-blanket.
- Separate control of “next sample” gas purge.
- Fritted glass tubes for efficient gas purging.
- Manual control of gas purge-blanket rate.
- Manual or remote on-off control of magnetic stirrer.
- Manual 5-position adjustment of magnetic stirrer rate.
- Voltammetry cell cap.
- Small volume glass cell vials.
- Mounted cell top compatible with all BAS solid working electrodes and reference electrodes.
- Stainless steel drip tray to catch spills.
- Cell lead connects directly to all BAS electrochemical controllers (Voltammographs or Electrochemical Analyzers).
- Easy and positive contact cell leads to electrodes.
- Vertically sliding cell top arm for easy cell vial placement and removal, and rinsing or replacement of sparge tubing, reference, auxiliary, and/or working electrodes.
- Cell enclosed in Faraday Cage for minimization of electrical interference.

**SPECIFICATIONS**

**Power:** 100-120/220-240 VAC, 50/60 Hz, V-A 10 Watts

**Main Fuse:** 1/16 A Slow Blow at 100-120 VAC  
1/32 A Slow Blow at 220-240 VAC

**Inlet Gas Pressure:** 5 psi maximum

**Size:** 11"(28cm) wide x 9"(23cm) deep x 12"(31cm) high

**Weight:** approximately 15 lbs. (7 Kg)

## **Section 2 - GENERAL INFORMATION**

### **USER UPDATES**

To receive product update information news, and valuable information related to this and other BAS products, fill out and return the BAS Warranty Enrollment Card which was shipped with the instrument. We would like to know who you are, and what else you want to know about electrochemical analyses.

### **TECHNICAL CHANGES**

We reserve the right to make technical changes to improve the instrument. Minor changes will be self-evident; improvements affecting use or maintenance will be described in supplementary pages to this manual.

### **DAMAGED SHIPMENTS**

Breakage of any part of this instrument during shipping should be reported immediately to the freight handler and BAS Customer Service. Unless other arrangements have been made, the freight handler (shipper) is responsible for all damage or breakage to the shipment. It is necessary to retain the original packing box and contents for inspection by the freight handler. BAS will replace any new instrument damaged in shipping with an identical product as expeditiously as possible after the claim filing date. Claims not filed within 7 days after shipping may be invalid.

Do not return damaged good to BAS without first contacting Customer Service for a Return Authorization Number (RA#). When a defective part is returned to BAS, the RA# immediately identifies you as the sender and describes the item being returned. BAS refuses all unauthorized return shipments.

### **PRODUCT WARRANTY**

BAS (Bioanalytical Systems, Inc.) warrants equipment manufactured by the company to be free from defects in material and workmanship for a period of 90 days from the date of shipment, except as provided hereinafter. This assumes normal usage under commonly accepted operating parameters. BAS agrees to either repair or replace, at its sole option and free of part charges to the buyer, any parts of such instrumentation which, under proper and normal conditions of use, prove to be defective within 90 days from date of shipment. Electrochemical cells and working electrodes are warranted for 60 days. This warranty and remedy are given expressly and in lieu of all other warranties, expressed or implied, of merchantability or fitness for particular purpose and constitutes the only warranty made by BAS.

BAS neither assumes nor authorizes any person to assume for it any other liability in connection with the sale, installation, service, or use of its instrumentation.

All products manufactured by BAS are tested and inspected prior to shipment. Upon prompt notification by the Buyer, BAS will correct any defects in warranted equipment of its manufacture either (by our option) by return of the item to our factory, or shipment of a

repaired or replacement part. BAS will not be obliged, however, to replace or repair any piece of equipment which has been abused, improperly installed, altered, damaged or repaired by others. Defects in equipment do not include decomposition, wear, or damage by chemical action or corrosion.

BAS shall have no liability whatsoever for special, consequential, or punitive damages of any kind arising from the sale, installation, use or servicing of its instrumentation.

This instrument is manufactured, either wholly or in part, for research purposes only. Use in medical diagnosis is not intended, implied or recommended by the manufacturer. Use for this purpose and accountability for the same rests entirely with the user.

**Limited obligations covered by this warranty include:**

- a. In the case of instruments not of BAS manufacture, the original manufacturer's warranty applies.
- b. Shipping charges under warranty are covered only in one direction. The Buyer is responsible for shipping charges to the factory, if return of the part is required.
- c. Expendable items including carbon paste, reference electrodes, source lights, panel lights, fuses, etc. are excluded from the warranty.

