6. Select simulator switch position I5.

7. Verify that the alarms reset, and that the simulator heater lamp is ON or flashing.

N. Check for Shorted Patient Probe Alarm (IC Incubator Only)

1. Select simulator switch position I6.

2. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.

3. Press the ALARM SILENCE touch switch.

4. Verify that the simulator heater lamp is OFF.

5. Verify that the displayed temperature is greater than 45 degrees C.

O. Inlet and Outlet Sensor Temperature Display Check

1. Place the incubator in the MANUAL MODE (IC Incubator Only).

2. Verify that all alarm conditions are cancelled.

3. Press the ENVIRONMENTAL TEMP touch switch.

4. With the simulator switch in position I6, verify an ENVIRONMENTAL TEMP display of 35.0 +/- 0.1 degrees C.

5. Press and hold the increase touch switch to display the inlet wall temperature.

6. Verify that the displayed temperature is 39.0 +/- 0.1 degrees C.

7. Press and hold the decrease touch switch to display the outlet wall temperature.

8. Verify that the displayed temperature is 31.0 +/- 0.1 degrees C.

P. Inlet Wall Temperature Greater than 45 degrees C Alarm Check

(28.0 degrees C to 37.5 degrees C Control Temperature Range)

4. Verify that the digital display indicates 33.0 +/- 0.1 degrees C, if not return to Section G. A/D Converter Check and Adjustment.

K. Calibration Resistor Check

1. Press the PATIENT TEMP touch switch.

2. Press and hold the CONTROL TEMP decrease touch switch. The displayed temperature should be 37.3 +/- 0.1 degrees C, if not return to Section G. A/D Converter Check and Adjustment.

L. Final Incubator Checks with Temperature Simulator

1. Set temperature simulator switch to position I3.

2. Press the MANUAL MODE touch switch.

3. Set the control temperature for 37.5 degrees C.

4. Press the SERVO MODE touch switch.

5. Set the control temperature for 37.5 degrees C.

6. Verify that the PATIENT-TEMP/SENSOR alarm activates (both audible and visual) within 20 seconds (24 seconds for the 50 Hz models).

7. Verify that the heater light remains ON or flashing.

8. Press the ALARM SILENCE touch switch.

M. Check for Open Patient Probe Alarm (IC Incubator Only)

1. Press the PATIENT TEMP touch switch.

2. Select simulator switch position I4.

3. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates. The PATIENT-TEMP/SENSOR alarm light should still be lit.

4. Verify that the simulator heater lamp is OFF.

5. Verify that the displayed temperature is less than 5 degrees C.

3. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 31.0 +/- 0.1 degrees C, if not go to Section H. A/D Zero Adjustment.

4. Select simulator switch position I2.

5. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 39.0 +/- 0.1 degrees C, if not go to Section I. A/D Gain Adjustment, if correct proceed to Section J. A/D Converter Final Check.

H. A/D Zero Adjustment

1. Place the selector switch in position I1, the air safety switch in the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).

2. Press and hold the increase touch switch.

3. Adjust potentiometer R17 on the control board for a digital display of 31.0 +/- 0.1 degrees C.

4. Return to Section G. A/D Converter Check, step 4.

I. A/D Gain Adjustment

1. Place the selector switch in position I2.

2. Press and hold the increase touch switch.

3. Adjust potentiometer R16 on the control board for a digital display of 39.0 +/- 0.1 degrees C.

4. Repeat Section H. A/D Zero Adjustment and Section I. A/D Gain Adjustment until both the A/D Zero and A/D Gain are properly adjusted.

J. A/D Converter Final Check

1. Select simulator switch position I3.

2. Press the PATIENT TEMP touch switch.

3. Press and hold the increase touch switch.

determine which of the two versions you have before adjusting R17. The newer board has two physical features that distinguish it from the older board. All test points (TP) are located along the top edge of the new board for easy access. Also both adjustment potentiometers (R17 and R18) are located together, next to the test points.

ALARM PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board clockwise (CW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R-17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board counterclockwise (CCW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

5. Perform the procedures described in Section B. Air Safety Circuit Check and Adjustment.

G. A/D Converter Check

1. Place incubator in the manual mode (IC Incubator Only).

2. Place the selector switch in the position I1, the air safety switch to the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).

5. Verify that there is no evidence of relay chatter. If relay chatter is present, replace the the power supply board and/or the control board.

6. Place the air safety switch in the DVM position.

7. Verify that the resistance is less than 52.7K ohms. If the resistance reading is out of tolerance, replace the power supply board. If the resistance reading is within tolerance, no calibration is required. Proceed to the next step.

E. Heater OFF Check

1. Place the air safety switch in the incubator (INC) position.

2. Rotate the ALARM ADJ control fully counterclockwise.

3. Set the CONTROL TEMP to 28 degrees C.

4. Verify that the heater lamp is completely off.

5. Slowly rotate the ALARM ADJ control knob clockwise until the alarm just activates.

6. Verify that the SYSTEM FAIL/OVERTEMP alarm light is lit.

7. Place the air safety switch in the DVM position.

8. Verify that the resistance is between 50.7K ohms and 51.5K ohms. If the resistance reading is out of tolerance replace the power supply board. If the resistance reading is within the tolerance, no calibration is required. If no calibration is required, go to Section G. A/D Converter Check.

F. Calibration Procedure

1. Place the air safety switch in the DVM position.

2. Set the incubator CONTROL TEMP to 37.5 degrees C.

3. Rotate the ALARM ADJ control for a reading of 50.8K ohms on the DVM.

4. Place the air safety switch in the incubator (INC) position.

   IMPORTANT: There are two versions of the power supply board which have been used in incubators. You must

5. Verify that the incubator is in the manual mode (IC Incubator only).

6. Set the CONTROL TEMP to 33.0 degrees C.

   NOTE: If an alarm is present the alarm must be cancelled before the check procedure can be completed. First refer to the calibration procedure in Section B. Calibration. to cancel the air safety alarm. If the alarm does not cancel refer to Section I A/D Gain Adjustment. If the alarm is still present refer to the IC and GC Incubator Service Manual for troubleshooting procedures.

C. Heater ON Check

1. Set the incubator CONTROL TEMP to 37.5 degrees C.

2. Verify that the heater lamp indicates full heat. This may take approximately 20 seconds.

3. Verify that no alarm condition is present at this time.

4. SLOWLY rotate the ALARM ADJ control clockwise until the alarm just trips. Be careful not to overshoot the alarm trip point.

5. After the SYSTEM FAIL/OVERTEMP alarm activates, switch the air safety switch to the DVM position.

6. Verify that the resistance reading on the DVM is between 50.7K ohms and 50.9K ohms. If not, go to Section F. Calibration Procedure.

   NOTE: If you repeat the test make sure the heater lamp indicates full heat. Replace the power supply board when the specified resistance readings are not attainable after calibration.

D. Reset Check

1. Place the air safety switch on the simulator in the incubator (INC) position.

2. Verify that the SYSTEM FAIL/OVERTEMP alarm activates.

3. SLOWLY rotate the ALARM ADJ control counterclockwise until the alarm just resets. Be careful not to overshoot the alarm trip point.

4. Verify that the SYSTEM FAIL/OVERTEMP alarm light is not lit.

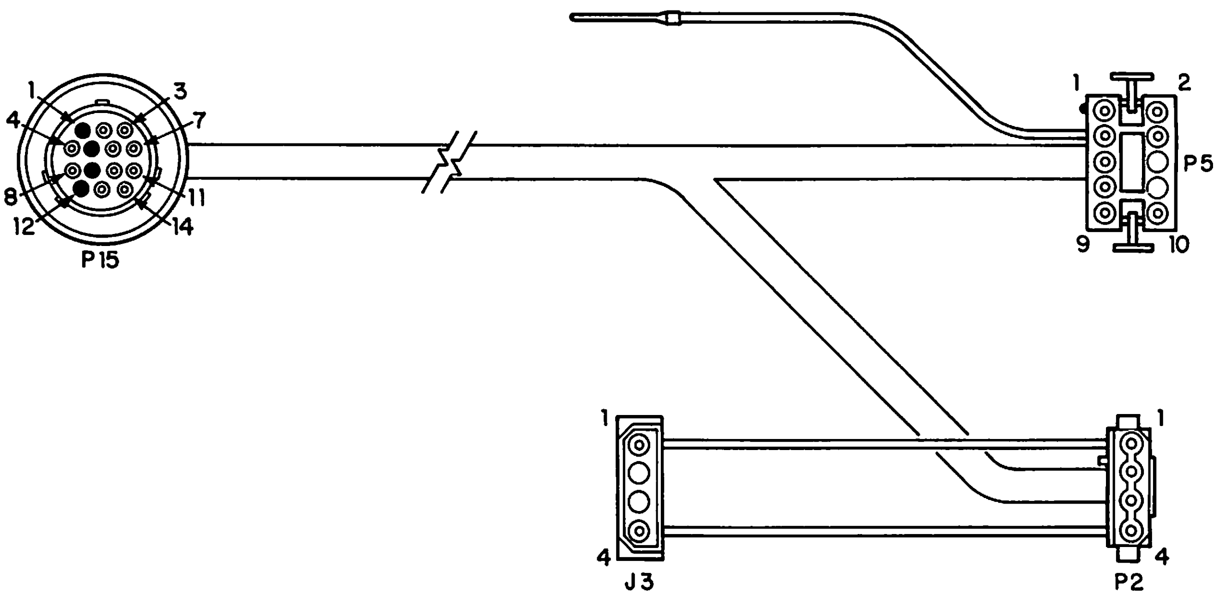


Figure 3.
Temperature Simulator Cable
(Stock No. 0690-1270-317)

5. Reconnect the cable connector P-2 which was disconnected above, into the female Mate-N-Lok connector on the test cable.

6. Disconnect P-5 from J-5 on the control board and set aside.

7. Connect the 10-pin Make-N-Lok connector on the test cable to the J-5 connector on the control board of the incubator.

8. Connect the single red wire (audible alarm line) on the test cable to pin 3 of P-5.

9. Connect the power cord to an appropriate power source and turn the incubator power switch to the ON position.

B. Air Safety Circuit Check and Adjustment

1. Place the air safety switch of the temperature simulator in the DVM/CAL position.

   NOTE: If the incubator alarm activates press the alarm silence touch switch.

2. Connect one of the following DVM's to connectors J-8 and J-9 (CAL RES) on the back of the temperature simulator.

   For the B & K 2815 meter use the 100K range and the ohms function position. The resistance reading must be between 39.8K ohms and 40.6K ohms (nominal 40.2K ohms).

   For the Beckman model 3020 meter use the 200K ohm scale. The resistance reading must be between 39.8K ohms and 40.6K ohms (nominal 40.2K ohms).

   For the Data Precision model 175 meter use the K ohm setting (high voltage) and the 100 ohm range. The resistance reading must be between 39.8K ohms and 40.4K ohms (nominal 40.2K ohms).

   IMPORTANT: If the meter is out of calibration return it to the manufacturer for calibration. The air safety circuit check and calibration depends on the accuracy of the DVM.

3. Connect the DVM to connectors J-7 and J-8 (AIR SAFETY) on the back of the temperature simulator.

4. Place the selector switch of the temperature simulator in the I1 position, the air safety switch in the INC position, and the alarm adjust control fully CCW.

3/EQUIPMENT CALIBRATION AND ADJUSTMENT

3.1 INCUBATOR CALIBRATION AND ADJUSTMENT

IMPORTANT: The procedures described in this manual are to be performed by trained and authorized personnel only. No calibration or maintenance procedures should be attempted by anyone not having such qualification. Read completely through each procedure before starting the procedure. Any exceptions may result in failure to properly and safely complete the procedure attempted.

WARNING: Disconnect power to the incubator before connecting or disconnecting the temperature simulator.

CAUTION: Use the static control work station (Ohmeda Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive electrical components. Do not use the static control work station when working on an energized unit.

NOTE: Allow the incubator to warm up for five minutes before performing this procedure. Incubators with a control temperature range of 28 degrees C to 39 degrees C require different procedures which have been included and noted. Perform the alternate steps required when necessary. Determine the incubators control temperature range before starting this procedure. If your incubator is a 28 degrees C to 39 degrees C model, two additional labels will have been added. One label will be on the front side of the incubator body, directly to the left of the control/display panel. Another label will be located on the control box near the electrical receptacle on the incubators side. Each label is in plain view and can be easily seen by the service personnel.

A. Temperature Simulator Connection (Figure 3)

1. Disconnect the incubator power cord from the electrical receptacle.

2. Connect the round 14-pin connector (P15) on the test cable to J-15 at the rear of the temperature simulator as shown in Figure 2.

3. Remove the cable connector P-2 from J-2 on the power supply board of the incubator.

4. Connect the 4-conductor male Mate-N-Lok connector from the test cable into J-2 of the power supply board.

or off.

E. Voltage Selector Switch

The voltage selector switch allows the temperature simulator to be used on either 100/120V or 220/240V incubators.

F. J-7 and J-8 Connectors

J-7 and J-8 connectors are used for calibration of the air safety circuit.

G. J-8 and J-9 Connectors

J-8 and J-9 connectors are used for a resistance accuracy check of the digital voltmeter.

H. NICC Connector(J-2)

The NICC connector is a 1/4" phone jack for connecting the temperature simulator to the patient probe jack of the NICC.

I. Incubator Connector (J-1)

The incubator connector is a miniature 1/8" phone jack for connecting the temperature simulator to the patient probe jack on the IC Incubator.

J. J-15 Connector

The J-15 connector is a multiple pin connector for connecting the temperature simulator to the IC or GC Incubators.

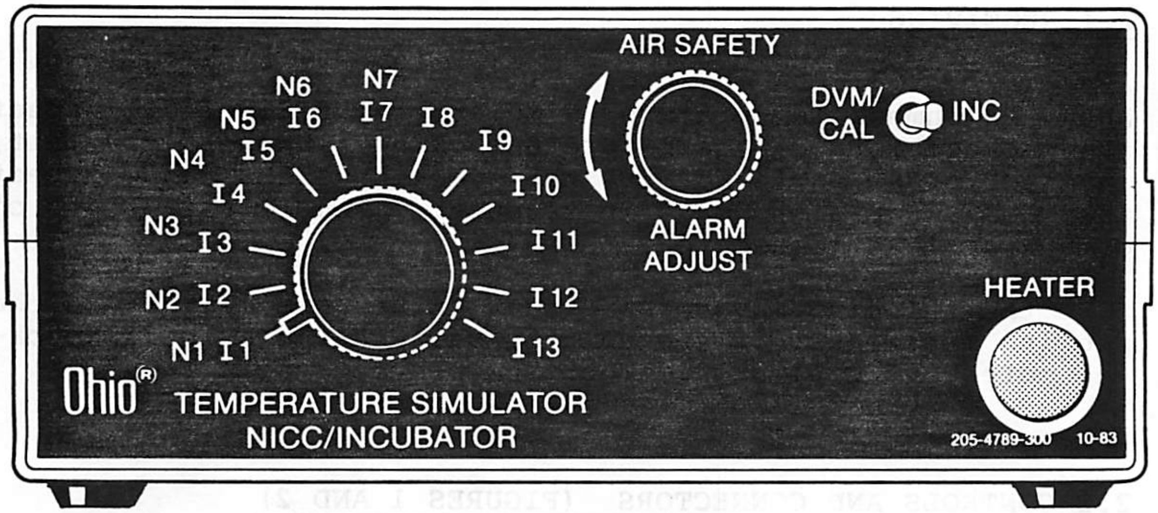


Figure 1.
Front Panel of Temperature Simulator

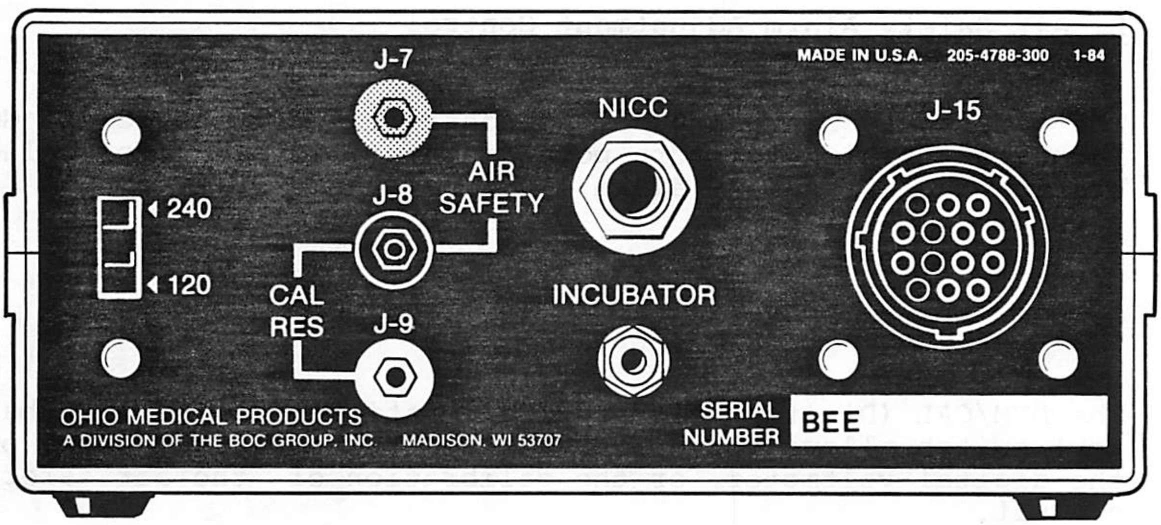


Figure 2.
Back Panel of Temperature Simulator

2/SETUP AND OPERATION

2.1 RECEIVING

When the Ohmeda Temperature Simulator is delivered, inspect the package for damage before unpacking. Unpack the unit, inventory the parts against the packing slips and inspect them for sign of damage in transit. Report any signs of damage or loss immediately.

Save the shipping invoices for any future claims. Store the packing materials; if the unit is shipped the original packing materials will provide optimum protection.

2.2 CONTROLS AND CONNECTORS (FIGURES 1 AND 2)

A. Main Selector Switch (S2)

The main selector switch allows the connection of different precision resistors to the IC or GC Incubator. Switch positions I1 through I13 are for the Incubators and N1 through N7 are for the NICC.

B. Air Safety Alarm Adjustment Control

The air safety alarm adjustment control is for the IC and GC Incubator. This ten turn potentiometer is used for calibrating the air safety alarm.

C. DVM/CAL or INC Switch

The DVM/CAL (Digital Voltmeter/Calibration) or INC (Incubator) switch allows for either a resistance accuracy check of the digital voltmeter or the calibration of the air safety circuit.

D. Heater Lamp

The heater lamp indicates when the heater for the incubator is active. The heater can be on full, pulsing on and off,

TABLE 1

S2 Switch Position	Patient Temperature P5 (Pins 1,2)	Inlet Wall Sensor P5 (Pins 5,7)	Outlet Wall Sensor P5 (Pins 9,10)	Air Safety Sensor P2 (Pins 2,3)
I1	7686 (31 C)	7686 (31 C)	7686 (31 C)	See Note
I2	5496 (39 C)	5496 (39 C)	7686 (31 C)	82000
I3	7060 (33 C)	5496 (39 C)	7686 (31 C)	82000
I4	36000 (open)	5496 (39 C)	7686 (31 C)	82000
I5	5970 (37 C)	5496 (39 C)	7686 (31 C)	82000
I6	3000 (short)	5496 (39 C)	7686 (31 C)	82000
I7	5900 (37.3 C)	4120 (45.5 C)	7686 (31 C)	82000
I8	5900 (37.3 C)	5496 (39 C)	7686 (31 C)	82000
I9	5900 (37.3 C)	4990 (41.3 C)	5900 (37.3 C)	82000
I10	5900 (37.3 C)	5496 (39 C)	7686 (31 C)	82000
I11	6190 (36.2 C)	5496 (39 C)	7686 (31 C)	82000
I12	5900 (37.3 C)	3900 (47.2 C)	7686 (31 C)	82000
I13	5900 (37.3 C)	4120 (45.9 C)	5900 (37.3 C)	82000

NOTE: A meter reading of 90.2K ohms will be shown with switch S1 in the INC position and the air safety switch fully counterclockwise (CCW). A reading of 40.2K ohms will be shown with switch S1 in the INC position and the air safety switch fully clockwise (CW). With switch S1 in the DVM CAL position the circuit will be open.