**SERVICE INFORMATION**

BAS provides a skilled service staff to solve your equipment oriented problems. For further details, call customer service personnel (765/463-4527). Following discussion of your specific difficulties, an appropriate course of action will be described and the problem resolved accordingly. Do not return any products for service until a RETURN AUTHORIZATION NUMBER (RA#) has been obtained. The RA# identifies you as the sender and describes to us the problem you are having in full detail. Turn-around time on service can be quoted to you at the time your RA# is issued, although we cannot determine the actual amount of service required until we have received your unit and verified the problem. All correspondence and shipments should be sent to:

RA # \_\_\_\_\_, Service Department  
BAS  
2701 Kent Avenue  
West Lafayette, IN 47906



## Section 3 - INSTALLATION

**INSPECTION OF SHIPMENT** After carefully unpacking the instrument, check the contents of the packages and inspect for breakage. Table 3.1 lists the parts of the C2 Cell Stand. This list is subject to change. Please refer to the packing slip with your instrument to verify the parts. Assembly of these various parts will be outlined in the following chapters.

Please retain the shipping box and packing material until you have fully tested the unit to be certain that no damage was incurred during shipping.

If a shortage exists, call BAS Customer Service and describe the shortage. A replacement part will be sent immediately subject to stock availability.

**Table 3.1** Parts List of C2 Cell Stand Package

---

Faraday Cage with stir and purge control
Gas Dispersion Tube (2)
Stir Bar
Glassy Carbon Working Electrode
Platinum Working Electrode
Voltammetry Cells (2)
Polishing Kit
Ag/AgCl Reference Electrode (3)
Platinum Wire Auxiliary Electrode
Gas Connection Tubing
Cables
Installation and Operations Manual

**POWER REQUIREMENTS** The C2 Cell Stand can be used with either 110V or 220V (50-60 Hz) power supply. Make sure that the position of the voltage select card corresponds to the local power supply.

### Voltage Selection

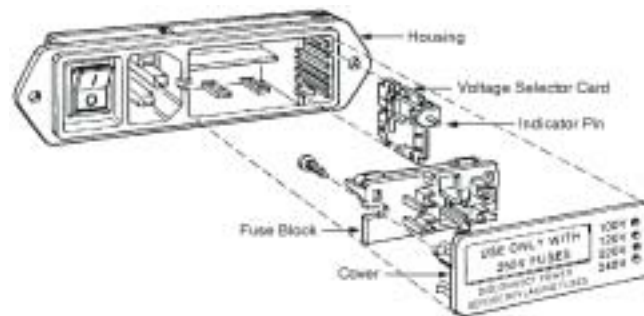
Should the power option need to be changed, unplug the line cord and open the cover using a small screwdriver or similar tool. Set aside the cover/fuse block assembly and pull the voltage select card straight out of the housing, using the white plastic indicator pin. Orient the selector card so that the desired voltage is readable at bottom of card. Orient

indicator pin to point straight up when desired voltage is readable at bottom. Insert the voltage selector card back into the housing, printed side of card facing the On/Off switch. The edge of the card containing the desired voltage should be inserted first. Replace cover and verify that the indicator pin shows the desired voltage.

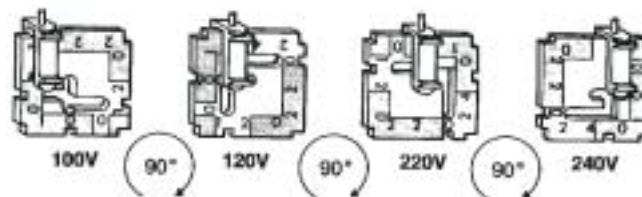
### Fusing Arrangement

To change from North American to European fusing arrangement: open cover, using a small screwdriver or similar tool. Loosen Phillips screw 2 turns, then remove fuse block from cover by lifting up and away from Phillips screw. Change fuses (note that 2 European fuses are required), invert fuse block and slide back onto Phillips screw and cover so that the 2 European fuses are up. Tighten Phillips screw and replace cover. Note that fuse(s) that go into the housing first are the active set.