1.2 SPECIFICATIONS

Length: 7" (178mm)

Width: 6 1/8" (156mm)

Height: 2 1/8" (54mm)

Weight: approximately 3 pounds (1.4kg) with shipping container 5 pounds (2.3kg)

Electrical Requirements: None

Resistance Range: 1.2K ohms to 82K ohms

1.3 ACCESSORY EQUIPMENT

Static Control Work Station, (Stock No. 0175-2311-000)

1/GENERAL INFORMATION

1.1 DESCRIPTION

The Ohmeda Temperature Simulator is a precision instrument for the calibration and adjustment of the Ohmeda Intensive Care (IC) Incubator, General Care (GC) Incubator, and the Neonatal Intensive Care Center (NICC). The simulator can also be used for temperature related troubleshooting of these Ohmeda products. A test cable is used to connect the simulator to the IC Incubator, GC Incubator or the NICC. Precision resistors are substituted for the thermistor sensors which are used to gather temperature information for the control circuits. The temperature simulator substitutes resistance values for the front wall sensor, rear wall sensor, air safety sensor, and patient probe sensor in the incubators. The temperature simulator substitutes resistance values for the patient probe sensor in the NICC.

Table 1 indicates the resistance values that are connected to the incubator's control unit for each S2 switch position. The temperatures indicated next to the resistance values are temperatures that are displayed on the control panel. For example, when the S2 switch is in the I5 position, the PATIENT TEMP displayed will be 37 degrees C. The ENVIRONMENTAL TEMP will be 35 degrees C (the average of the inlet and the outlet wall temperatures), the inlet wall temperature will be 39 degrees C and the outlet wall temperature will be 31 degrees C.

A checkout procedure for the Ohmeda Temperature simulator and test cable is described in the maintenance section of this manual. When the operation of the temperature simulator or test cable is in question, use the checkout procedure to verify proper operation. A schematic is also included in this manual.

CONTENTS

PRECAUTIONS

WARNINGS

Disconnect power to the incubator before connecting or disconnecting the temperature simulator.

Unplug test cable before cleaning and inspection.

CAUTIONS

Servicing of this product in accordance with this manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this manual which is clearly and thoroughly understood.

Use the static control work station (Ohmeda Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive electrical components. Do not use the static control work station when working on an energized unit.

Do not use a unit which is not functioning properly. It recommended that repairs be made by an authorized Service Representative of Ohmeda. Contact the nearest Ohmeda Zone or Regional Service Office for assistance.

Do not autoclave or gas sterilize the Ohmeda Temperature Simulator or its parts. Permanent damage to the device will result. Only competent individuals trained in the repair of this equipment should attempt to service this equipment.

Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda.

IMPORTANT

The information contained in this manual pertains only to those models of products which are marketed by Ohmeda* as of the effective date of this manual or the latest revision thereof. This manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience as well as the availability to them of proper tools and test equipment. Consequently, Ohmeda provides this manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that customer has received said information from Ohmeda does not imply in any way that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstance may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review and customers are cautioned to obtain and consult the latest revision thereof and suggestions are invited from our customers for consideration by Ohmeda in connection with these periodic reviews.

CAUTION: Servicing of this product in accordance with this manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this manual which is clearly and thoroughly understood.

This manual only contains calibration information for the Ohio Intensive Care (IC) Incubator, General Care (GC) Incubator, and the Neonatal Intensive Care Center (NICC). Refer to the IC and GC Incubator Service Manual (0178-0110-000) or the NICC and Overhead Radiant Heater Service Manual (0178-0102-000) for complete service information.

* Formerly Ohio Medical Products.

USER RESPONSIBILITY

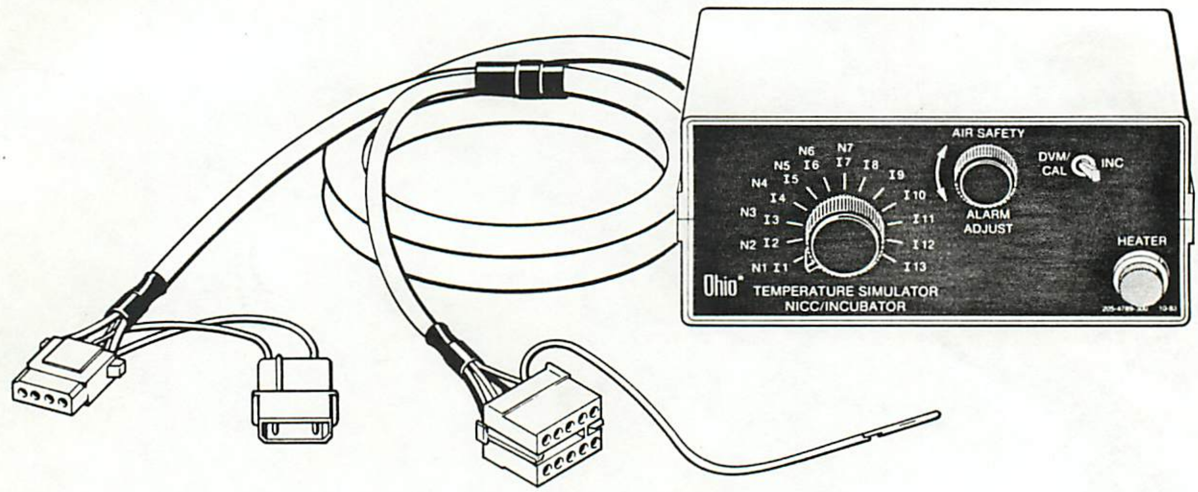
This Product will perform in conformity with the description thereof contained in this operation manual and accompanying labels and/or inserts, when assembled, operated, maintained and repaired in accordance with the instructions provided. This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated, should be replaced immediately. Should such repair or replacement become necessary, Ohmeda recommends that a telephonic or written request for service advice be made to the nearest Ohmeda Regional Service Office. This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Ohmeda, or altered without the prior written approval of Ohmeda's Safety Department. The user of this Product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alterations by anyone other than Ohmeda.

CAUTION: Federal law in the U.S.A. and Canada restricts this device to sale by or on the order of a licensed practitioner.

TRACEABILITY: Federal law in the U.S.A. requires traceability of this equipment. Please fill out the self addressed traceability registration card included with this product and return it to Ohmeda. If additional cards are required order Stock Number 0205-7244-300.

Ohmeda

Temperature Simulator
Operation Maintenance Manual



NOTE: DO NOT USE THIS MANUAL FOR CAL. USE SERVICE MANUAL PROCEDURE.

BOC Health Care

1. With the simulator switch in position I6, place the incubator in MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 37.5 degrees C.

2. Press the ENVIRONMENTAL TEMP touch switch.

3. Verify that the simulator heater lamp is ON or flashing.

4. Select simulator switch position I7.

5. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.

6. Press the ALARM SILENCE touch switch.

7. Press the hold the increase touch switch to display the inlet wall temperature.

8. Verify that the displayed temperature is greater than 45 degrees C and that the simulator heater lamp is OFF.

9. Select simulator switch position I8.

10. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

<u>P. Inlet Wall Temperature Greater than 45 degrees C Alarm Check</u> (28.0 degrees C to 39.0 degrees C Control Temperature Range)

1. With the simulator switch in position I6, place the incubator in MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 38.5 degrees C.

2. Press the ENVIRONMENTAL TEMP touch switch.

3. Verify that the simulator heater lamp is ON or flashing.

4. Select simulator switch position I12.

5. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.

6. Press the ALARM SILENCE touch switch.

7. Press the hold the increase touch switch to display the inlet wall temperature.

8. Verify that the displayed temperature is greater than 46.5 degrees C and that the simulator heater lamp is OFF.

9. Select simulator switch position I8.

10. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

Q. Environmental Temperature Greater Than 39 degrees C Alarm Check

(28.0 degrees C to 37.5 degrees C Control Temperature Range)

1. Select simulator switch position I9.

2. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.

3. Press the ALARM SILENCE touch switch.

4. Verify that the ENVIRONMENTAL TEMP display is greater than 39 degrees C and that the simulator heater lamp is OFF.

Q. Environmental Temperature Greater Than 39 degrees C Alarm Check (28.0 degrees C to 39.0 degrees C Control Temperature Range)

1. Select simulator switch position I9.

2. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.

3. Press the ALARM SILENCE touch switch.

4. Verify that the ENVIRONMENTAL TEMP display is greater than 40.5 degrees C and that the simulator heater lamp is OFF.

R. Check for SERVO MODE Low End Alarm (IC Incubator Only)

1. Select simulator switch position I10.

2. Place the incubator in the SERVO MODE.

3. Press the PATIENT TEMP touch switch and record the temperature displayed.

4. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C below the noted patient temperature.

5. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).

6. Verify that the heater is OFF.

7. Increase the CONTROL TEMP 0.4 degrees C. Be careful not to overshoot.

8. Verify that the alarm cancels.

S. Check for SERVO MODE High End Alarm (IC Incubator Only)

1. Select simulator switch position I11.

2. Press the PATIENT TEMP touch switch and record the temperature displayed.

3. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C above the noted patient temperature. Be careful not to overshoot.

4. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).

5. Decrease the CONTROL TEMP 0.4 degrees C. Be careful not to undershoot.

6. Verify that the alarm cancels and the simulator heater lamp is ON or flashing. This may take approximately 20 seconds.

T. Servo Mode Operational Check (IC Incubator only.

1. Disconnect the main test cable and ground wire from the temperature simulator.

2. Connect a 2 conductor cable with miniature phono plugs (by others) to the temperature simulator and to the patient probe jack on the incubator.

3. Select simulator switch position I11.

4. Press the PATIENT TEMP touch switch and not the temperature displayed.

5. Place the incubator in the SERVO MODE.

6. Adjust the control temperature to 0.5 degrees C above the noted patient temperature.

7. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

8. Use s stop watch and start timing when you place the incubator in the SERVO MODE.

9. After 11 minutes have passed, press the MANUAL MODE touch switch.

10. Verify that the control temperature has increased to 33.3 degrees C.

11. Press the PATIENT TEMP touch switch and note the temperature displayed.

12. Place the incubator in the SERVO MODE.

13. Adjust the control temperature 0.5 degrees C below the noted temperature.

14. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

15. Use a stop watch and start timing when you place the incubator in the SERVO MODE.

16. After 11 minutes have passed, press the MANUAL MODE touch switch.

17. Verify that the control temperature has decreased to 32.7 degrees C.

18. Disconnect the 2 conductor cable from the temperature simulator.

U. Temperature Simulator Removal

1. Switch the power switch on the incubator to the OFF position.

2. Disconnect the incubator power cord from the power source.

3. Remove the single red wire of the test cable from pin 3 of P-5.

4. Remove the test cable connector from the control board connector J-5.

5. Reconnect P-5 to the J-5 connector on the control board.

6. Remove the test cable connector which is connected to J-2 on the power supply board.

7. Reconnect P-2 to the J-2 connector on the power supply board.

3.2 NICC CALIBRATION AND ADJUSTMENTS FOR THE 4-POT CONTROL BOARD (0208-6345-700)

The following procedure defines the operations necessary for proper calibration of the circuit board. Because of variations in the energy limiting boxes and the analog panel meters, the board is calibrated while it is installed in the control box and involves the setting of four multi-turn potentiometers.

1. Connect the NICC and the necessary test equipment as shown in Figure 39, Page 40 of the NICC Service Manual, and remove the back panel from the NICC control unit.

2. Turn on the autotransformer and adjust it so that the DVM reads 12 +/- 2 VAC. All wattmeter readings assume a voltage of 120 +/-2 VAC.

A. Board Self-Test

1. Enter the self-test mode by depressing the TIMER RESET switch while changing the MODE SELECTOR switch from OFF to SERVO.

2. Verify that the four alarm lamps (PROBE OPEN, HIGH-LOW TEMP ALARM, PRESS TIMER RESET, HIGH-LOW ALARM SILENCED)and the audio alarm are being energized on and off at approximately a 1 Hz rate. The audio will vary with the settings of the RATE and PITCH controls on the NICC.

3. Set MODE SELECTOR switch to OFF.

B. Board Calibration

1. With the MODE SELECTOR in the OFF position, the PROBE TEMPERATURE meter should fall on the 90 degrees F. mark. Adjust the mechanical meter zero screw located on the meter if necessary.

   NOTE: Be sure to view the meter from a point perpendicular to the face of the meter to reduce parallax error, and help assure maximum accuracy of the readings.

2. Enter the calibration mode by depressing both the TIMER RESET and ALARM SILENCE switches while changing the MODE SELECTOR switch from OFF to SERVO.

3. Turn the SERVO TEMPERATURE SELECTOR control fully counterclockwise (CCW).

4. Verify that the knob on the pointer is at 95 degrees F. If it is not loosen the knob set screws and reposition the knob.

5. Set the decade resistance box to 1468 ohms +/- .1% (Temperature Simulator position N1).

6. Connect a DVM as follows: Positive lead to TP-3 (Zero Adjust) and the negative lead to ground (negative lead of capacitor C13).

7. Adjust potentiometer R13 (zero) so that the DVM reads 0.000 +/- 0.001 VDC.

8. Set the decade resistance box to 1200 ohms +/- .1% (temperature simulator position N2).

9. Set the SERVO TEMPERATURE SELECT control to 37.0 degrees C.

10. Adjust trimmer R12 (Gain Adjust) until the "PROBE OPEN" light, HIGH-LOW TEMP ALARM SILENCED light, and the audio alarm are all energized. If only the PROBE OPEN light is lit, adjust R12 counterclockwise (CCW). If only the HIGH-LOW TEMP ALARM SILENCED light is lit, adjust R12 clockwise (CW).

11. Adjust R14 (Cal.) so that the DVM reading does not change more than +/- .001 VDC as the METER CHECK switch is depressed and released. Dirty contacts on the METER CHECK switch can cause unstable or nonrepeatable readings. If this problem is experienced, replace the switch.

12. With the 1200 ohm resistance (temperature simulator position N2) still connected, adjust R33 (METER) so that the PROBE TEMPERATURE meter indicates 37.0 degrees C.

13. Set the MODE SELECTOR switch to the OFF position.

<u>C. Checkout Procedure</u>

1. With the MODE SELECTOR switch in the OFF positon, depress the two FLUORESCENT LIGHTS switches for one to three seconds, and release. The fluorescent lights should light.

2. Depress the two FLUORESCENT LIGHTS switches again. The light should extinguish.

NOTE: If any of the following steps fail, recheck the calibration.

3. Set the decade resistance box to 1468 ohms +/- 0.1% (temperature simulator position N1) and the SERVO TEMPERATURE SELECTOR to 95 degrees F.

4. Move the MODE SELECTOR switch from OFF to SERVO.

5. Verify that the amber HEATING indicator and the white POWER indicator are lit.

6. Verify that the wattmeter reads 825 (+75, -20) watts when the autotransformer is adjusted for 120 +/- 2 VAC.

7. Set the decade resistance box to 3000 ohms +/- 0.1% (temperature simulator position N7). Verify that the PROBE OPEN and HIGH-LOW TEMP ALARM lamps and the audio alarm are on, and that the HEATING indicator is OFF. Line power should be less than 25 watts, and the PRESS TIMER RESET and ALARM SILENCE switches should have no effect on the alarms.

8. Vary the audio alarm PITCH and RATE controls over their entire ranges to verify proper operation.

9. Set the decade resistance box to 1468 ohms +/- 0.1% (temperature simulator position N1). Verify that the PROBE OPEN lamp deactivates, and the HIGH-LOW TEMP ALARM lamp and audio alarm remain on.

10. Depress the ALARM SILENCE switch and verify that the HIGH-LOW TEMP ALARM SILENCED lamp is on and the HIGH-LOW TEMP ALARM lamp is off.

11. Set the decade resistance box to 1200 ohms +/- 0.1% (temperature simulator position N2). Verify that the PROBE TEMPERATURE meter indicates 98.6 +/- 0.1 degrees F (needle within the red band).

12. Set the decade resistance box to 1163 ohms +/- 0.1% (temperature simulator position N3). Verify that the PROBE TEMPERATURE meter indicates 100 +/- 0.2 degrees F.

13. Set the decade resistance box to 1334 ohms +/- 0.1% (temperature simulator position N4). Verify that the PROBE TEMPERATURE meter indicates 94 +/- 0.2 degrees F.

14. Depress the METER CHECK switch and verify that the PROBE TEMPERATURE meter indicates within the red band on the meter scale.

15. Set the decade resistance box to 1217 ohms +/- 0.1% (temperature simulator position N6) and the SERVO TEMPERATURE SELECTOR control to 98.0 F.

16. Turn the SERVO TEMPERATURE SELECTOR control clockwise (CW) and verify that the HIGH-LOW TEMP ALARM lamp and the audio alarm activate at 100 +/- 0.2 degrees F.

17. Depress the ALARM SILENCE switch and verify that the HIGH-LOW TEMP ALARM lamp turns off and the HIGH-LOW TEMP ALARM SILENCED lamp turns on.

18. Adjust the SERVO TEMPERATURE SELECTOR control to 99.5 degrees F and verify that the HIGH-LOW TEMP ALARM SILENCED lamp turns off.

19. Turn the SERVO TEMPERATURE SELECTOR control counter-clockwise (CCW) and verify that the HIGH-LOW TEMP ALARM lamp and the audio alarm activate at 96 +/- 0.2 degrees F.

20. Adjust the SERVO TEMPERATURE SELECTOR control to 96.5 degrees F and verify that the HIGH-LOW TEMP ALARM lamp and the audio alarm deactivate.

21. Put the unit into the calibration mode by setting the MODE SELECTOR switch to OFF, then SERVO MODE while depressing the TIMER RESET and ALARM SILENCE switches.

22. Set the SERVO TEMPERATURE SELECTOR control to 98.6 degrees F.

23. Set the decade resistance box to 1200 ohms +/- 0.1% (temperature simulator position N2). Verify that the PROBE OPEN and HIGH-LOW TEMP ALARM SILENCED lamps and the audio alarm are on.

24. Move the MODE SELECTOR switch to the OFF position, then back to SERVO. The wattmeter should read 200 +/- 50 watts.

25. Move the MODE SELECTOR switch to NON-SERVO and verify the following wattmeter readings for the indicated NON-SERVO HEAT SELECTOR control setting.

Non-Servo Heat Selector	Wattmeter
OFF	Less than 25 W
3	425 +/- 50 W
5	725 +/- 50 W
HIGH	825 +75/-50 W

26. Set the decade resistance box to 1217 ohms +/- 0.1% (temperature simulator position N6), and move the MODE SELECTOR switch to SERVO.

27. As the SERVO TEMPERATURE SELECTOR control is varied according to the table below, verify that the indicated wattmeter readings are present.

Servo Temp Selector	Wattmeter
99.0 degrees F	825 +75/-50 W
98.5 degrees F	740 +/- 50 W
98.0 degrees F	200 +/- 50 W
97.5 degrees F	Less than 25 W

28. Set the decade resistance box to 1468 ohms +/- 0.1% (temperature simulator position N1).

29. Set the NON-SERVO HEAT SELECTOR to 2.

30. Move the MODE SELECTOR switch from OFF to NON-SERVO, and immediately start a stopwatch.

31. After 15 +/- 2 minutes the PRESS TIMER RESET light and the audio alarm should activate.

32. Press the TIMER RESET switch and verify that the PRESS TIMER RESET light and audio alarm deactivate.

33. Move the MODE SELECTOR to OFF.

34. Perform a leakage current test. There should be less than 5uA of leakage with the ground intact, and less than 90 uA with the ground wire open (for 120V models). Leakage current tester (Stock No. 0175- 2284-000) and DMM can be used for the test.

3.3 NICC CALIBRATION AND ADJUSTMENT FOR OLDER MODEL

CONTROL BOARD (0208-6068-700)

1. Turn off fluorescent lights and accessory phototherapy light (if so equipped).

2. Set MODE SELECTOR to OFF.

3. Disconnect unit from pipeline oxygen and turn off cylinder oxygen supply.

4. Disconnect power cord from power source and connect it to the receptacle on the wattmeter harness. (see Figure 39, Page 40 of NICC Service Manual #0178-0102-000).

5. Remove back panel from control unit and make visual inspection. Correct any obvious defects such as loose connections and/or damaged components.

6. Remove probe and connect temperature simulator or resistor decade box to PROBE ATTACH jack with a cable and phone plug assembly.

7. Connect remaining test equipment as shown in Figure 39, Page 40 of the NICC Service Manual #0178-0102-000. Adjust autotransformer to minimum voltage and plug it into an appropriate power source.

8. Connect a DVM to the wattmeter as shown in Figure 39 of the NICC Service Manual.

   NOTE: If the normal line voltage in the area where the unit is used is 110 volts or less (90 volts for 100 volt models, 200 volts for 220 volt models, or 210 volts for 240 volt models) set the autotransformer to the actual measured line voltage whenever you are directed to set it to 120 volts (100 volts, 220 volts, or 240 volts) in this procedure.

9. Turn the autotransformer on and adjust it so the digital voltmeter DVM reads 120 +/-2 VAC, 100 +/-2 VAC, 210 +/-4 VAC, or 230 +/-4 VAC.

10. Verify that the PROBE TEMPERATURE meter pointer lines up with the 90 degrees F marker. Be sure to view meter from a point perpendicular to face of meter dial to reduce parallax error.

    NOTE: Make all PROBE TEMPERATURE meter readings in this manner to assure maximum accuracy of readings.

11. If error is greater than +/- 0.1 degrees F, adjust the mechanical meter zero screw directly below the dial for reading of exactly 90 F.

12. Set decade box to 1468 ohms (temperature simulator position N1).

13. Flip MODE SELECTOR switch to SERVO. If audio alarm activates it may be silenced by pressing the SILENCE ALARM pushbutton now and throughout the calibration procedure.

14. Verify that the white POWER indicator is glowing.

15. Verify that the amber HEATING indicator is glowing.

16. Check that the power indicated on the wattmeter is 825 +75/-10 watts when the AC voltmeter reads 120 VAC, 100 VAC, 210 VAC, or 230 VAC. If wattage is low, but both heaters are warm, continue with calibration.

    NOTE: If normal line voltage in the unit's area of use is low, and a measured line voltage rather than standard specified voltage is set on the autotransformer, the wattage readings stated in the following step must be adjusted accordingly. Calculate the new wattage by first determining the percentage of difference between the standard voltage and the measured voltage. Double this percentage and decrease the wattage by this doubled percentage. For example, if 825 watts is nominal at 120 VAC, at 108 VAC (10% less) it would be 20% less (165 watts) or 660 watts.

17. Reset autotransformer if necessary.

18. Verify that the PROBE TEMPERATURE meter reads 90 degrees +/- 0.1 degrees F.

19. If necessary, remove the hole plug on bottom of control unit and adjust P1 with an insulated shaft screwdriver for 90 degrees F.

20. Set decade box to 1200 ohms (98.6 degrees F/37 degrees C), temperature simulator position N2.

21. Check that the PROBE TEMPERATURE meter pointer lines up with the 98.6 degrees F/37 degrees C marker within +/- 0.1 degrees F. If it does, go to Step 23. If not, go to Step 22.

22. Note how far PROBE TEMPERATURE meter pointer is away from 98.6 degrees F. Adjust P2 to reduce error by one-half. Adjust P1 to reduce remaining error by one-half. Alternate adjustments until 98.6 degrees +/- 0.1 degrees F is reached. Note that P1 is more sensitive than P2. Now reset the decade box to 1468 ohms (temperature simulator position N1) and check to see that the PROBE TEM-

PERATURE meter reads 90 degrees +/- 0.1 degrees F. Touch up with P1 if necessary. Set decade box back to 1200 ohms (temperature simulator position N2) and repeat the above procedure if necessary. When complete, the meter should read 98.6 +/- 0.1 degrees F at 1200 ohms and 90 +/- 0.1 degrees F at 1468 ohms.

23. Set the decade box to 1163 ohms (temperature simulator position N3).

24. Verify that PROBE TEMPERATURE meter reads 100 +/- 0.15 degrees F).

25. Set the decade box to 1334 ohms (temperature simulator position N4).

26. Verify that PROBE TEMPERATURE meter reads 94 +/- 0.15 degrees F).

27. If not correct, recheck the accuracy of the readings at 90 degrees F and 98.6 degrees F (Step 22).

28. Depress METER CHECK pushbutton. PROBE TEMPERATURE pointer should fall within red band on meter scale. If necessary, adjust P13 for exactly 98.6 degrees F/37 degrees C.

29. Set the decade box to 1304 ohms (95 degrees F, temperature simulator position N5).

30. Set the SERVO TEMPERATURE SELECTOR knob fully counterclockwise (CCW) to 95 degrees F (reposition knob if necessary).

31. Switch DVM to DC scale and connect meter between TP2 (error voltage) and ground (negative lead of C4).

32. Check that DVM reads 0 +/- 0.005 VDC.

33. If necessary, adjust P3 (low temperature reference voltage) for 0 +/- 0.005 VDC.

34. Set decade box to 1163 ohms (temperature simulator position N3).

35. Set SERVO TEMPERATURE SELECTOR to 100 degrees F.

36. Verify that DVM reads 0.000 +/- 0.005 VDC.

37. If necessary, adjust P4 (high temperature reference voltage) for 0.000 +/- 0.005 VDC.

38. Repeat Steps 29 through 37 once, adjusting only if necessary.

39. Set decade box to 1200 ohms (98.6 degrees F, temperature simulator position N2).

40. Set the SERVO TEMPERATURE SELECTOR to 98.6 degrees F/37 degrees C.

41. DVM should read 0 +/- 0.1 VDC. If not, recheck Steps 29 and 37.

42. Set decade box to 1217 ohms (temperature simulator position N6).

43. Slowly turn SERVO TEMPERATURE SELECTOR to 100 degrees F. The AUDIO ALARM should sound and the red HIGH-LOW TEMP ALARM indicator should light between 99.5 degrees F and 100 degrees F.

44. If necessary, very slowly adjust P6 (LOW ALARM ADJUST) so that alarm activates between 99.5 degrees F and 100 degrees F (turn P6 clockwise (CW) to activate and counterclockwise (CCW) to deactivate).

45. Depress the ALARM SILENCE pushbutton and check that the AUDIO ALARM silences and the red HIGH-LOW TEMP ALARM indicator goes out, and the blue ALARM SILENCED indicator lights.

46. Slowly turn SERVO TEMPERATURE SELECTOR to 96 degrees F. The AUDIO ALARM should sound and the red HIGH-LOW TEMP ALARM indicator should light between 96.5 degrees F and 96 degrees F.

47. If necessary, very slowly adjust P5 (HIGH ALARM ADJUST) so that alarm activates between 96.5 degrees F and 96 degrees F (turn P5 counterclockwise (CCW) to activate and clockwise (CW) to deactivate).

48. Depress ALARM SILENCE pushbutton and check that the AUDIO ALARM silences the red HIGH-LOW TEMP ALARM indicator goes out, and the blue ALARM SILENCED indicator lights.

49. Set the SERVO TEMPERATURE SELECTOR to 99 degrees F.

50. Check to see that the wattmeter reads 825 +75/-10 watts at 120 VAC, 100 VAC, 210 VAC, or 230 VAC. If necessary, perform the following steps:

    NOTE: If normal line voltage in unit's area of use is low, and a measured line voltage rather than standard specified voltage is set on the autotransformer, the wattage readings in this step must be adjusted accordingly. Calculate the new wattage by first determining the percentage of difference between the standard voltage and the measured voltage. Double this percentage and decrease the wattage by this doubled percentage.

    a. Connect the DVM to Test Jack J2.

b. Set the SERVO TEMPERATURE SELECTOR for +0.200 +/-0.005 VDC at J2.

c. Connect the DVM to Test Jack J3.

d. Set P7 for -0.400 +/- 0.005 VDC at J3.

e. Disconnect DVM.

f. Set decade box for 1200 ohms (temperature simulator position N2).

g. Set SERVO TEMPERATURE SELECTOR to 98.0 degrees F.

h. Adjust P8 (POWER OFFSET ADJUST) for 200 +/-25 watts at 120 VAC (100 VAC, 210 VAC, or 230 VAC).

i. Set decade box to 1217 ohms (temperature simulator position N6.

51. Set SERVO TEMPERATURE SELECTOR to 98 degrees F.

52. Check to see that the wattmeter reads 200 +/- 50 watts.

    NOTE: See note in Step 50. Same note applies here.

53. If necessary, adjust P8 (POWER OFFSET ADJUST) for 200 +/- 50 watts.

54. Set the SERVO TEMPERATURE SELECTOR to 97.5 degrees F.

55. Check to see that the wattmeter reads 0 +25/-0 watts.

56. Remove the plug from the PROBE ATTACH jack, (temperature simulator position N7. DO NOT REMOVE PLUG with temperature simulator)

57. Check to ensure that the PROBE OPEN indicator and HIGH-LOW TEMP ALARM indicator activate, the AUDIO ALARM sounds, the HEATING indicator goes out, and the wattmeter reads 0 +25/-0 watts.

58. If necessary, turn P10 (PROBE OPEN ADJUST) clockwise (CW) to deactivate PROBE OPEN indicator. Press ALARM SILENCE pushbutton. Slowly adjust P10 counterclockwise (CCW) until the AUDIO ALARM activates, then turn P10 an additional 1/4 turn (90 degrees) counterclockwise (CCW). Verify conditions stated in Step 57.

59. Depress ALARM SILENCE pushbutton and check that nothing changes (all alarms remain active).

60. Depress TIMER RESET and check that nothing changes.

61. Vary the audio alarm PITCH and RATE controls over their range. Ensure that the audio alarm remains audible dur-

ing this adjustment. Return PITCH and RATE controls to original setting.

62. Reinsert plug from decade box into PROBE ATTACH jack, (temperature simulator position N6).

63. Verify that the AUDIO ALARM, PROBE OPEN AND HIGH-LOW TEMP ALARM indicators deactivate.

64. Set SERVO TEMPERATURE SELECTOR to 98 degrees F. Set decade box to 1217 ohms (temperature simulator position N6).

NOTE: Steps 65 (65a) and 66 (66a) check (or adjust) the 15 minute timer. For circuit boards without relays (No P11) go to Step 65. For circuit boards with relays (P11 on board) go to Step 65a.

65. Connect the DVM between Test Jack J4 and ground (negative lead of capacitor C4). The DVM should indicate somewhat less than +5 VDC. Turn the SERVO TEMPERATURE SELECTOR clockwise (CW) towards 99 degrees F slowly and watch for a sudden voltage drop of -1.5 VDC. This should occur when wattmeter indicates between maximum wattage and 75 watts less than maximum.

After voltage drops, turn SERVO TEMPERATURE SELECTOR an additional 0.25 degrees F. clockwise (CW). Depress the TIMER RESET pushbutton and hold for 3 seconds, then release the pushbutton and immediately start the monitor timer.

If the voltage does not drop between maximum wattage and 75 watts less than maximum, set SERVO TEMPERATURE SELECTOR for 50 watts less than maximum and adjust P12 clockwise until the desired voltage drop is indicated on the DVM.

66. The AUDIO ALARM should sound and the red PRESS TIMER RESET AND CHECK INFANT AND CONDITIONS indicator should light at end of 14.5 +/- 1.5 minutes. If alarm is not activated at end of time period, check that the DVM reads between 0 and -1.5 VDC. If not, repeat Step 65.

65a. Turn the SERVO TEMPERATURE SELECTOR clockwise toward 99 degrees F slowly and listen for relay K1 to energize (audible click). The relay should energize when the wattmeter indicates between maximum wattage and 75 watts less than maximum.

After relay K1 energizes, turn SERVO TEMPERATURE SELECTOR an additional 0.25 degrees F clockwise (CW). Depress the TIMER RESET pushbutton and hold for 3 seconds, then release pushbutton an immediately start the monitor timer.

66a. At the end of 14.5 +/- 1.5 minutes the AUDIO ALARM should sound and the red PRESS TIMER RESET AND CHECK INFANT AND CONDITIONS indicator should light. If not, adjust P11 (TIME ADJUST) clockwise (CW) to increase TIMER period or counterclockwise and decrease timer period. Press TIMER RESET for 3 seconds and repeat 15 MINUTE TEST.

If the relay does not energize between maximum wattage and 75 watts less than maximum, set SERVO TEMPERATURE SELECTOR for 50 watts less than maximum and adjust P12 clockwise until the relay energizes.

67. Flip MODE SELECTOR switch to NON-SERVO. Turn NON-SERVO HEAT SELECTOR fully counterclockwise (CCW) of OFF position (reposition knob if necessary).

68. Turn HEAT SELECTOR to position 1. If necessary, adjust P9 (NON- SERVO ADJUST) until wattmeter indicates from 25 to 50 watts.

69. Turn NON-SERVO HEAT SELECTOR stepwise to the HIGH position, note the wattmeter reading for each position. Check to see that the wattmeter reading increases in each position and that it reads 825 +75/-10 watts at 120 VAC (100 VAC, 210 VAC, or 230 VAC.).
NOTE: See note preceding Step 50. Same note applies here.

70. If necessary, slightly adjust P9 for 825 +75/-10 watts at 120 VAC (100 VAC, 210 VAC, or 230 VAC).

71. Turn NON-SERVO HEAT SELECTOR to OFF position.

72. Wattmeter should read less than 25 watts. If necessary, repeat Steps 68 through 72.

73. Turn the NON-SERVO HEAT SELECTOR to the HIGH position, depress the TIMER RESET pushbutton and hold for 3 seconds, then release it and start the 15 minute timer.

74. At the end of 14.5 +/- 1.5 minutes the AUDIO ALARM should sound and the red PRESS TIMER RESET AND CHECK INFANT AND CONDITIONS indicator should light up.

75. Depress TIMER RESET pushbutton and hold for 3 seconds. The AUDIO ALARM should deactivate. The PRESS TIMER RESET AND CHECK INFANT AND CONDITIONS indicator should go out.

76. Flip the MODE SELECTOR to OFF.

77. Depress and hold for the three seconds the INSIDE PAIR fluorescent light switch. Check that the two inside lamps light.
NOTE: On early production MOTHERBOARD type NICC units the fluorescent lamps will not operate with the MODE

SELECTOR switch in the OFF position. Return MODE SELECTOR switch to MANUAL position and repeat Step 77.

78. Depress and hold for three seconds the OUTSIDE PAIR fluorescent light switch. Check that the two outside lamps light.

79. Repeat Steps 77 through 79 once.

80. Connect accessory phototherapy light (if so equipped) to proper power source.

81. In sequence, depress each of the three light switches momentarily (1 to 3 seconds) and release. Check that all of the lamps are lit.

82. Depress each switch again and check that all of the lamps go out.

83. Replace control unit back panel.

4/MAINTENANCE

4.1 GENERAL

CAUTION: Do not use a unit which is not functioning properly. It recommended that repairs be made by an authorized Service Representative of Ohmeda. Contact the nearest Ohmeda Zone or Regional Service Office for assistance.

When the unit is returned for repair, pack it carefully in the original shipping container, if possible, and ship it prepaid. Send a letter with the unit providing details of difficulties experienced and the repairs felt necessary. Replacement parts will be charged at the current list plus a reasonable labor charge unless the warranty is in effect.

4.2 CARE AND CLEANING

WARNING: Unplug test cable before cleaning and inspection.

CAUTION: Do not autoclave or gas sterilize the Ohmeda Temperature Simulator or its parts. Permanent damage to the device will result.

Clean the cabinet surfaces of the Ohmeda Temperature Simulator regularly with a solution of mild detergent and warm water; rinse and wipe dry with a soft cloth, never place sharp objects on the cabinet surface since these may scratch the finish.

5/SERVICE SECTION

5.1 REPAIR POLICY AND PROCEDURE

Do not use malfunctioning equipment. Make all necessary repairs, or have the equipment serviced by an Authorized Ohmeda Service Representative. After repair, test the equipment to ensure that it is functioning properly, in accordance with the manufacturer's published specifications.

To ensure full reliability, have all repairs and service done by an Authorized Ohmeda Service Representative. If this cannot be done, replacement and maintenance of those parts listed in this manual may be undertaken by a competent, trained individual having experience in the repair of calibration equipment.

CAUTION: Only competent individuals trained in the repair of this equipment should attempt to service this equipment.

Replace damaged parts with components manufactured or sold by Ohmeda. Then test the unit to ascertain that it complies with the manufacturer's published specifications.

Contact the nearest Ohmeda Service Center for service assistance. If you send the unit to an Ohmeda Service Center, package it securely in the original shipping container, if possible, and ship it prepaid. Enclose a letter with the unit describing in detail any difficulties experienced and the repairs felt necessary. In all cases, other than where Ohmeda's warranty is applicable, repairs will be made at Ohmeda's current list price plus a reasonable labor charge.

CAUTION: Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda.

5.2 DISSASSEMBLY (FIGURE 5)

1. Remove the two Phillips head cover screws from the bottom of the temperature simulator.

2. Carefully remove the top cover of the temperature simulator.

3. All front and rear panel connectors are accessible for replacement at this point. The J-15 connector unplugs from the circuit board and can also be replaced. It is recommended that only the entire circuit board be

replaced and not individual components if problems arise.

5.3 REASSEMBLY

1. Replace the top cover of the temperature simulator.

2. Replace the two Phillips head screws.

3. Perform the checkout procedure outlined in Section 5.4 CHECKOUT PROCEDURE.

5.4 CHECKOUT PROCEDURE

This checkout procedure is for the Ohmeda Temperature Simulator (0217-2788-800) and the Test Cable (0690-1230-317). Use this procedure to verify proper operation of the simulator and the test cable.

1. Perform the resistance checks as outlined in Table 2. Take the resistance measurements at the rear of the simulator or at the end of the test cable when it is attached to the simulator.

2. Measure the resistance from the tip and the sleeve of the INCUBATOR phone jack to J15-3 and J15-7. The resistance measured must be less than 0.15 ohms.

3. Apply 120 VAC between J3-1 and J3-4 or P2-1 and P2-4 and verify that the neon lamp is on.

4. Measure the resistance of the test cable terminals listed in Figure 3. The resistance measured must be less than 0.15 ohms.

    a. P15-3 to P5-1

    b. P15-7 to P5-2

    c. P15-11 to P5-5

    d. P15-14 to P5-7

    e. P15-2 to P5-9

    f. P15-6 to P5-10

    g. P15-10 to P2-2

    h. P15-13 to P2-3*

i. P15-4 to P2-1

j. P15-8 to P2-4

k. Tip of red wire to P-3

NOTE: Verify that the shield covering these conductors is tied to P2-3 at the P2 end of the cable. The shield must not be connected to P15.