**Figure 3.1** Removal of Voltage Selector Card



**Figure 3.2** Voltage Selector Card Orientation



### Fuse Rating

Be sure that correctly-rated fuse(s) are used:

100-110 V	1/16 Amp
220-240 V	1/32 Amp

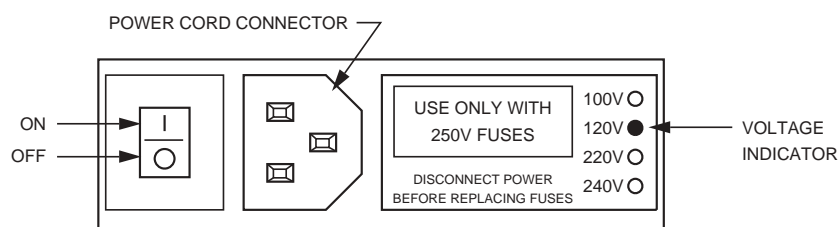
Use of repaired fuses or short-circuiting of the fuse holder is prohibited. Connect the instrument only to sockets with a ground contact by using the three-pronged power cord included with delivery. For problem-free operation and for safety considerations, be sure that the instrument is firmly connected to a positive ground via the power cord.

**CELL STAND CONNECTION** This section will show the connection of the cell stand to the cell and cell stand controllers.

### Power Cord Connection

Push the socketed (female) end of the power cord into the port on the Voltage Selector Card located in the lower center of the back-panel (See Figure 3.3). Before making this connection, make certain the power on/off switch is in the off position. This switch is labelled with a 0 and 1. When 0 is pushed, the power is off and when 1 is pushed, the power is on.

**Figure 3.3** Power Cord Connection



### C2 to BAS 100B Electrochemical Analyzer

The C2's gas purge and stirring can be controlled by the BAS 100B Electrochemical Analyzer. The control line is the gray colored ribbon cable (P/N ER-9515) between the remote (25 pin D, male) connector on the rear of the cell stand and the cell stand (25 pin D, female) connector on the rear panel of the BAS 100B. See Figure 3.4.

The electrode (cell) leads are connected to the BAS 100B by inserting the stainless steel LEMO connector on the end of the cell lead cable into the CELL input connector on the rear panel of the BAS 100B. Again Figure 3.4 illustrates this connection.