TABLE 2

Acceptable Simulator Resistance Values

S-2 SWITCH	SW S1	SW R1	MIN. OHMS	MAX. OHMS	CONNECTION POINTS	CONNECTION POINTS
I1-8, 10-12	-	-	7678	7694	J15-2 & J15-6	P5-9 & P5-10
I9, 13	-	-	5894	5907	J15-2 & J15-6	P5-9 & P5-10
I1	-	-	7678	7694	J15-3 & J15-7	P5-2 & P4-1
I2	-	-	5490	5501	J15-3 & J15-7	P5-2 & P5-1
I3	-	-	7053	7067	J15-3 & J15-7	P5-2 & P5-1
I4	-	-	34200	37800	J15-3 & J15-7	P5-2 & P5-1
I5	-	-	5910	6030	J15-3 & J15-7	P5-2 & P4-1
I6	-	-	2970	3030	J15-3 & J15-7	P5-2 & P5-1
I7-10, 12, 13	-	-	5894	5907	J15-3 & J15-7	P5-2 & P5-1
I11	-	-	6128	6252	J15-3 & J15-7	P5-2 & P5-1
N1	-	-	1466	1469	NICC JACK	NICC JACK
N2	-	-	1198	1201	NICC JACK	NICC JACK
N3	-	-	1161	1164	NICC JACK	NICC JACK
N4	-	-	1332	1335	NICC JACK	NICC JACK
N5	-	-	1302	1305	NICC JACK	NICC JACK
N6	-	-	1215	1218	NICC JACK	NICC JACK
N7	-	-	2998	3001	NICC JACK	NICC JACK
I1	-	-	7678	7694	J15-11 & J15-14	P5-7 & P5-5
I2-6, 8, 10	-	-	5490	5501	J15-11 & J15-14	P5-7 & P5-5
I7, 13	-	-	4116	4124	J15-11 & J15-14	P5-7 & P5-5
I9	-	-	4985	4995	J15-11 & J15-14	P5-7 & P5-5
I12	-	-	3880	3959	J15-11 & J15-14	P5-7 & P5-5
I1	DVM	-	40159	40240	J8 & J9	N/A
I1	DVM	CCW	87660	92740	J7 & J8	N/A
I1	DVM	CW	40159	40240	J7 & J8	N/A
I1	INC	CCW	87660	92740	J15-10 & J15-13	P2-3 & P2-2
I1	INC	CW	40159	40240	J15-10 & J15-13	P2-3 & P2-2
I2-13			77900	86100	J15-10 & J15-13	P2-2 & P2-2

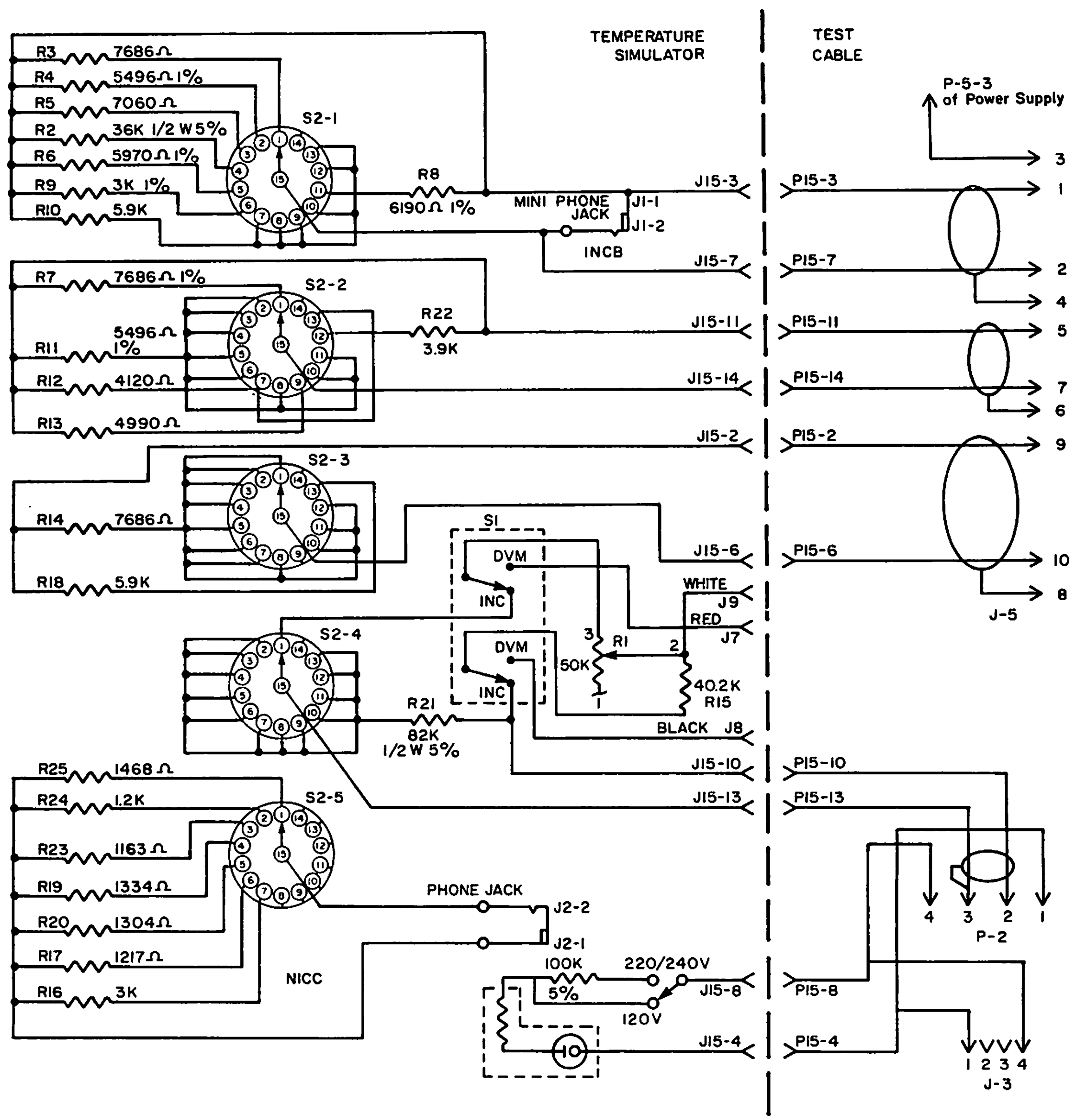


Figure 4.
Temperature Simulator with Cable Schematic

5.5 SCHEMATIC AND ILLUSTRATED PARTS (FIGURES 4, 5, AND 6)

ITEM	STOCK NUMBER
1. Case, Pac-Tec W/2-Screws and Pad Feet	0217-2787-300
2. Switch Assembly, Voltage Selector	0608-6135-700
3. Wire, Gray 22 AWG Stranded	0999-8209-010
4. Wire, Black 22 AWG Stranded	0999-8201-010
5. Wire, Red 22 AWG Stranded	0999-8203-010
6. Screw, 4-40 x 1/4" PH HD ST ST (4)	0140-6517-104
7. Wire Harness	0608-6136-700
8. Front Panel, Aluminum	0214-2265-500
9. Lamp, Neon	0690-2100-313
10. Label, Front	0205-4789-300
11. Knob, Black Small	0212-1952-300
12. Knob, Black Large	0212-1953-300
13. Jack, White Pin	0690-1950-339
14. Jack, Black Pin	0690-1950-341
15. Jack, Red Pin	0690-1950-340
16. Jack, Miniature Phone	0690-1950-330
17. Jack, Standard Phone	0690-1950-332
18. Label, Back	0205-4788-300
19. Back Panel, Aluminum	0214-2266-500
20. Screw, 4-40 x 3/8" Tamper Resistant (4)	0400-3137-300
21. Wire Harness W/Connectors	0608-6130-700
22. Nut, 4-40 Hex (4)	0144-3117-113
23. P.C. Board Assembly	0631-5002-700

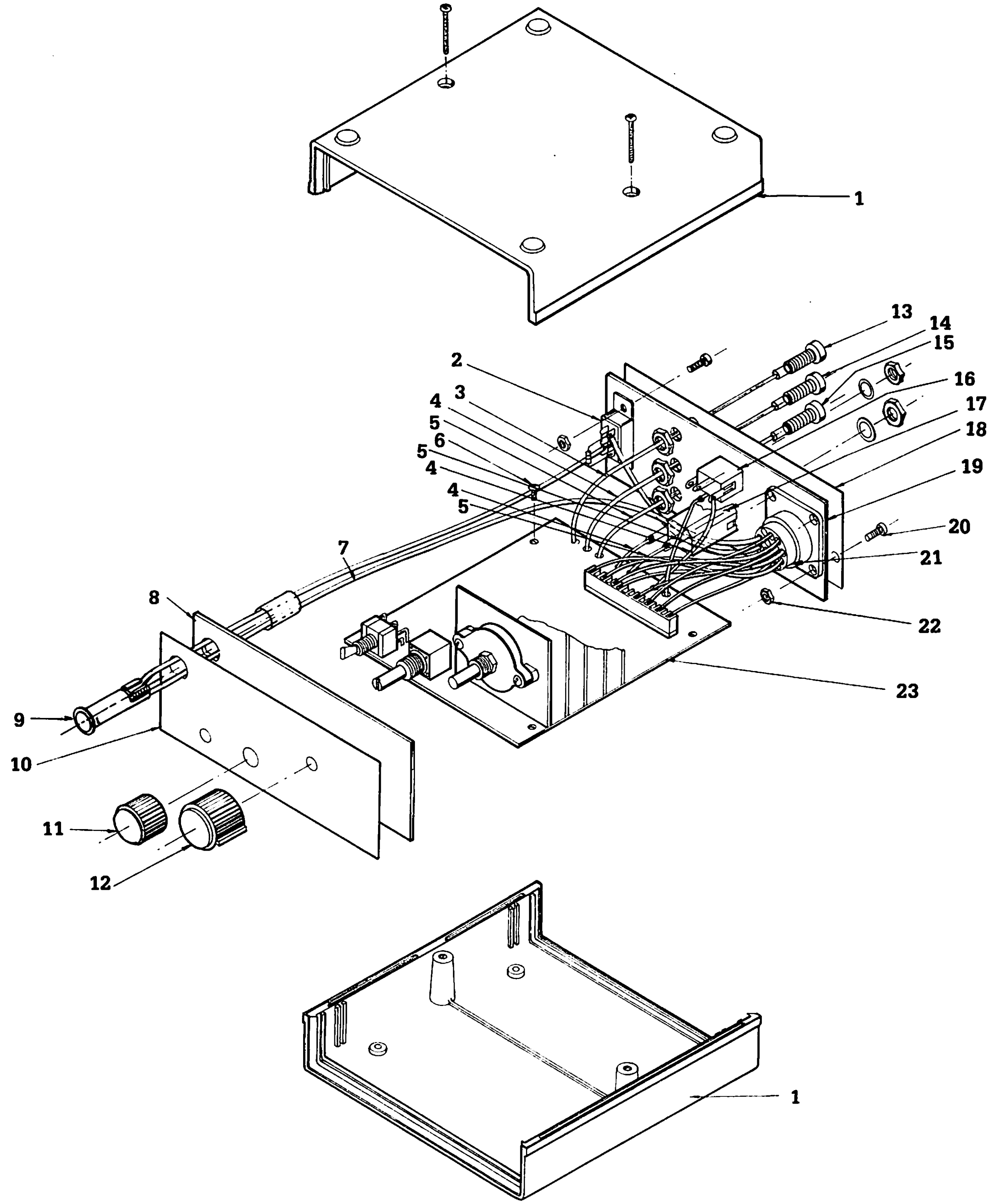


Figure 5.
Exploded View
Temperature Simulator

FIGURE 6

SYMBOL	DESCRIPTION	STOCK NUMBER
S2	Switch, 5 Pole 18 Position	0690-2500-355
S1	Switch, Right Angle DP DT	0690-2500-353
J15	Header, 15-Pin	0690-1563-317
R1	Resistor, Variable 50k10 Turn	0681-0976-015
R25	Resistor, 1468 ohm .1% 1/4 Watt	0680-0250-340
R12	Resistor, 4120 ohm .1% 1/4 Watt	0680-0250-341
R24	Resistor, 1200 ohm .1% 1/4 Watt	0680-0250-336
R15	Resistor, 40200 ohm .1% 1/4 Watt	0680-0250-347
R21	Resistor, 82000 ohm 5% 1/2 Watt	0680-0605-350
R23	Resistor, 1163 ohm .1% 1/4 Watt	0680-0250-335
R19	Resistor, 1334 ohm .1% 1/4 Watt	0680-0250-339
R17	Resistor, 1217 ohm .1% 1/4 Watt	0680-0250-337
R3, R14, R7	Resistor, 7686 ohm .1% 1/4 Watt(3)	0680-0250-346
R13	Resistor, 4990 ohm .1% 1/4 Watt	0680-0250-342
R6	Resistor, 5970 ohm 1% 1/4 Watt	0680-0250-352
R5	Resistor, 7060 ohm .1% 1/4 Watt	0680-0250-345
R20	Resistor, 1304 ohm .1% 1/4 Watt	0680-0250-338
R4, R11	Resistor, 5496 ohm .1% 1/4 Watt(2)	0680-0250-343
R9, R16	Resistor, 3000 ohm .1% 1/4 Watt(2)	0680-0250-350
R2	Resistor, 36000 ohm 5% 1/2 Watt	0680-0510-300
R8	Resistor, 6190 ohm 1% 1/4 Watt	0680-0250-353
R10, R18	Resistor, 5900 ohm .1% 1/4 Watt(2)	0680-0250-344
R22	Resistor, 3920 ohm 1% 1/4 Watt	0680-2100-309

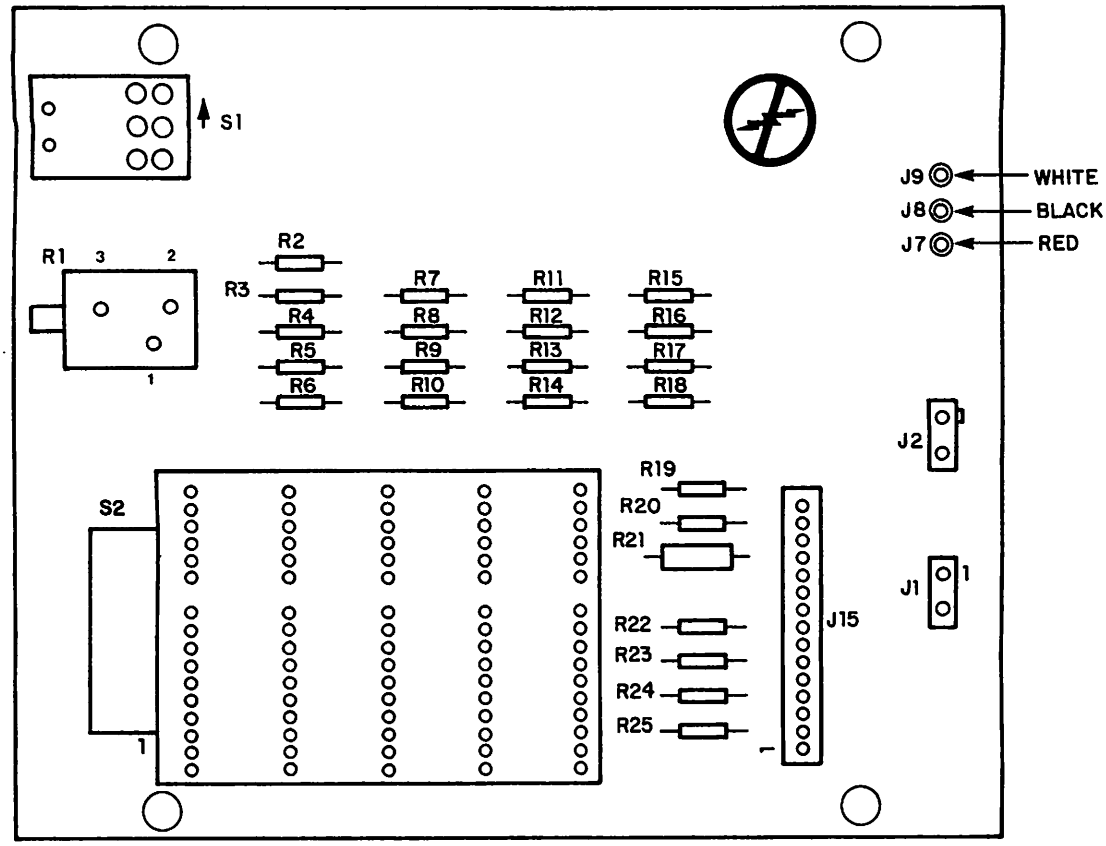


Figure 6.
Component Location for 0631-5002-700

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Addendum to the 37.5C, 39C, and 41C Intensive Care and General Care Incubators 10/87

Addendum Stock Number 6600-0032-000

Service Manual Stock Number 0178-0110-000
Dated 04 86

This addendum describes the required changes to the service manual for software revision 09.1 and also includes additional information. Each section heading details the changes required to that section.

Section 1/ Functional Description

Add Section F., Alarm Operation, 4 pages.

Section 2/ Specifications

No changes required

Section 3/ Check-Out Procedure

Replace Section 3, Check-Out Procedure, with the attached section.

Section 4/ Static Control

No changes required

Section 5/ Temperature Simulator Set-up

No changes required

Section 6/ Calibration and Adjustments

Replace Section 6, Calibration and Adjustments, with the attached section.

Section 7/ Incubator Hood Repairs

No changes required

Section 8/ Lower Unit Disassembly

No changes required

Section 9/ Lower Unit Repairs

Add Triac Replacement and Base Slab Replacement Sections if required. The 4/86 version has these sections.

Section 10/ Phototherapy Lamp

No changes required

Section 11/ Troubleshooting

Add Section 11.1 J., System Failure Error Codes, 1 page.

Section 12/ Illustrated Parts

No changes required

Section 13/ Schematics

No changes required

Appendix

Add Section F., Part Numbers for Blue Incubators.

1/ FUNCTIONAL DESCRIPTION

F. Alarm Operation

The Intensive Care Incubator has three discrete alarm levels as indicated in Table A-1.

Table A-1 IC Incubator Alarms (37.5C, 39C, 41C Models)

Alarm Type	Indicator	Alarm Silence	Heater Shutdown	Error Code	Mode
Patient Temp- erature	PATIENT TEMP/SENSOR	15 minutes	No	None	Servo
Over Temp- erature or Probe Fail- ure	SYSTEM FAIL OVERTEMP	15 minutes	Yes	None *	All (over temp) Servo (probe)
System Failure	SYSTEM FAIL OVERTEMP	Nonsilenceable	Yes	E01-E06	All
Power failure	Control panel LEDs OFF	Nonsilenceable	Yes	None	All

* HH.H is displayed instead of the patient temperature in the event of a probe failure.

Table A-2 GC Incubator Alarms

Alarm Type	Indicator	Alarm Silence	Heater Shutdown	Error Code
Over Temp- erature	SYSTEM FAIL OVERTEMP	15 minutes	Yes	None
System Failure	SYSTEM FAIL OVERTEMP	Nonsilenceable	Yes	E01-E06
Power Failure	Control panel LEDs OFF	Nonsilenceable	Yes	None

* HH.H is displayed instead of the patient temperature in the event of a probe failure.

Patient Temperature Alarm

This alarm is triggered when the patient temperature differs from the control temperature by more than one degree centigrade and represents a temperature difference requiring your attention.

To double check the control temperature press the CONTROL TEMP touch switch. Alarms in this category may be due to a manual change to the control temperature, thermal radiation from an external source, or heat loss from prolonged operation with the rear hood open. Pressing the ALARM SILENCE touch switch silences the alarm for 15 minutes to allow you to correct the alarm condition.