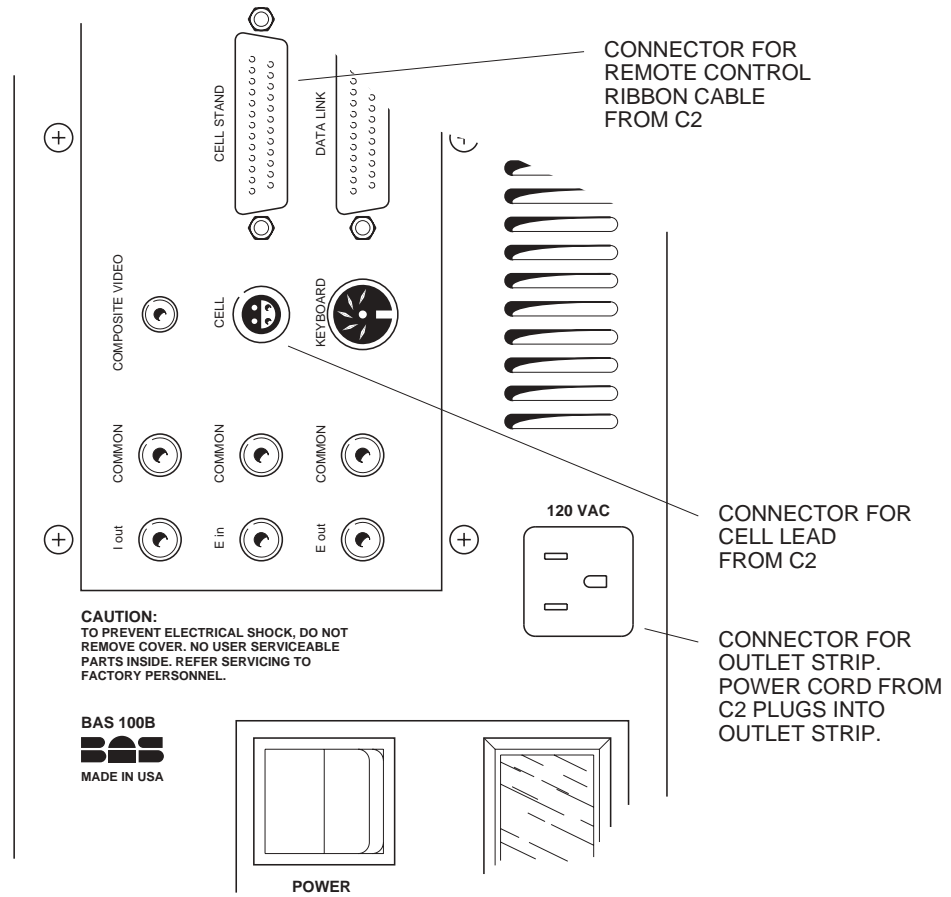
### C2 to CV-X7 Series Voltammograph

The cell lead from C2 Cell Stand connects directly into the CV-X7 (e.g., CV-27 and CV-37) Series Voltammographs. The stainless steel connector on the end of the cell lead cable is plugged into the CELL connector on the rear panels of the CV-X7 instruments. Figure 3.5 illustrates this simple connection.

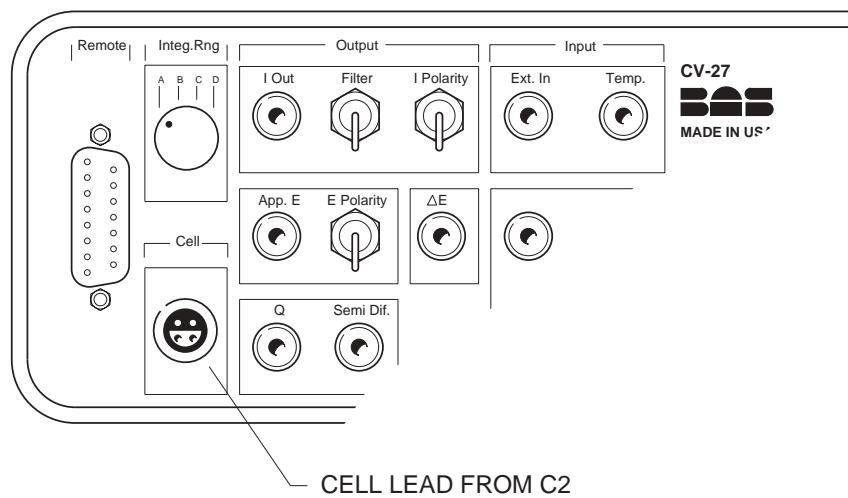
### C2 to CV-1B

The C2 Cell Stand can connect directly to the CV-1B Cyclic Voltammetry controller. The stainless steel connector on the end of the cell lead cable from the C2 Cell Stand plugs into the connector mounted on the CV-1B.

**Figure 3.4** Connection of C2 to BAS 100B Electrochemical Analyzer



**Figure 3.5** Connection of C2 to CV-X7 Voltammograph

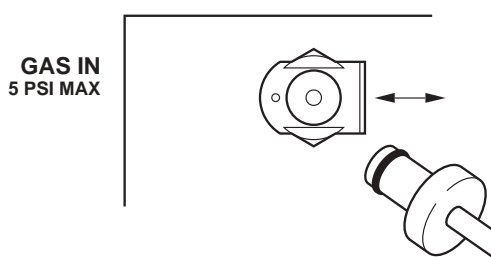


### Gas Inlet Connection

The C2 Cell Stand package contains 0.25" O.D. tygon tubing and a gas line fitting. One end of the gas line fitting is barbed to fit inside the tygon tubing. Push the barbed end into the tubing. The other end of the fitting connects to the "GAS INLET" port on the rear panel of the C2. To attach the line, simply push the connector into the port. A retaining clip will snap into place (See Figure 3.6). The open end of the tygon tube is connected to a regulated gas supply. The inlet gas pressure must not exceed 5 psi.

To remove the tube from the cell stand, squeeze the retaining ring tab against the connector and then pull the tube and connector away from the cell stand.

**Figure 3.6** Gas Line Connection to C2 Cell Stand

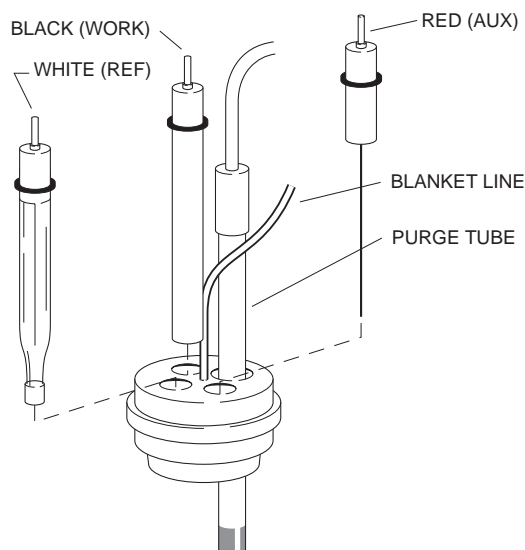


### Electrode Leads

The wires coming through the back panel are the electrode lead wires. The connectors are the spring-loaded press-on type. Simply push the connector over the corresponding pin on the electrode to make the connection (See Figure 3.7). The wires are color coded to the electrode it attaches. The code is:

black	working
white	reference
red	auxiliary

**Figure 3.7** Electrode Lead Connections



### Purging/Blanketing Lines

The cell stands have the ability to purge or blanket the sample solution with an inert gas. The purge removes oxygen by bubbling an inert gas, typically nitrogen, helium or argon, through the solution. The blanketing function is to maintain an inert atmosphere above the sample to keep the oxygen or air components from re-entering the sample solution.

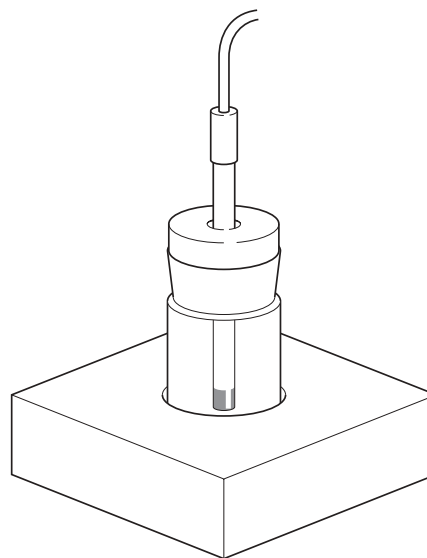
The purge/blanket lines are the three plastic tubes coming out of the cell arm support post. The two larger 1/8" lines are labeled "test sample" and "next sample". These two lines should be pressed into the teflon tops of the two glass fritted sparge tubes. To insert the lines: remove the teflon top from glass tube, place on a flat surface with large opening down, press sparge line into smaller opening of teflon top, and then insert glass sparge tube into teflon top.

The blanket line is pushed into smallest hole in the center of the cell top. The blanket line should extend to just beyond the bottom of the cell cap.

The test sample dispersion tube should be inserted into the recessed hole in the cell top. The depth of the tube in the cell can be adjusted with the o-ring.

The C2 Cell Stand also allows sparging of the "next sample" to be tested. The "next sample" vial with top is placed in the square plastic block. The "next sample" purge tube is inserted through the hole and its depth adjusted with the o-ring. The next sample is illustrated in Figure 3.8.