Overtemperature or Probe Failure Alarms

These alarms are triggered for when:

1. The environmental temperature is above 39.0C (102.2F) for 37.5C incubators.

   For those incubators with 39C or 41C control temperatures, the inlet wall alarm point is 45C plus the difference between the selected control temperature and 37.5C. For example, if the control temperature is 38.5C, the inlet wall alarm point is 45.0C plus 1.0C (38.5C - 37.5C).

   A hysteresis of 0.2C has been added to prevent unnecessary recycling of this alarm.

2. The inlet wall temperature is above 45.0C (113.0F) for 37.5C incubators.

   For those incubators with 39C or 41C control temperatures, the inlet wall alarm point is 45C plus the difference between the selected control temperature and 37.5C. For example, if the control temperature is 38.5C, the inlet wall alarm point is 45.0C plus 1.0C (38.5C - 37.5C).

   A hysteresis of 0.2C has been added to prevent unnecessary recycling of this alarm.

3. The infant compartment air temperature exceeds 39.5 +/- 0.5C for 37.5C units, 41.0 +/- 0.5C for 39.0C units or 42.5 +/- 0.5C for 41.0C units.

4. The patient probe is disconnected or malfunctioning in Servo Mode. (Patient temperature is displayed as HH.H)

Alarms in this category not due to the patient probe may be caused by temperature overshoot during warm up, a manual change in the control temperature, thermal radiation from an external source, or restarting a warm incubator that has been turned off for several minutes.

The temperatures of the individual wall sensors can be checked to help isolate the problem. To check the rear wall sensor, press the ENVIRONMENTAL TOUCH TEMP switch and hold down the UP ARROW. To display the front sensor temperature, hold down the DOWN ARROW.

NOTE: A faulty A to D converter will now trigger error code E05., Faulty wall sensors will trigger error codes E03 (rear) or E04 (front).

System Failure Alarms

These alarms can not be silenced. The error codes in the temperature display indicate the type of failure and identify the components involved:

E01	A to D Converter failure	Defective U1 or U10 on control board
E02	Program execution error. Loop counter missing major subroutines	Defective U5, U7, U6 on control board
E03	Rear wall sensor open or shorted	Replace sensor or wiring
E04	Front wall sensor open or shorted	Replace sensor or wiring
E05	Calibration drift exceeds 0.5C	Defective U1, U10, U2, U3 on control board
E06	Self test failure	Defective U5, U7, U6 on control board

Power Failure Alarm

A separate battery operated power failure alarm sounds an audible alarm when the external power source fails or is accidentally disconnected. This alarm cannot be silenced. The alarm battery also provides power to store the previous control temperature and mode of operation for approximately ten minutes.

NOTE: The battery does not power the control panel indicators, hence during a power failure alarm the control panel indicators will be off.

3/ CHECK-OUT PROCEDURE

WARNING: Do not perform the Check-Out Procedure while a patient occupies the incubator.

WARNING: Operate the incubator at an ambient temperature between 20-29C (68-85F). If the incubator is operated below 60F the SYSTEM FAIL-OVERTEMP alarm activates and prevents normal operation.

A. MECHANICAL CHECKS

WARNING: Disconnect the power to the incubator for the mechanical portion of the Checkout Procedure.

1. Incubator Hood

   a. Check the condition of the hood. The hood should be free of cracks or other signs of deterioration.

   b. Check the rotation of the hood for smooth operation.

   c. Check that both hoods remain stationary in any open position. Open the front hood section to the detent position. Open the rear hood section an equal amount.

   d. Check that the hood wipers are correctly installed on the hood retainers and in good operating condition (i.e. not cracked or worn).

   NOTE: The rear upper hood retainer has a felt wiper.

   e. Check the condition of the hood bumpers on the lower base, on the rear upper retainer, and on the side of the incubator hood. The bumpers should be free of cracks or other signs of deterioration.

   f. Close the incubator hood. Check the wall temperature sensors, located in the white housings at the center of each hood section (front and rear), for proper contact with the metal hood retainers. The sensors should be slightly depressed when the hood is closed.

   g. If a hood thermometer is present, check that it does not have cracked glass or a separation in the

mercury column. Replace the thermometer if it is cracked or has a separation in the mercury column.

Note: The use of mercury thermometers is not recommended.

WARNING: Use only the Teflon sheathed Ohio thermometer.

h. Check the condition of the tube support clamps if present.

2. Tilt Mechanism

a. Check the tilt mechanism for smooth operation.

b. Check the five locking positions; horizontal, 5 and 10 degrees left and right of horizontal.

c. Return the bed to the horizontal position.

3. Bed Platform

a. Remove the mattress and check its condition.

b. Release the four latches which hold the bed in position and remove the bed. Check the operation of the four latches. They should slide into holes in the side of the incubator to lock the bed in place.

c. Check the condition of the rear wall shield and the legibility of the refresher instructions on the shield.

d. Check the condition of the conductive rubber foot on the underside of the bed platform.

4. Lower Unit

a. Lift up on and remove the air filter and the humidifier reservoir cover. These items are located directly under the bed platform with the filter resting on the humidifier cover.

b. Close the incubator hood.

c. Open the cover of the humidifier fill port and drain any water in the humidifier reservoir into a container by turning the humidifier fill mechanism down. Tilt the incubator if necessary.

d. Verify that the cover of the humidifier fill port is open and pull the fill port out of the lower unit.

NOTE: The white plastic cover on the fill port must be open for installation and removal.

e. Check the condition of the O-ring and rubber seals on the fill port mechanism.

f. Open the incubator hood.

g. Remove the humidifier reservoir and check it for structural damage.

h. Remove the blower wheel by holding the blower wheel still and turning the blower wheel nut (inside the wheel) counterclockwise.

i. Inspect the blower wheel for structural damage.

j. Replace the blower wheel and tighten the blower wheel nut securely on the motor shaft. Make sure the blower wheel turns freely.

k. Replace the humidifier reservoir and cover. The plastic rod protruding from the reservoir must fit into the hole in the reservoir cover.

l. Close the incubator hood.

m. Open the cover on the humidifier fill port and push it back into the lower assembly.

NOTE: The white plastic cover on the fill port must be open for installation and removal.

n. Check the operation of the humidity control by rotating the control knob between the minimum (MIN) and maximum (MAX) humidifier settings. The reservoir cover should move across the top of the reservoir.

NOTE: For proper operation, the end of the metal rod protruding from the back of the reservoir must engage the spiral groove on the control knob mechanism.

o. Open the incubator hood.

p. Inspect the air filter for dust and lint; replace if necessary. The air filter must be changed at least every two months; longer use may result in a restriction of the air flow. Replace the air filter if necessary and record the installation date on the filter.

q. Install the air filter with the foam pad down.

r. Check that all warning labels are in place and legible.

s. Replace the bed and close the four latches.

t. Replace the mattress.

u. Close the incubator hood.

5. Shelf and Upright

a. Check that the upright is securely fastened to both sides of the incubator.

b. Check that the shelf is properly mounted on the upright.

c. Check that the locking thumb nuts hold the shelf securely to the upright.

6. Cabinet

a. Check the operation of the drawers if present.

b. Check for free operation of the casters.

c. Lock the two front casters and check if the incubator is held in place.

7. Blower Wheel Operation

a. Connect the power cord for this step only.

b. Switch the power ON and check the blower wheel operation in the five tilted positions; horizontal, 5 and 10 degrees left and right of horizontal. Warm air should exit from the rear vents and there should be no noises indicating that the blower wheel is rubbing against the housing. If the blower wheel is rubbing refer to the blower motor replacement procedure of Section 9.

NOTE: If the bed is not properly latched in position, no power will be supplied to the blower.

c. Switch the power OFF.

8. Power Cord

Inspect the power cord for cracks, cuts or other damage. A damaged power cord must be replaced.

9. Overall Inspection

Make an overall visual inspection of the incubator and accessories for damaged or missing parts.

Refer to Section 6 for operational and safety checks.

B. CONTROL UNIT CHECKS

1. Connect the incubator power cord to an appropriate power source (See rating plate for proper voltage etc.). Switch the power ON and verify the following:

   a. The audible alarm sounds for approximately half a second.

   b. The software revision appears in the temperature display.

   c. The maximum control temperature setting, 37.5, 39.0, 41.0, appears in the temperature display.

   d. A short beep sounds and the AC line frequency, 60.H, (50.H on 50 Hz models) appears in the temperature display.

   e. The MANUAL MODE and CONTROL TEMP indicators are illuminated and 33.0C appears in the temperature display.

2. Hold down the ALARM SILENCE touch switch and verify that all the indicator lamps are lit with the exception of the SERVO MODE indicator. The display should indicate three number eights (88.8).

   NOTE: The Servo mode indicator does not appear on the GC model.

3. Connect the patient temperature probe to the incubator.

4. Press the SERVO MODE touch switch and verify the following: (Omit for the GC)

   a. The yellow SERVO MODE indicator is lit.

   b. The CONTROL TEMP is at 36.5C.

   c. If the temperature of the patient probe is within 1C of the 36.5C control temperature a short beep will be heard. Otherwise a PATIENT TEMP/SENSOR alarm sounds.

d. If the alarm sounds, press the PATIENT TEMP touch switch to display the patient temperature. Verify that it differs from the 36.5C control temperature by more than one degree and press the ALARM SILENCE touch switch to silence the alarm.

NOTE: Silencing this alarm will not interfere with the Checkout Procedure. Subsequent alarm conditions will override the alarm silence.

5. Remove the patient temperature probe from the connector and verify that the SYSTEM FAIL - OVERTEMP alarm sounds and the red indicator lamp is lit. (Omit for GC)

6. Press the ALARM SILENCE touch switch and verify that the alarm is silenced and the indicator lamp remains on. (Omit for GC)

7. Connect the patient temperature probe and verify that the SYSTEM FAIL - OVERTEMP indicator lamp is extinguished. (Omit for GC)

8. Press the ENVIRONMENTAL TEMP touch switch and verify that the ENVIRONMENTAL TEMP indicator illuminates and the temperature displayed is between 20.0C and 40.0C.

9. Press the PATIENT TEMP touch switch and verify that the PATIENT TEMP indicator lamp is lit and the temperature displayed is between 20.0C and 40.0C.

10. Hold the patient temperature probe between your fingers and verify that the displayed temperature changes.

11. Press the MANUAL MODE touch switch and verify that a short beep sounds and the MANUAL MODE indicator lamp is lit. (Omit for GC)

12. Press the CONTROL TEMP touch switch and verify that the CONTROL TEMP indicator lamp is lit.

13. Press and hold the UP ARROW touch switch and verify that the maximum manual control temperature attainable is 37.5C, 39.0C or 41.0C. This temperature should agree with the maximum control temperature displayed after the software revision number when the unit is switched on.

NOTE: The arrow switches are enabled for approximately 30 seconds by pressing the CONTROL TEMP touch switch. Press the switch again if more time is required.

14. Press the CONTROL TEMP touch switch.

15. Press and hold the DOWN ARROW touch switch and verify that the minimum manual control temperature attainable is 28.0C.

16. Press the CONTROL TEMP touch switch and verify that the UP and DOWN ARROW touch switches deactivate approximately 30 seconds (36 seconds for 50 Hz models) after pressing the CONTROL TEMP touch switch.

17. Press the SERVO MODE touch switch. (Omit for GC)

    NOTE: The PATIENT TEMP/SENSOR indicator will illuminate and an alarm will sound if the patient probe temperature differs from the control temperature by more than 1C.

18. Press the CONTROL TEMP touch switch. (Omit for GC)

19. Press and hold the UP ARROW touch switch and verify that the maximum servo control temperature attainable is 37.5C, 39.0C, or 40.0C. This temperature should be identical to the Manual Mode Maximum control temperature. (Omit for GC)

20. Press and hold the DOWN ARROW touch switch and verify that the minimum servo control temperature attainable is 35.0C (Omit for GC)

C. FRONT AND REAR WALL SENSOR CHECKS

1. Rotate the incubator hood to the fully retracted position.

2. Press the ENVIRONMENTAL TEMP touch switch.

3. Press and hold the UP ARROW touch switch. The displayed temperature is the temperature of the rear wall sensor.

4. Place your index finger on the rear (inlet) wall sensor and verify a change in the displayed temperature.

5. Press and hold the DOWN ARROW touch switch. The displayed temperature is the temperature of the front wall sensor.

6. Place your index finger on the front (outlet) wall sensor and verify a change in the displayed temperature.

7. Close the incubator hood.

D. CALIBRATION RESISTOR CHECK

1. Press the PATIENT TEMP touch switch.

2. Press and hold the DOWN ARROW touch switch. The displayed temperature should be 37.3 +/- 0.5C. When the displayed temperature is not within this specification, a nonsilenceable SYSTEM FAIL - OVERTEMP alarm activates and the error code E05 appears in the temperature display.

E. POWER FAILURE ALARM AND MEMORY TEST

NOTE: The battery must be fully charged to pass the ten minute test or partially charged to pass the two minute test. If the battery is defective, replace it. (The maintenance schedule recommends battery replacement every two years.)

1. Place the incubator in the Servo Mode and adjust the control temperature to 35.5C. (Omit for GC)

   NOTE: The patient probe must be connected to the incubator. If the probe temperature is less than 35.5C the PATIENT TEMP/SENSOR indicator will light and an alarm will sound.

2. Place the incubator in the Manual Mode and adjust the control temperature to 30.5C. On the GC simply adjust the control temperature.

3. Place the incubator in the Servo Mode. (Omit for GC)

4. Disconnect the power cord (Do not switch the power OFF). Verify that the power failure alarm sounds and all display indicators are extinguished. Allow the alarm to sound for two minutes.

   NOTE: If the power failure alarm is tested for ten minutes, the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient.

5. Reconnect the power cord and verify that the IC incubator returns to a control temperature of 35.5C in the Servo Mode of operation.

   The GC should show a control temperature of 30.5C.

NOTE: If the temperature of the patient probe differs from the control temperature by more than 1C the PATIENT TEMP/SENSOR indicator will illuminate and an alarm will sound.

6. Place the incubator in the Manual Mode and verify that a control temperature of 30.5C is displayed. (Omit for GC)

F. ALARM TIMER CHECK (OMIT FOR GC)

1. Place the power switch in the ON position.

2. With the patient probe disconnected press the SERVO MODE touch switch.

3. Record the present time or start a stop watch.

4. Press the ALARM SILENCE touch switch.

5. Wait approximately 15 minutes and record the time that the alarm sounds. The alarm should sound in 15 minutes +/- 30 seconds.

G. OPERATIONAL CHECK

1. Place the incubator in an area where drafts and abrupt changes in room temperature are not common. The ambient room conditions of the room will affect the incubator performance. Room temperature should be between 20C (68F) and 29.5C (85F).

2. Inspect the power cord for cracks, cuts or other damage. A damaged cord should be replaced.

3. Connect the power plug to a proper power source.

4. Switch the incubator power ON.

5. Adjust the CONTROL TEMP to 34C. Set the humidity control knob to minimum with no water in the reservoir.

6. Allow approximately one hour for warm up (more or less time may be needed depending on the ambient room temperature).

7. The displayed ENVIRONMENTAL TEMP should be 34 +/- 1.0C.

H. PHOTOTHERAPY LAMP CHECK

1. Inspect the power cord for cracks, cuts or other damage. A damaged power cord should be replaced.

2. Check the overall appearance and the physical condition of the lamp head and the lamp control unit for any obvious damage.

3. Switch the power ON. Replace the lamps if required.

I. RADIANT WARMER CHECK

Refer to the Radiant Warmer Operation and Maintenance Manual.

6/Calibration and Adjustments

CAUTION: Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

NOTE: The Intensive Care and General Care Incubators are similar in design. Calibration of the Intensive Care and General Care Incubators is covered in this section. When the wording "IC Incubator Only" appears in a step title the entire step does not pertain to the GC Incubator. In addition some sections are written for only the IC or the GC Incubator.

Note: The three Intensive Care Incubators are referred to in this procedure as the 37.5 IC Incubator, the 39.0 IC Incubator, and the 41.0 IC Incubator.

The Control Temperature range for the 37.5 IC Incubator is from 28.0 to 37.5 degrees C.

The Control Temperature range for the 39.0 IC Incubator is from 28.0 to 39.0 degrees C.

The Control Temperature range for the 41.0 IC Incubator is from 28.0 to 41.0 degrees C.

Refer to the Specifications Section for more information.

Note: Allow up to 20 seconds for the alarm light to cancel for some procedures.

A. Static Control Integrity Check

Check the conductive bumpers (located on the front upper hood retainer) and neoprene wipers (located on hood retainers) for less than 100K ohms of resistance.

B. Isolation and Shielding Check

1. Patient Probe Isolation Check
Use an ohmmeter and check for infinite resistance between the metal disc and the mini-connector tip and sleeve of the patient probe. A very low resistance reading means the patient probe is not isolated and must be replaced.

2. EMI Shielding Check
Use an ohmmeter and measure the resistance between the metal retainer on the left front bed latch and the ground pin of the power cord. The resistance should be less than 100K ohms.

C. Power Supply Board Check (Board Layout-Section 12, Schematic Section 13)

WARNING: When performing service procedures with the power connected, extreme care must be taken to avoid direct or indirect contact with any of the electrical circuitry because of existing shock hazard.

1. Control Unit Access

a. Place the power switch in the OFF position.
b. Disconnect the power cord from the power source.
c. Remove the two screws which mount the control unit to the incubator.
d. Slide the control unit out. For easy removal make sure the power cord is not wrapped tightly on the cord holder.

Table 6-1

Test Points on Power Supply Bd.	D.C. Voltage
1. TP 7 (earlier version only)	+8.0V (Min +7 Max +12) (Unregulated voltages)
2. TP 8	5±0.2V
3. TP 4	-9±1V
4. TP 6	+9.6±0.05V
Adjust pot R18 on P.S. Bd. if necessary	
5. TP 5	5±0.2V
6. With the meter attached to TP 5, remove the power cord from the power source and check for 5±0.2V. (This checks the standby battery supply).	

2. Power Supply Voltage Check

a. Connect the negative lead of a DMM to TP-9 (ground) on the power supply board.
b. Connect the positive lead of a DMM to the test points listed in Table 6-1, one at a time.
c. Connect the power cord to the proper power source and turn the power switch ON. Allow the unit to warm up for five minutes before taking readings. Verify that the supply voltage is present at all test points. Switch OFF the power before making connections to the other test points (line voltage is still present at some points).
d. Disconnect the power cord and then disconnect the DMM from the power supply board.

D. Temperature Simulator Connection

(Figure 5-1)

WARNING: Disconnect power to the incubator before connecting or disconnecting the temperature simulator.

NOTE: Allow the incubator to warm up for five minutes before performing this procedure. Incubators with a control temperature range of 28 degrees C to 39 or 41 degrees C require different procedures which have been included and noted. Perform the alternate steps required when necessary. Determine the incubators control temperature range before starting this procedure.

1. Disconnect the incubator power cord from the electrical receptacle.

2. Connect the round 14-pin connector (P15) on the test cable to J-15 at the rear of the temperature simulator.

3. Remove the cable connector P-2 from J-2 on the power supply board of the incubator.

4. Connect the 4-conductor female Mate-N-Lok connector from the test cable into J-2 of the power supply board.

5. Reconnect the cable connector P-2 which was disconnected above, into the female Mate-N-Lok connector on the test cable.

6. Disconnect P-5 from J-5 on the control board and set aside.

7. Connect the 10-pin Make-N-Lok connector on the test cable to the J-5 connector on the control board of the incubator.

8. Connect the single red wire (audible alarm line) on the test cable to pin 3 of P-5.

9. Connect the power cord to an appropriate power source and turn the incubator power switch to the ON position.

E. Air Safety Circuit Check and Adjustment (Schematic Section 13)

1. DVM Accuracy Check

a. Place the air safety switch of the temperature simulator in the DVM/CAL position.

NOTE: If the incubator alarm activates press the alarm silence touch switch.

b. Connect the DVM to connectors J-8 and J-9 (CALS RES) on the back of the temperature simulator.
c. For the B & K Model 2815 meter (or equivalent) use the 100K range and the ohms function position. The resistance reading should be between 39.8K ohms and 40.6K ohms (nominal 40.2K ohms).

IMPORTANT: If your meter is out of calibration return it to the manufacturer for calibration. The air safety circuit check and calibration depends on the accuracy of the DVM.

2. Air Safety Check:

a. Connect the DVM to connectors J-7 and J-8 (AIR SAFETY) on the back of the temperature simulator.
b. Place the selector switch of the temperature simulator in the I1 position, the air safety switch in the INC position, and the alarm adjust control fully CCW.
c. Verify that the incubator is in the manual mode (IC Incubator only).
d. Set the CONTROL TEMP to 33.0 degrees C.
e. If no alarm is present proceed to the next step.

NOTE: If an alarm is present the alarm must be cancelled before the check procedure can be completed. First refer to the calibration procedure in step 4 to cancel the air safety alarm. If the alarm does not cancel refer to Section F, A/D Converter Check and Adjustment. After silencing the alarm return back to this section and continue with this procedure. If the alarm is still present after completing Section F. refer to the troubleshooting section.

3. Heater ON Check:

a. Set the incubator CONTROL TEMP to 37.5 degrees C.
b. Verify that the heater lamp indicates full heat. This may take approximately 20 seconds.
c. Verify that no alarm condition is present at this time.
d. SLOWLY rotate the ALARM ADJ control clockwise until the alarm just trips. Be careful not to overshoot the alarm trip point.
e. After the SYSTEM FAIL/OVERTEMP alarm activates, switch the air safety switch to the DVM position.
f. Verify the resistance measurements as follows:

1. The resistance measurement for the 37.5 IC Incubator should be between 50,700 ohms and 50,900 ohms. If not, go to the Calibration Procedure.

2. The resistance measurement for the 39.0 IC Incubator should be between 47,760 ohms and 47,960 ohms. If not, go to the Calibration Procedure.

3. The resistance measurement for the 41.0 IC Incubator should be between 43,740 ohms and 43,940 ohms. If not, go to the Calibration Procedure in step 5.

NOTE: If you repeat the test make sure the heater lamp indicates full heat. Replace the power supply board when the specified resistance readings are not attainable after calibration.

4. Reset with Heater ON - Operational Check

a. Place the air safety switch on the simulator in the incubator (INC) position.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm activates.
c. SLOWLY rotate the ALARM ADJ control counterclockwise until the alarm just resets. Listen for the relay to reset and watch for the alarm light to extinguish.
d. If steps 2, 3, and 4 are completed as stated no calibration is required. Proceed to the A/D Converter Check & Adjustment in step F.

6/Calibration and Adjustments

5. Calibration Procedure:

a. Place the air safety switch in the DVM position.
b. Set the incubator CONTROL TEMP to:
1. 37.5 degrees C for the 37.5 IC Incubator.
2. 39.0 degrees C for the 39.0 IC Incubator.
3. 41.0 degrees C for the 41.0 IC Incubator.

c. Rotate the ALARM ADJ control for a DVM resistance reading of:
1. 50,800 ohms for the 37.5 IC Incubator.
2. 47,860 ohms for the 39.0 IC Incubator.
3. 43,840 ohms for the 41.0 IC Incubator.

d. Place the air safety switch in the incubator (INC) position.

IMPORTANT: There are two versions of the power supply board which have been used in incubators. You must determine which of the two versions you have before adjusting R17. The newer board has two physical features that distinguish it from the older board. All test points (TP) are located along the top edge of the new board for easy access. Also both adjustment potentiometers (R17 and R18) are located together, next to the test points.

Older Version Power Supply Board
ALARM PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board clockwise (CW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R-17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

Newer Version Power Supply Board
ALARM PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board counterclockwise (CCW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

e. Perform steps 2, 3, and 4 of Section E. Air Safety Circuit Check and Adjustment.

F. A/D Converter Check and Adjustment (Control Board Layout Section 12)

1. A/D Converter Check

a. Place incubator in the manual mode (IC Incubator Only).
b. Place the selector switch in position I1, the air safety switch in the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).
c. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 31.0 ± 0.1 degrees C, if not go to step 2, A/D Zero Adjustment.
d. Select simulator switch position I2.
e. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 39.0 ± 0.1 degrees C, if not go to step 3, A/D Gain Adjustment, if correct proceed to step 4, A/D Converter Final Check.

2. A/D Zero Adjustment

a. Place the selector switch in position I1, the air safety switch in the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).
b. Press and hold the increase touch switch.
c. Adjust potentiometer R17 on the control board for a digital display of 31.0 ± 0.1 degrees C.
d. Return to Section F1, A/D Converter Check, and repeat steps d and e.

3. A/D Gain Adjustment

a. Place the selector switch in position I2.
b. Press and hold the increase touch switch.
c. Adjust potentiometer R16 on the control board for a digital display of 39.0 ±0.1 degrees C.
d. Repeat Section F2, A/D Zero Adjustment, and Section F3, A/D Gain Adjustment, until both the A/D Zero and A/D Gain are properly adjusted.

4. A/D Converter Final Check

a. Select simulator switch position I3.
b. Press the PATIENT TEMP touch switch.
c. Press and hold the increase touch switch.
d. Verify that the digital display indicates 33.0 ± 0.1 degrees C, if not return to Section F. A/D Converter Check and Adjustment.

G. Calibration Resistor Check

1. Press the PATIENT TEMP touch switch.

2. Press and hold the CONTROL TEMP decrease touch switch. The displayed temperature should be 37.3 ± 0.1 degrees C, if not return to Section F. A/D Converter Check and Adjustment.

H. Final Incubator Checks with Temperature Simulator:

1. PATIENT-TEMP/SENSOR Alarm Check (IC Incubator Only)

a. Set temperature simulator switch to position I3.
b. Press the MANUAL MODE touch switch.
c. Set the control temperature for 37.5° C.
d. Press the SERVO MODE touch switch.
e. Set the control temperature for 37.5° C.
f. Verify that the PATIENT-TEMP/SENSOR alarm activates (both audible and visual) within 20 seconds (24 seconds for the 50 Hz models).
g. Verify that the heater light remains ON or flashing.
h. Press the ALARM SILENCE touch switch.

2. Check for Open Patient Probe Alarm (IC Incubator Only)

a. Press the PATIENT TEMP touch switch.
b. Select simulator switch position I4.
c. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates. The PATIENT-TEMP/SENSOR alarm light should still be lit.
d. Verify that the simulator heater lamp is OFF.
e. Verify that the displayed temperature is less than 5 degrees C or HH.H is indicated.
f. Select simulator switch position I5.
g. Verify that the alarms reset, and that the simulator heater lamp is ON or flashing.

3. Check for Shorted Patient Probe Alarm (IC Incubator Only)

a. Select simulator switch position I6.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the simulator heater lamp is OFF.
e. Verify that the displayed temperature is greater than 45 degrees C or HH.H is indicated.

4. Inlet and Outlet Sensor Temperature Display Check

a. Place the incubator in the MANUAL MODE (IC Incubator Only).
b. Verify that all alarm conditions are cancelled.
c. Press the ENVIRONMENTAL TEMP touch switch.
d. With the simulator switch in position I6, verify an ENVIRONMENTAL TEMP display of 35.0 ± 0.1 degrees C.
e. Press and hold the increase touch switch to display the inlet wall temperature.
f. Verify that the displayed temperature is 39.0 ± 0.1 degrees C.
g. Press and hold the decrease touch switch to display the outlet wall temperature.
h. Verify that the displayed temperature is 31.0 ± 0.1 degrees C.

5. Inlet Wall Temperature Greater than 45 degrees C Alarm Check for the 37.5 IC Incubator

a. With the simulator switch in position I6, place the incubator in MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 37.5 degrees.
b. Press the ENVIRONMENTAL TEMP touch switch.
c. Verify that the simulator heater lamp is ON or flashing.
d. Select simulator switch position I7.
e. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
f. Press the ALARM SILENCE touch switch.
g. Press the hold the increase touch switch to display the inlet wall temperature.
h. Verify that the displayed temperature is greater than 45 degrees C and that the simulator heater lamp is OFF.
i. Select simulator switch position I8.
j. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

6. Inlet Wall Temperature Greater than 45.0C Alarm Check for the 39.0 and 41.0 IC Incubators.

Note: When the control temperature is between 37.6 degrees C and 39.0 or 41.0 degrees C., in the manual mode, the alarms are increased by the CONTROL TEMP minus 37.5.

a. With the simulator switch in position I6, place the incubator in the MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 38.5 degrees C.
b. Press the ENVIRONMENTAL TEMP touch switch.
c. Verify that the simulator heater lamp is ON or flashing.
d. Select simulator switch position I12.
e. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
f. Press the ALARM SILENCE touch switch.
g. Press the hold the increase touch switch to display the inlet wall temperature.
h. Verify that the displayed temperature is greater than 46.5 degrees C and that the simulator heater lamp is OFF.
i. Select simulator switch position I8.
j. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

7. Environmental Temperature Greater Than 39 degrees C Alarm Check for the 37.5 IC Incubator

a. Select simulator switch position I9.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the ENVIRONMENTAL TEMP display is greater than 39 degrees C and that the simulator heater lamp is OFF.

8. Environmental Temperature Greater Than 39.0C Alarm Check for the 39.0 and 41.0 IC Incubator

Note: When the control temperature is between 37.6 degrees C and 39.0 or 41.0 degrees C., in the manual mode, the alarms are increased by the CONTROL TEMP minus 37.5.

a. Select simulator switch position I13.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the ENVIRONMENTAL TEMP display is greater than 40.5 degrees C and that the simulator heater lamp is OFF

9. Check for SERVO MODE Low End Alarm (IC Incubator Only)

a. Select simulator switch position I10.
b. Place the incubator in the SERVO MODE.
c. Press the PATIENT TEMP touch switch and record the temperature displayed.
d. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C below the noted patient temperature.
e. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).
f. Verify that the heater is OFF.
g. Increase the CONTROL TEMP 0.4 degrees C. Be careful not to overshoot
h. Verify that the alarm cancels.

10. Check for SERVO MODE High End Alarm (IC Incubator Only)

a. Select simulator switch position I11.
b. Press the PATIENT TEMP touch switch and record the temperature displayed.
c. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C above the noted patient temperature. Be careful not to overshoot.
d. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).
e. Decrease the CONTROL TEMP 0.4 degrees C. Be careful not to undershoot.
f. Verify that the alarm cancels and the simulator heater lamp is ON or flashing. This may take approximately 20 seconds.

I. Temperature Simulator Removal

1. Switch the power switch on the incubator to the OFF position.

2. Disconnect the incubator power cord from the power source.

3. Remove the single red wire of the test cable from pin 3 of P-5.

4. Remove the test cable connector from the control board connector J-5.

5. Reconnect P-5 to the J-5 connector on the control board.

6. Remove the test cable connector which is connected to J-2 on the power supply board.

7. Reconnect P-2 to the J-2 connector on the power supply board.

J. Air Safety Checks

1. Air Safety Thermistor Resistance Check
a. Connect the DVM between the cable end of P2-2 and P2-3 (2 inside pins of 4 pin connector P-2).
b. Check for an open (infinite resistance) or low resistance) condition. Typical resistance values for the air safety sensor are shown in the Appendix Page A-4. If an open or short condition exists check the air safety mate-n-lok connector located behind the control panel. Also check the cable continuity between J-2 and the mate-n-lok connector.
c. Place your finger on the air safety thermistor located behind the outlet wall sensor (front wall sensor).
d. Verify a change in the resistance measurement as the thermistor temperature changes. If the resistance does not change or is out of specification change the air safety sensor.
e. Disconnect the DVM and reconnect P-2 to J-2 on the power supply board.

2. Final Air Safety Check (37.5C Incubator Only)

NOTE: This test must be conducted in an ambient room temperature between 68 and 80 degrees F.
a. Allow the incubator to stabilize at a room temperature between 68 and 80 degrees F.
b. Reconnect the power cord and switch the power on.
c. Set the incubator to a control temperature of 37.5C in the manual mode (IC Incubator Only).
d. Set the humidity control to minimum humidity.
e. Place the incubator in the environmental temperature mode.
f. Allow the incubator to heat to 37.5C.
g. Verify that an air safety alarm does not occur during this initial warm up period. A 39.0 degree C environmental temperature alarm may occur during this test. The 39.0 degree C alarm may be distinguished from the air safety alarm by observing the environmental temperature at which the alarm condition cancels. If the alarm cancels at an environmental temperature of exactly 38.8 degrees C the alarm was the 39.0 degree environmental temperture alarm. If the alarm cancels at an environmental temperature lower than 38.8 degrees C the alarm was an air safety alarm.
h. Allow the incubator to stabilize at 37.5C.
i. Verify an ENVIRONMENTAL TEMP display of 37.5±0.5C.

K. Patient Probe

1. Examination

a. Examine the patient probe, lead wire and miniature phone plug for damage and wear.
b. Connect the patient probe to the incubator.
c. Place the incubator in the MANUAL MODE.
d. Press the PATIENT TEMP touch switch.
e. Gently flex the patient probe lead wire and watch for an HHH temperature display. An open or shorted patient probe is indicated by an HHH temperature display. Replace the patient probe if an open or shorted condition exists.

2. Accuracy Check

a. Fill a styrofoam cup with warm water (approximately 37.0C).
b. Attach the patient probe to the calibration thermometer (OMP #0217-2999-800) tip using a rubber band to hold it in place. The metal disk of the probe must be contacting the thermometer.
c. Place the patient probe and calibration thermometer in the cup of water. Gently, stir the water with the thermometer while performing the next step.
d. Check that the thermometer and temperature displayed in the patient temperature mode agree within ±0.5C.

L. Control Unit Closure and Static Control Work Station Removal

1. Slide the control unit in. Keep the control unit to the left side as far as possible.

2. Replace the two screws which mount the control unit to the incubator cabinet.

3. Remove the wrist strap and ground cords. Place them in the static control work station pouches.

4. Fold up the static control work station.

M. IC Incubator Control Unit Check

1. Connect the incubator power cord to an appropriate power source (see rating plate for proper voltage, etc.). Place the power switch in the ON position and verify the following:
a. The unit is operating in the MANUAL MODE and the respective yellow indicator lamp is lit.
b. The CONTROL TEMP is at 33.0C.

2. Press the ALARM SILENCE touch switch and verify that all the indicator lamps are lit with the exception of the SERVO MODE indicator. The display should indicate three number eights (88.8).

3. Connect the patient temperature probe to the incubator.

4. Press the SERVO MODE touch switch and verify the following:
a. The yellow indicator light for the servo mode is lit.
b. A short beep tone is heard from the alarm.
c. The CONTROL TEMP is at 36.5C.
d. The PATIENT-TEMP/SENSOR alarm will activate if the patient temperature is more than 1C from the control temperature.

5. Press the ALARM SILENCE touch .switch.

6. Remove the patient temperature probe from the connector and verify that the SYSTEM FAIL/OVERTEMP alarm sounds and the red indicator lamp is lit.

7. Press the ALARM SILENCE touch switch and verify that the alarm is silenced and the indicator lamp remains ON.

8. Connect the patient temperature probe and verify that the SYSTEM FAIL/OVERTEMP indicator lamp is extinguished.

9. Press the ENVIRONMENTAL TEMP touch switch and verify that the respective indicator lamp is lit and the temperture displayed is between 20.0C and 40.0C.

10. Press the PATIENT TEMP touch switch and verify that the respective indicator lamp is lit and the temperature displayed is between 20.0C and 40.0 C.

11. Hold the patient temperature probe between your fingers and verify that the displayed temperature changes.

12. Press the MANUAL MODE touch switch and verify that a short beep tone is heard and the respective indicator lamp is lit.

13. Press the CONTROL TEMP touch switch and verify that the respective indicator lamp is lit.

14. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum manual control temperature attainable is 37.5C, 39.0C or 41.0C depending on the type of incubator you have.

15. Press the CONTROL TEMP touch switch.

16. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum manual control temperature attainable is 28.0C.

17. Press the CONTROL TEMP touch switch and verify that the control temperature may not be increased or decreased approximately 30 seconds (36 seconds for 50 Hz models) after pressing the CONTROL TEMP touch switch.

18. Press the SERVO MODE touch switch. If necessary, press the ALARM SILENCE touch switch.

19. Press the CONTROL TEMP touch switch.

20. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum servo control temperature attainable is 37.5C.

21. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum servo control temperature attainanble is 35.0C.

N. GC Incubator Control Unit Check

1. Connect the incubator power cord to an appropriate power source, (see rating plate for proper voltage etc.) and switch the power ON. The CONTROL TEMP should be at 33.0C.

2. Press the ALARM SILENCE touch switch and verify that all the indicator lamps are lit. The display should indicate three number eights (88.8).

3. Connect the patient temperature probe to the incubator.

4. Press the ENVIRONMENT TEMP touch switch and verify that the respective indicator lamp lights and the temperature displayed is between 20.0C and 40.0C.

5. Press the PATIENT TEMP touch switch and verify that the respective indicator is lit and the temperature displayed is between 20.0C and 40.0C.

6. Hold the patient temperature probe between your fingers and verify that the displayed temperature changes.

7. Press the CONTROL TEMP touch switch and verify that the respective indicator lamp is lit.

8. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum control temperature attainable is 37.5C.

9. Press the CONTROL TEMP touch switch.

10. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum control temperature attainable is 28.0C.

11. Press the CONTROL TEMP touch switch and verify that the control temperature may not be ↑ increased or ↓ decreased approximately 30 seconds (36 seconds for 50 Hz models) after pressing the CONTROL TEMP touch switch.

O. Inlet and Outlet Sensor Check

1. Rotate the incubator hood to the fully retracted position.

2. Press the ENVIRONMENTAL TEMP touch switch.

3. Press and hold the CONTROL TEMP ↑ increase touch switch. The displayed temperature is the inlet wall (rear wall) surface sensor temperature.

4. Place your index finger on the back inlet wall surface sensor and verify a change in the displayed temperature.

5. Press and hold the CONTROL TEMP ↓ decrease touch switch. The displayed temperature is the outlet wall (front wall) surface sensor temperature.

6. Place your index finger on the front outlet wall surface sensor and verify a change in the displayed temperature.

7. Close the incubator hood.

P. Calibration Resistor Check

1. Press the PATIENT TEMP touch switch.

2. Press and hold the CONTROL TEMP ↓ decrease touch switch. The displayed temperature should be 37.3C ± 0.1C. When the displayed temperature is 37.3C ± 0.5C or greater a SYSTEM FAIL/OVERTEMP alarm activates.

Q. IC Incubator Power Failure Alarm and Memory Test

NOTE: The battery (located on the power supply board) must be in a fully charged condition to pass the 10 minute test or partially charged to pass the two minute test.

Replace the battery every 2 years or when it is defective. There is no maintenance required for the battery.

1. Place the incubator in the SERVO MODE and adjust the control temp for 35.5C.

2. Place the Incubator in the MANUAL MODE and adjust the CONTROL TEMP for 30.5C.

3. Place the incubator in the SERVO MODE.

4. Disconnect the power cord (do not turn the power switch OFF) and verify that the power failure alarm sounds and all display indicators are extinguished. Allow the alarm to sound for 2 minutes.