**Figure 3.8** "Next Sample" Vial



### Cell Top/Sample Vial Placement

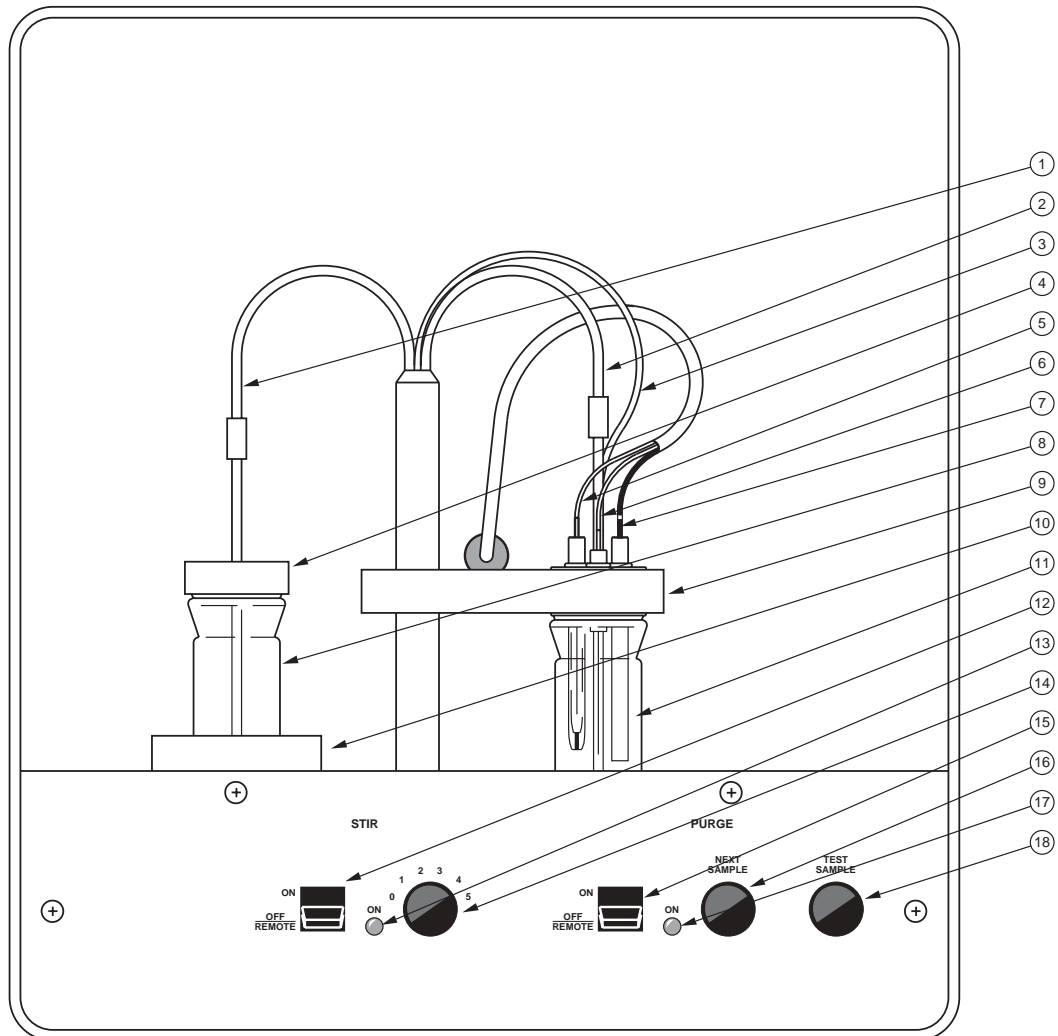
The cell top arm is raised, the cell is placed under the cell top, and the arm is lowered onto the cell. The cell top snaps out of the cell arm for easy cleaning.

## **Section 4 - OPERATION**

### **IDENTIFICATION OF FRONT PANEL CONTROLS**

1. Gas Sparge Line. Next sample gas sparge line.
2. Gas Sparge Line. Gas sparge line for test sample.
3. Gas Blanket Line. Gas blanket line for test sample.
4. Next Sample Vial Top.
5. Reference Electrode Lead. White lead connected to reference electrode.
6. Auxiliary Electrode Lead. Red lead connected to auxiliary electrode.
7. Working Electrode Lead. Black lead connected to working electrode.
8. Next Sample Cell Vial.
9. Cell Top and Arm.
10. Next Sample Vial Holder.
11. Test Sample Cell Vial.
12. Stir Control. Switch to manually control stirrer or to select for remote control.
13. Stir LED. LED is lit when stir is turned on, either manually or remotely.
14. Stir Rate Selection. Switch to control stir rate.
15. Test Sample Gas Purge Control. Switch to manually control gas purge in test sample vial or to select for remote control.
16. Next Sample Gas Purge Rate Control. Needle valve controlling rate of gas flow to Next Sample gas dispersion tube. NOTE: Next Sample Vial gas line is always on. Gas purge control switch (No. 15 on this figure) does not control gas flow to Next Sample Vial.
17. Gas Purge LED. LED is lit when gas purge is turned on for test sample vial, either manually or remotely.
18. Test Sample Purge Rate Control. Needle valve controlling rate of gas flow to test sample gas dispersion tube.