WARNING: If the power failure alarm is tested for 10 minutes the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient.

5. Reconnect the power cord and verify that the incubator returns to a control temperature of 35.5C in the SERVO MODE of operation.

6. Place the incubator in the MANUAL MODE and verify a control temperature of 30.5C.

R. GC Incubator Power Failure Alarm and Memory Test

NOTE: The battery (located on the power supply board) must be in a fully charged condition to pass the 10 minute test or partially charged to pass the two minute test.

Replace the battery every 2 years or when it is defective. There is no maintenance required for the battery.

1. Record the control temperature.

2. Disconnect the power cord (do not turn the power switch OFF) and verify that the power failure alarm sounds and all display indicators are extinguished. Allow the alarm to sound for 2 minutes.

WARNING: If the power failure alarm is tested for 10 minutes the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient.

3. Reconnect the power cord and verify that the incubator returns to the recorded control temperature.

S. IC Incubator Audible Alarm Timer Check

1. With the patient probe disconnected, press the SERVO MODE touch switch. Verify an audible alarm and the SYSTEM FAIL/OVERTEMP indicator is lit.

2. With a stopwatch begin timing the audible alarm silence when the ALARM SILENCE touch switch is pressed.

3. Wait approximately 13 minutes and record the time that the audible alarm activates. The alarm should sound in 13±2 minutes.

T. Operational Check

CAUTION: Placing the incubator close to external heating and cooling devices can cause incorrect temperature readings.

1. Place the incubator in an area that is relatively free from air currents and has an ambient temperature between 70F and 85F.

2. Place a calibrated mercury thermometer about four inches above the center of the mattress.

3. Connect the power cord to the power source.

4. Switch the incubator power ON.

5. Adjust the CONTROL TEMP to 34C in the MANUAL MODE. Set the humidity control to minimum with no water in the reservoir.

6. Allow approximately 1 hour warmup time. (May need more or less time depending on ambient temperature.)

7. Compare the temperature on the mercury thermometer (the air temperature in incubator) with the displayed environmental temperature. The temperatures should be 34±1.0C.

U. Servo Mode Operational Check (IC Incubator Only)

1. Disconnect the main test cable and ground wire from the temperature simulator.

2. Connect a 2 conductor cable with 1/8 inch miniature phone plugs (obtain locally) on each end to the temperature simulator and to the patient probe jack on the incubator.

3. Select simulator switch position I11.

4. Press the PATIENT TEMP touch switch and note the temperature displayed.

5. Place the incubator in the SERVO MODE.

6. Adjust the control temperature to 0.5 degrees C above the noted patient temperature.

7. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

8. Use a stop watch and start timing when you place the incubator in the SERVO MODE.

9. After 11 minutes have passed, press the MANUAL MODE touch switch.

10. Verify that the control temperature has increased to 33.3 degrees C.

11. Press the PATIENT TEMP touch switch and note the temperature displayed.

12. Place the incubator in the SERVO MODE.

13. Adjust the control temperature 0.5 degrees C below the noted temperature.

14. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

15. Use a stop watch and start timing when you place the incubator in the SERVO MODE.

16. After 11 minutes have passed, press the MANUAL MODE touch switch.

17. Verify that the control temperature has decreased to 32.7 degrees C.

18. Disconnect the 2 conductor cable from the temperature simulator and the incubator.

V. Phototherapy Lamp Check

1. Check the overall condition of the phototherapy lamp and controller. The lamp cover should be free of cracks or other signs of deterioration.

2. When the Phototherapy Lamp is mounted in the upright the swivel mount should hold the lamp in position.

3. Check the phototherapy control unit for bent power plug pins.

4. Check the control unit power cord connector for bent pins (earlier version only).

5. Check the strain relief on the power cord.

6. Check the power cord for cuts or worn insulation and replace it if necessary.

7. Connect the power cord from the phototherapy lamp housing to the controller (earlier version only).

8. Connect the incubator to the appropriate power source. Install the controller into one of the accessory slide positions next to the incubator main control unit. Check for easy installation and removal.

9. Switch the phototherapy controller power ON and verify the lamps light.

W. Radiant Warmer Check

Refer to the Radiant Warmer Operation and Maintenance Manual for the Check-Out Procedure (Section 4.3)

X. Electrical Safety Check

1. Power Cord Inspection

a. Examine the power cord for damage and wear.
b. Examine the power plug for loose or bent pins. Replace the power cord if the cord or plug is damaged.

2. Fuses

Check for the correct value and type of fuses on the incubator and phototherapy lamp control unit if present.

3. Power Outlets and Accessory Outlets

Check for correct polarity and proper tension on all outlets present on the incubator.

Y. Ground Resistance Check

Perform a ground resistance check on the incubator accessory outlets and each individual electrical accessory. Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and the main control unit accessory outlets, Phototherapy Lamphouse and Phototherapy control unit. Tug and flex each end of the power cord during the measurement. The ground resistance **must** be less than 0.15 ohms. Higher readings may indicate loose or oxidized connections in the power cord or the incubator grounding circuits.

Z. Leakage Current Tests

Perform separate electrical safety and leakage current tests on the incubator and each electrical accessory. Perform the test on each individual device, not as a system.

Measure the leakage current in all wiring configurations both ON and OFF, grounded and ungrounded, and normal and reverse polarities. Make sure the heater is ON full during the test. Set the Control Temperature to 37.5C on the incubator and set the intensity control to maximum on the radiant warmer.

Use the leakage current tester OMP #0175-2284-000 and digital multimeter (DMM) for the following procedure:

1. Connection (Figure 6-1)

a. Connect the device under test to the outlet on the leakage current tester.
b. Make sure the polarity switch on the leakage tester is in the OFF Position then plug the line cord into a grounded 115-120 volt 60 Hz wall outlet.
c. Connect the positive lead of the DMM to the positive +METER OUT output.
d. Connect the negative lead of the DMM to the negative - METER OUT output.
e. Set the DMM on the millivolt scale.
f. Connect one end of the test cable to the EXTERNAL GROUND jack on the Leakage Current Tester.
g. Use the other end of the test cable (needle probe tip) to contact the exposed conductive surface of the device under test.

2. Normal Polarity Leakage Current Test

a. Place the polarity switch of the Leakage Current Tester in the NORMAL position. (This is in the grounded mode).
b. Switch ON the power of the device under test.
c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps, (i.e., 100 mv is equivalent to a leakage current of 100 ua).
d. Record the leakage current measured in the appropriate space on the Leakage Current Form.
e. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.
f. Record this measurement in the appropriate space on the Leakage Current Form.
g. Switch the power switch of the **device under test** OFF and then repeat steps 2c through 2f.

3. Reverse Polarity Leakage Current Test

a. Place the polarity switch on the Leakage Current Tester in the REVERSE position. (This is the grounded mode.)
b. Switch ON the power of the device under test.
c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps, (i.e., 100 mv is equivalent to a leakage current of 100 ua).
d. Record the leakage current measured in the appropriate space on the Leakage Current Form.
e. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.
f. Record this measurement in the appropriate space on the Leakage Current Form.
g. Switch the power switch of the device under test OFF and then repeat steps 2c through 2f.

6/Calibration and Adjustments

The leakage current must not exceed 500 µa (1000 µa for export units) when measuring from heater to ground.

NOTE: Bed should be in place. Attach jumper with alligator clips on both ends between heater and test probe.

The leakage current must not exceed 100 µa (200 µa for export units) when measuring from chassis to ground. The leakage current must not exceed 50 µa when measured between the non-isolated patient probe tip and ground.

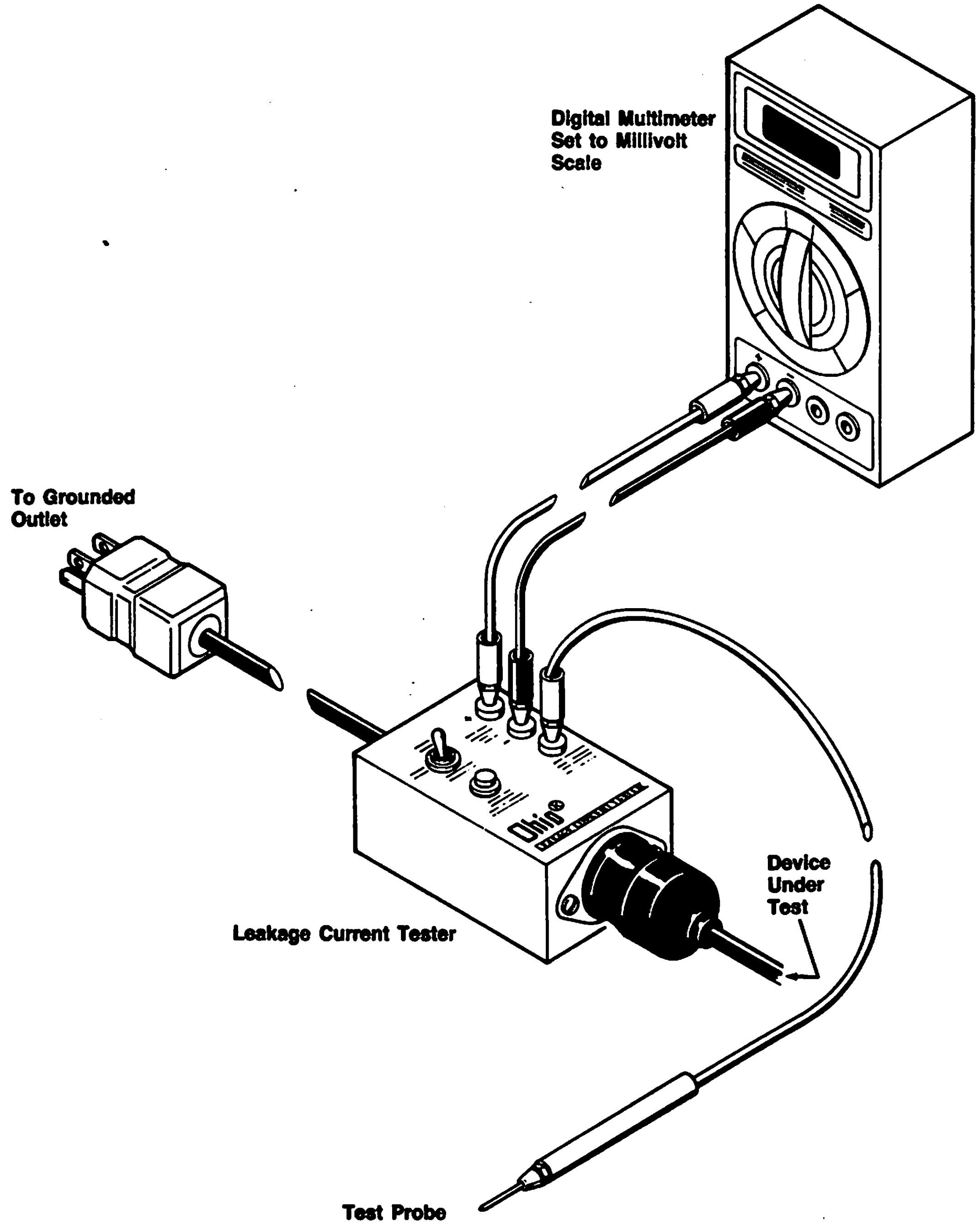
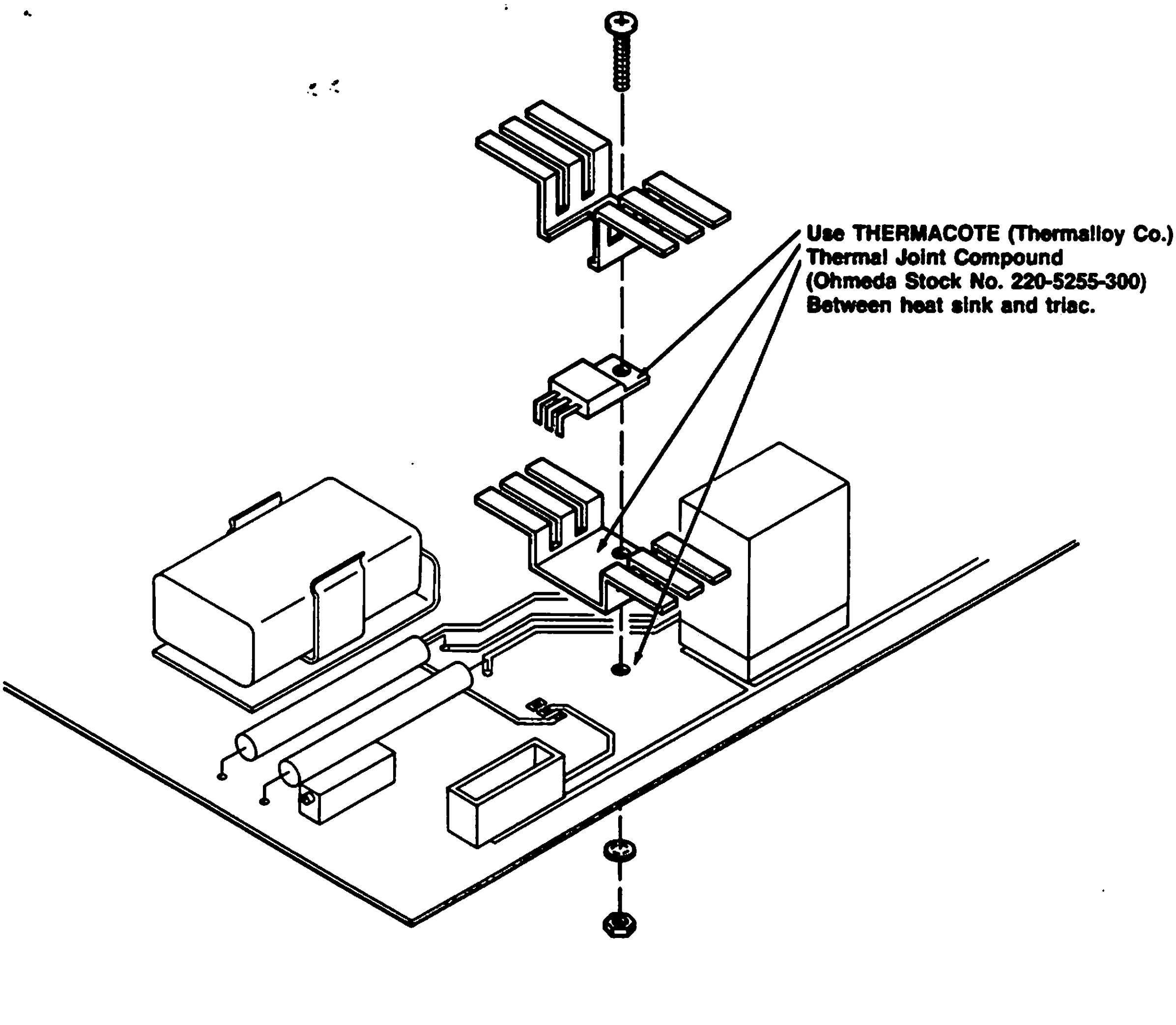


Figure 6-1
Leakage Current Tester Setup

9/Lower Unit Repairs

Triac Replacement for the Earlier Version Power Supply Board

1. Set up the static control work station.
2. Place the power switch in the OFF position.
3. Disconnect the incubator power cord.
4. Remove the power supply board from the incubator. See Section 9K. Power Supply Board Replacement.
5. Place the component side of the power supply board up.
6. Remove the mounting screw for the triac.
7. Disassemble the triac and heat sink as shown.
8. Apply a thermal joint compound (Ohmeda part number 0220-5255-300) between the heat sink and the triac.
9. Assemble the new triac and the heat sink as shown.
10. Mount the triac heat sink assembly to the circuit board with the mounting screw.
11. Install the Power Supply Board in the incubator. See Section 9K. Power Supply Board Replacement.
12. Perform the Functional Checkout and Electrical Safety Checks.



Triac Heat Sink Assembly for
Early Version Power Supply Board

9/Lower Unit Repairs

Base Slab Replacement

1. Remove incubator drawers and rotate hood to open position.

2. Remove shelf/frame assembly (if fitted) from incubator humidifier filler end.

3. Remove mattress and any other loose items.

4. With assistance, carefully lay incubator down on the humidifier filler end.

5. Pull off casters and remove four (4) hex head caster mounting sockets.

6. Remove four (4) hex nuts and washers.

7. Carefully remove the base slab from main assembly.

NOTE: When replacing the base slab on an older incubator, order four (4) each of the following parts:

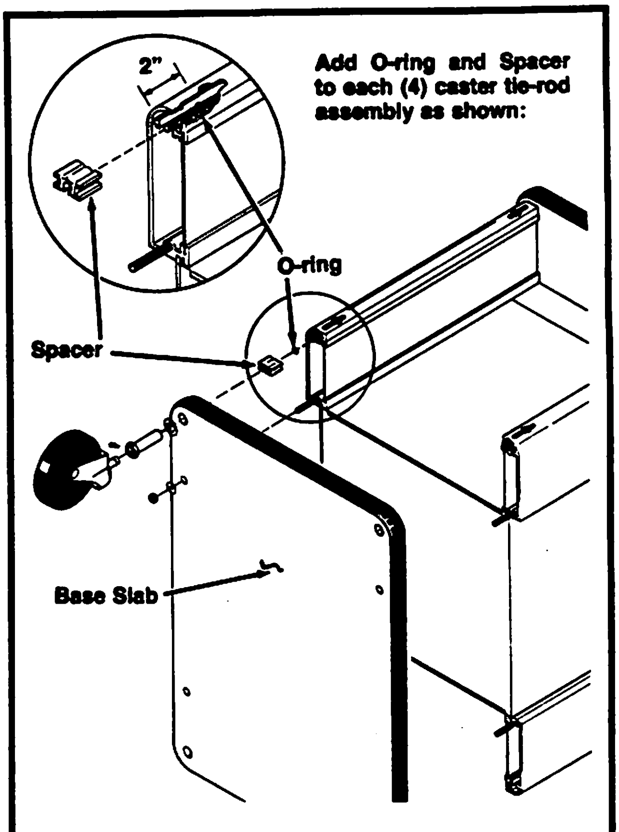
Spacer, Tie-rod **217-2956-300**
O-ring **210-0410-300**

8. Place an 'O' Ring (210-0410-300) on each caster mounting tie-rod, two (2) inches from end (refer to Figure).

9. Place spacer (217-2956-300) on each caster tie-rod with the slots engaged on rails of extrusion.

10. Place new slab on unit and refit hex nuts with washers and hex head caster mounting sockets.

Note: Tie-rods may need alignment through access holes.



Cabinet Assembly

11/TROUBLESHOOTING

11.1 TROUBLESHOOTING TABLE

J. System Failure Error Codes

Note: These alarms can not be silenced. The error codes are displayed in the temperature display Refer to the troubleshooting table for a description of the type of failure and the components involved:

Error Code	Problem	Possible Solutions
E01	A to D Converter failure	Defective U1 or U10 on control board
E02	Program execution error. Loop counter missing major subroutines	Defective U5, U7, U6 on control board
E03	Rear wall sensor open or shorted	Replace sensor or wiring
E04	Front wall sensor open or shorted	Replace sensor or wiring
E05	Calibration drift exceeds 0.5C	Defective U1, U10, U2, U3 on control board
E06	Self test failure	Defective U5, U7, U6 on control board

APPENDIX

F. Part Numbers for Blue Incubators

The I.C. Incubator is available in a blue and cream finish. The blue I.C. Incubator has blue drawers and a blue finish in the area of the tilt mechanism. The top and bottom cabinet panels and the monitor shelves are cream colored.