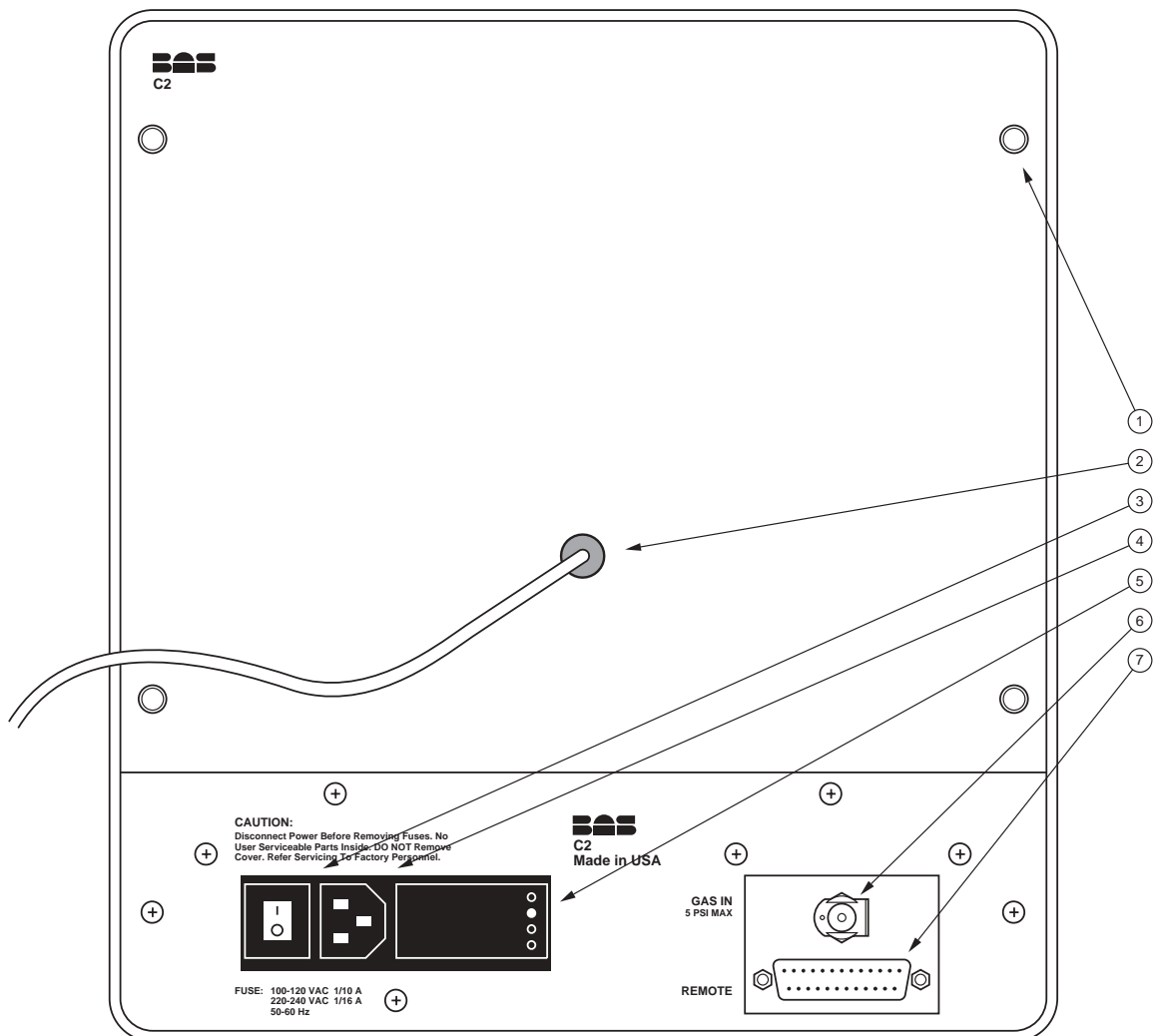
Figure 4.1 Front Panel





**IDENTIFICATION OF REAR PANEL CONNECTORS**

1. Thumb Screws. Four thumb screws for easy removal of back panel.
2. Cell Lead. Cell lead with silver LEMO connector for connection to BAS instruments
3. Power On/Off.
4. Power Cord. Socket for power cord. Be sure that the 3-prong power cord is connected to a grounded outlet.
5. Fuse Holder/Voltage Selection. Shows the selected line voltage.
6. Gas Inlet Connector. Bulkhead fitting providing connection to external gas source.  
NOTE: 5 psi maximum pressure
7. Remote Connector. 25 pin D connector for remote control by BAS 100 Series Electrochemical Analyzers

**Figure 4.2** Rear Panel

**GAS PURGE****Test Sample**

The flow rate of the gas and whether it is directed toward purging or blanketing the sample is controlled by a front panel knob and switch (Figure 4.1, No. 18 and 15).

When toggled to the ON position, the gas flow is diverted to the purge tube and can not be changed by REMOTE control. When switched to the OFF/REMOTE position, the gas is directed to the BLANKET tube. It must be in this position to control PURGE via external control through the REMOTE connector on the rear panel. Thus, without REMOTE control the ON Position activates the PURGE line and the REMOTE position activates the blanket line. For REMOTE control of PURGE and BLANKET functions, the switch must be in the REMOTE position. The rate of flow is controlled by rotating the knob labelled Test Sample. Counter-clockwise rotations will increase the flow, clockwise rotation will decrease the flow to the cell. The LED is lit when the purge function is switched on, either manually or remotely.

**Next Sample**

The C2 Cell Stand allows sparging of the next sample while analyzing the test sample. The gas flow to the Next Sample Needle Valve is continuous; it is not affected by the gas control switch (Figure 4.1, No. 15). The rate of flow is controlled by rotating the knob labelled Next Sample. Counter-clockwise rotation will increase flow, clockwise rotation will decrease flow.

**STIR**

The C2 Cell Stand has a magnetic stirrer built into the unit. The stirring functions on, off and rate can be controlled by the front mounted switches.

The switch under the STIR label controls whether the stirrer is ON or OFF or is REMOTELY controlled (See Figure 4.1, No. 12). The ON position overrides all other commands and turns the stirrer motor on. The REMOTE position is equivalent to off in manual operation but is the required position for turning on the stirrer by external (REMOTE) control. At least 2 seconds should pass after stirrer is turned off before it is turned on again.

The rate of stirring is controlled by the knob directly to the right of the control switch. The "0" position is no stirring and the stir rate increases with an increase in the position number.

The LED is lit when the stir function is switched on, either manually or remotely.

**REMOTE CONTROL**

The remote connector of the C2 unit allows the stirring and gas purge functions to be controlled by an external unit. This cell stand was specifically designed to be controlled by the appropriate commands from the BAS 100 Series Electrochemical Analyzer. These functions can be activated from any controller providing a contact closure to ground and at 5V DC and 100 mA power supply. The pin designations are as follows:

Pin	Description
4	digital ground
7	digital ground
8	STIR
14	+5V DC $\pm$ 5% (100 mA) Power Supply
21	PURGE

The appropriate BAS 100/A/B star commands are STIR, YSTIR, NSTIR, NTG, YNTG, NNTG, CPL and UNCPL. Please refer to the BAS 100/A/B manual for details on the operation of these commands.

**FARADAY CAGE AND CELL HOLDER**

The Faraday cage will shield the cell from most electrical interferences. The cell door must be closed during the experiments for proper shielding. The Faraday cage should be on a relatively vibration free table and the Faraday cage should not be moved during the experiment. Movement of the cell leads during an experiment may result in a noisy voltammogram.

Unconnected wires (cell leads) and water lines for temperature control passing through the wall of the faraday cage are sources of line frequency interference for small signals. For best results, remove any unnecessary leads and properly ground the water line.

The cell is placed on the stainless steel drip pan in the Faraday cage. The cell top is slid down the bar onto the cell. The electrodes are inserted into the cell top and electrode connections made. The cell top slides out of the cell arm for easy cleaning.

**REMOVAL OF BACK PANEL** The back panel may be easily removed by unscrewing the four thumb screws shown in Figure 4.2, No.1.

## **Section 5 - MAINTENANCE**

This section describes some general cautions, maintenance points, electronic troubleshooting, and the procedure for obtaining service.

### **CAUTIONS AND GENERAL MAINTENANCE**

This is a very rugged instrument and with proper care should give years of service. Following is a brief list of cautions and general maintenance considerations that will extend the lifetime of the instrument.

Follow customary, good laboratory practices.

Clean all spills, especially salt solutions, from on or near the cabinet immediately.

Avoid placing unit in a corrosive atmosphere.

Avoid dropping, shaking, and other forms of mechanical abuse since this could cause loosening of components or subassemblies.

Clean gas lines, i.e., rinse and wipe dry, after each use.

Do not bend auxiliary electrode (platinum wire) when removing or placing cell vial. Repeated bending will cause the wire to break.

### **SERVICE PROCEDURE**

There are no user serviceable parts in this unit and all service requests should be referred to BAS service personnel. In certain cases, BAS will provide electronic schematics and service procedures to qualified electronic maintenance facilities but only upon written request and then only on the approval of the Service Coordinator.

If a problem arises and appears equipment oriented, call BAS at (765) 463-4527 and ask for Customer Service (see Section 2).



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