The new component part numbers for the blue finish I.C. Incubator are:

Component Parts	Part Number	Qty. Req.
Upper Slab (Table Top)	*6600 0014 500	1 ea
Lower Slab (Base Plate)	*6600 0012 500	1 ea
Plate, Tilt Mechanism Covers	*6600 0015 500	2 ea
Cover, Raceway Access	*6600 0016 500	1 ea
Cover, Lower Tilt Mechanism	*6600 0017 500	1 ea
Shelf 12"	*6600 0019 500	as req.
Shelf 18"	*6600 0020 500	as req.
Front Plate Drawer (small)	*6600 0028 500	as req.
Front Plate Drawer (large)	*6600 0029 500	as req.

Assemblies	Part Number
Deluxe Drawer Kit	6600 0003 800
Upright and Shelf Assy.	6600 0014 800
Tilt Mechanism Assy.	6600 0002 800
Monitor Shelf Assy. 12"	6600 0015 800
Monitor Shelf Assy. 18"	6600 0016 800

* Note: Order these items to change from an orange finish to a blue finish.

Information: The lower tilt mechanism cover (part number 6600 0017 500) has been changed from 2 piece to 1 piece construction.

Disassemble/Reassemble the incubator as detailed in Section 9. Incorporate the caster tie-rod modification detailed in Section 9 N. if this is not installed.

Ohmeda

37.5C, 39.0C and 41.0C Intensive Care and General Care Incubators

Service Manual

BOC Health Care

Ohmeda
Service Manual

Intensive Care and General Care Incubators

Revision 4 86

Important

The information contained in this service manual pertains only to those models of products which are marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience as well as the availability to them of proper tools and test equipment. Consequently, Ohmeda provides this service manual to its customers purely as a business convenience and for the customer's general information only, without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that customer has received said information from Ohmeda does not imply in any way that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstances may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review and customers are cautioned to obtain and consult the latest revision thereof before undertaking any service of the equipment. Comments and suggestions are invited from our customers for consideration by Ohmeda in connection with these periodic reviews.

WARNING: After completing a repair of the incubator or any of its accessories the appropriate calibration procedure must be performed to make sure the incubator or accessory is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

WARNING: After completing any portion of the calibration and check procedures for the incubator, the Check-Out Procedure as described in the O&M manual must be performed. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

CAUTION: Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.

CAUTION: This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual static control precautions MUST be observed. Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

Repair Policy and Procedure

Do not use an improperly functioning unit until all necessary repairs are made and the unit is tested to ascertain that it is functioning in accordance with the manufacturer's published specifications.

To ensure full reliability, it is recommended that all repairs be performed by an authorized Ohmeda Service Representative. However, if this cannot be done, replacement of those parts designated in the Service Manual may be undertaken by a competent individual having experience in the repair of devices of this nature.

CAUTION: No repair should ever be attempted by anyone not having experience in the repair of devices of this nature.

CAUTION: Use only Ohmeda replacement parts to maintain the static control properties of the incubator.

Technical Competence

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Table of Contents

This manual has been completely revised and replaces the manual dated:
0178-0110-000 6.85.C.20.12.08. Printed in U.S.A.

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Table of Contents Continued

This manual has been completely revised ad replaces the manual dated:
0178-0110-000 6.85.C.20.12.08. Printed in US.A.

Precautions

Warnings

After completing a repair of the incubator or any of its accessories the appropriate calibration procedure must be performed to make sure the incubator or accessory is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference. See "Important" Page.

After completing any portion of the calibration and check procedures for the incubator, the Check-Out Procedure as described in the O&M manual must be performed. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference. See "Important" Page.

Do not perform the check-out procedure while a patient occupies the incubator. See Page 3-1.

Disconnect the power to the incubator for this portion of the Check-Out Procedure. See Page 3-1.

The ground cord includes a one megohm current limiting resistor. Do not remove this resistor from the ground cord. See Page 4-1.

Do not connect the alligator clip of the ground cord to the inside of the control unit. See Page 4-1.

Disconnect power to the incubator before connecting or disconnecting the Temperature Simulator. See Page 5-2.

When performing service procedures with the power connected, extreme care must be taken to avoid direct or indirect contact with any of the electrical circuitry because of existing shock hazard. See Page 6-1.

If the power failure alarm is tested for 10 minutes the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient. See Page 6-7.

Power MUST be disconnected prior to removing the bed platform. The air heater is NOT GROUNDED; an electrical shock hazard could exist. See Page 8-1.

Allow the unit to cool for 15 minutes before disassembly of the lower unit. See Page 8-1.

Power MUST be disconnected for reassembly of the lower unit. See Page 8-1.

High voltage is present at the power switch. Disconnect the power cord. See Page 9-21.

Disconnect the power cord before replacing the Phototherapy Lamps. See Page 10-1.

Do not replace the fluorescent lamps while the Phototherapy Lamp is mounted on an occupied incubator. See Page 10-1.

Disconnect power to the incubator before attempting to replace a fuse. See Page 10-1.

For continued protection against a fire hazard, replace the fuse with the same type and rating. See Page 10-1.

Shock hazard exists from charged capacitor. Discharge capacitor before making wiring changes. See Page 10-6.

Cautions

Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood. See "Important" Page.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual static control precautions must be observed. Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices. See "Important" Page.

No repair should ever be attempted by anyone not having experience in the repair of devices of this nature. See "Important" Page.

Use only Ohmeda replacement parts to maintain the static control properties of the incubator. See "Important" Page.

Neutral line voltage is present. See Pages 1-1 and 1-2.

Operate the incubator at an ambient temperature between 20-29C (68-85F). If the incubator is operated below 60F the SYSTEM FAIL-OVERTEMP alarm activates and prevents normal operation. See Page 3-1.

Mercury vaporizes readily when heated. Hazardous concentrations of mercury vapor could result if the thermometer is accidently broken. For safety the thermometer (obsolete accessory) is completely encapsulated in a Teflon® sheath. If the thermometer is broken remove it from service immediately. Be careful not to allow the broken glass to puncture the Teflon sheath and allow the mercury to escape. If the thermometer and Teflon sheath are broken be sure to thoroughly clean and remove all traces of mercury from the incubator. Wear protective handware or take other measures to guard against cuts in case of thermometer breakage. See Page 3-1.

Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices. See Page 4-1.

The Velostat material is conductive. Do not place electrically powered circuit boards on it. See Page 4-1.

Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices. See Page 5-2.

When the two mounting bolts are removed from the incubator hood, the incubator hood must be realigned as described in this section. See Page 7-2.

An incubator hood alignment tool is required for the replacement of a counterbalance. Be sure to follow the counterbalance replacement procedure in this section. See Page 7-2.

Two people are required to support the incubator hood at each end before removing the mounting bolts. See Page 7-2.

Work with one counterbalance assembly at a time to avoid confusion of parts. See Page 7-3.

Be careful not to allow the hoods to slip and rotate quickly under the lower unit. Damage to the hoods may result. See Page 7-7.

Do not allow the bottom panel to pinch any of the rear sensor wiring. The rear sensor leads must be routed to the left of the center support rib (when viewed from the rear of the incubator). Make sure the sensor cable is routed in the cut outs on the support webbing. See Page 8-1.

Use the Static control Work Station (Part No. 0175-2311-000) to ensure that static charges are safely conducted to ground and not through static sensitive devices. See Page 9-1.

To avoid damaging the pins, use extreme care when removing them. See Page 10-4.

Introduction

This service manual covers the service requirements for the Intensive Care and General Care Incubators. At the time of this printing there were three Intensive Care Incubators, the 37.5C, the 39.0C, and the 41.0C degree incubators. The software program for each unit is different. The Specifications section describes the functional differences of the three units. The Calibration and Adjustments Section describes the differences for the calibration and adjustment of each unit.

1/Functional Descriptions

A. Power Supply Board (Earlier Version)

The power supply contains circuitry for the conversion, control, and regulation of the voltage supplies. As one of its major functions, the power supply board furnishes the D.C. voltages required by the microprocessor and its associated circuitry.

The power supply board also furnishes regulated D.C. to keep the Ni-Cad battery used for standby power charged at all times. Also on the power supply board are components to provide zero voltage switching of the A.C. power to the incubator air heater. Opto-isolators are used to interface microprocessor information.

Completely independent functionally is an air over-temperature safety circuit which also resides on the power supply board. This safety circuit will open the A.C. line to the heater in the event of a catastrophic failure of the microprocessor, the zero voltage switch, or the power triac.

Please refer to the power supply schematic No. 0176-0104-002 and the appropriate power supply board layout (Figures 12-23, 12-24, 12-26, and 12-28) for the following description of the specific operating characteristics of the power supply board.

A nominal voltage of 8 Vac at 500 ma is input to the board at the 8 pin Mate-N-Lok header (J-3) on pins 5 and 6 from transformer Stock No. 0208-7563-300. Bridge rectifier D-6 and capacitor C-3 provide full wave D.C. to the input of the 5 volt regulator U-7. TP-7 can be used to monitor the unregulated D.C. input to the regulator.

The output of regulator U-7 is nominally +5.0 volts and is used for Vcc on the microprocessor and logic circuits. The output is measureable at TP-8 and pins 9, 10, and 11 of J-1 (POS), with respect to TP-9 and pins 3, 12, 13, of J-1 (NEG.). When furnishing 500 ma (10 ohms load), the output should be between 4.8 and 5.2V when the supply voltage is varied ±10% from nominal. The maximum allowable ripple voltage is 150 millivolts peak to peak.

The transformer also supplies 11.5 Vac to pins 2 and 4 of J-3. This source is used to supply negative and positive D.C. voltages to the analog switch on the control board and also a regulated D.C. for charging the Ni-Cad battery. The supply voltage is also used to provide a line frequency interrupt signal to the microprocessor by means of an opto-isolator.

Diode D-1 and zener diode D-5 along with C-9 are used to provide a nominal -9 VDC at J-1 pin 5. Regulation is not critical and it is therefore expected that this supply may vary by ±12% from nominal. Diode D-2 and capacitor C-4 produce the unregulated positive voltage used as an input to regulator U-8. The output of U-8 is adjusted by means of potentiometer R-18 to provide 9.6±0.05 volts for charging the Ni-Cad standby battery. The regulated 9.6V is also used as the positive supply for the analog switch. The 9.6V can be measured at TP-6 and at J-1 pin 16. The maximum allowable ripple voltage is 200 millivolts peak to peak.

The output of the Ni-Cad battery is regulated by a 5 volt regulator, U-9 which outputs 5±.2 volts D.C. at TP-5 and J-1 pins 1 and 2. The maximum allowable ripple voltage is 150 millivolts peak to peak. The battery is connected through R-16 to the output of D-3 and the input of U-9 by means of a pair of normally open contacts on the main power switch. These switch contacts are connected to the board at J-3 pins 7 and 8.

NOTE: All waveshapes shown in this section are with a 60 Hz line frequency input.

The opto-isolator U-6 is used to furnish the timing-interrupt signal to the microprocessor. The output of U-6 is available at J-1 pin 4. Figure 1-1 is representative of what this output should look like.

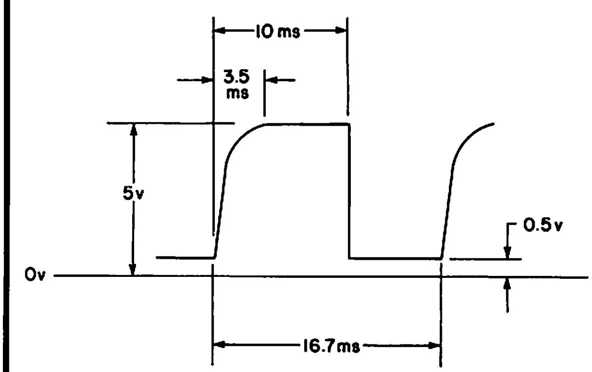


Figure 1-1.
Output Signal of U-6

U-5, U-2, and Triac Q-1 are the major components used to control the power to the incubator air heater. The air heater is rated at 415 watts with an input of 115 Vac. The microprocessor provides a logic "low" voltage of 0.45 Vdc maximum at TP-14 (J-1 pin 6) when the heater is required to be "ON". This logic low will cause saturation of the internal Darlington transistor in U-5 which effectively shorts terminals 4 and 5 of the opto-isolator. This results in a logic "high" voltage on pin 13 of U-2 which is a zero-voltage switch module. The magnitude of this logic high at pin 13 (TP-2) should be 6±1.0 Vdc.

NOTE: This signal must be measured with respect to the negative lead of C-10 **not** TP-9.

CAUTION: Neutral line voltage is present.

1/Functional Descriptions

The heater is turned off by the microprocessor providing a logic "high" of 2.4V minimum at TP-14, the input to U-5. U-5 will cut off, and the voltage at pin 13 of U-2 will drop to 2.6V±0.4V. In the "ON" condition U-2, the zero voltage switch, will provide positive pulses synchronized to the incoming A.C. line monitored at TP-3. The desired wave shape of these pulses is shown in Figure 1-2.

NOTE: This signal must be measured with respect to the negative lead of C-10. A grounded oscilloscope cannot be used.

CAUTION: Neutral line voltage is present.

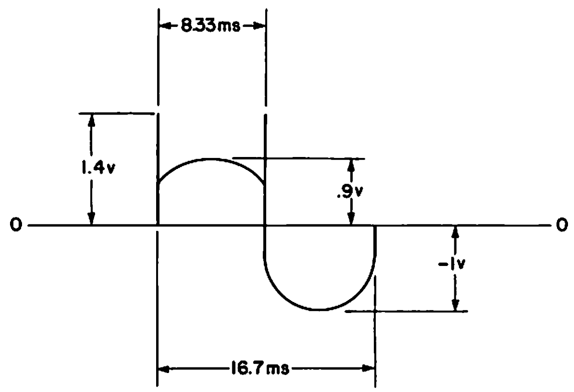


Figure 1-2
Output Signal of U-2

A 50 ohm, 300 watt load resistor could be used to substitue the heater and check the operation of triac Q-1 and the zero voltage switch U-2. Switch-on of the A.C. power should occur not later than 3 degrees after the zero voltage crossing of the A.C. line.

The remainder of the circuits on the power supply board are used to comprise the air safety system. The major components of this circuit are U-4, U-1, Q-2, and relay K-1. The main function of this circuit is to provide a safety back-up in the event of a failure (short circuit) of triac Q-1, a gross malfunction of the microprocessor, or a failure of the zero voltage switch U-2.

A Remote Air Temperature Sensor (NTC Thermistor) is connected to U-1 through J-2 pins 2 and 3. On 37.5°C units when the temperature of this sensor reaches 39.6°C (50,800 ohms±0.1%) this should result in a low voltage on the output of U-1, (0.2 volts or less). This turns off triac Q-2, which de-energizes relay K1 and cuts the A.C. power to the heater. Adjustment of the circuit turn-off point is provided for by potentiometer R-17. This circuit has about 2°C Hysteresis built in and resets when the resistance is less than approx. 57.2K ohms. After the adjustment is made the trip point should occur between 50.7K and 50.9K ohms.

The U-3 opto-isolator is used to provide a signal to the microprocessor that indicates the status of the air safety relay. With the relay in its normally closed position, 115 Vac neutral signal will be present at the input of U-3 (pin 1 with respect to pin 2). The output of U-3 at TP-12 with respect to TP-9 will be the wave shape as shown in Figure 1-3. If the relay opens, there will be no neutral signal present at the input of U-3 which causes the output to go to a logic high, 5.0±0.2 VDC.

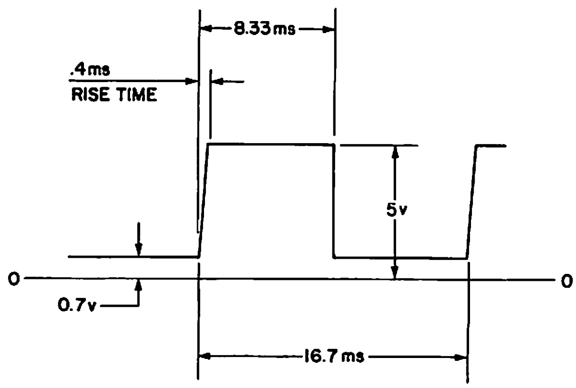


Figure 1-3
Output Signal of U-3

The microprocessor also has a capability to trip the safety circuit. On 37.5°C units, if the inlet wall temperature exceeds 45°C or the average wall temperature exceeds 39°C (possibly because of failed triac), the microprocessor will output a logic high of 2.4 V minimum to the input of opto-isolator U-4. TP-13 or J-1 pin 7 can be used to monitor this voltage. The logic high will turn off U-4's internal Darlington transistor causing the inhibit input of U-1 to become a logic high of 6.0 volts or greater. This will result in the voltage at TP-10 falling to a value of 0.2 V maximum.

Under normal operating conditions, TP-13 is a logic low 0.45 V or less which results in TP-11 being low at 0.5 V or less allowing U-1 to output a high of 4.8V or greater at TP-10 and the gate of triac Q-2.

NOTE: Typical wave shape on gate of triac Q-2 (TP-10) with respect to the negative lead of C-10 in the "ON" condition is shown in Figure 1-4.

CAUTION: Neutral line voltage present.

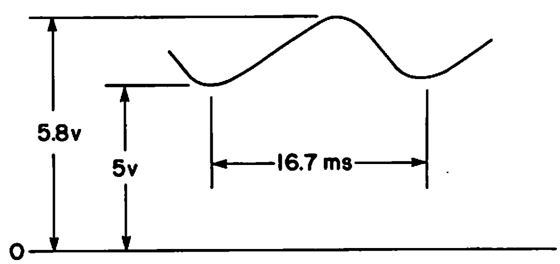


Figure 1-4
Signal on Gate of Triac Q-2 in ON Condition

1/Functional Description

B. Power Supply Board (Later Version)

The power supply contains circuitry for the conversion, control, and regulation of the voltage supplies. As one of its major functions, the power supply board furnishes the D.C. voltages required by the microprocessor and its associated circuitry.

The power supply board also furnishes regulated D.C to keep the Ni-Cad battery used for standby power charged at all times. Also on the power supply board are components to provide zero voltage switching of the A.C. power to the incubator air heater. Opto-isolators are used to interface microprocessor information.

Completely independent functionally is an air over-temperature safety circuit which also resides on the power supply board. This safety circuit will open the A.C. line to the heater in the event of a catastrophic failure of the microprocessor or the power triac.

Please refer to the later version power supply schematic No. 0176-0104-002 and the appropriate power supply board layout (Figures 12-25, 12-27 and 12-29) for the following description of the specific operating characteristics of the power supply board.

A nominal voltage of 8 Vac at 500 ma is input to the board at the 8 pin Mate-N-Lok header (J3) on pins 5 and 6 from the transformer. Bridge rectifier CR8 and capacitor C6 provide full wave rectified D.C. to the input of the 5 volt regulator VR2.

The output of regulator VR2 is +5.0 volts nominally and is used for Vcc on the logic circuits. The output is measurable between TP8 (POS) and TP9 (NEG). When furnishing 500 ma (10 ohms load), the output should be between 4.8 and 5.2V when the supply voltage is varied ±10% from nominal. The maximum allowable ripple voltage is 150 millivolts peak to peak.

The transformer also supplies 11.5 Vac to pins 2 and 4 of J3. This source is used to supply negative and positive D.C. voltages to the analog switch on the control board and also a regulated D.C. for charging the Ni-Cad battery. The supply voltage is also used to provide a line frequency interrupt signal to the microprocessor by means of an opto-isolator.

Diode CR2 and zener diode VR1 along with C3 are used to provide a nominal -9 Vdc at J1 pin 5. Regulation is not critical and it is therefore expected that this supply may vary by ±12% from nominal. Diode CR4 and capacitor C5 produce the unregulated positive voltage used as an input to regulator VR3. The output of VR3 is adjusted by means of potentiometer R18 to provide 9.6±0.05 volts for charging the Ni-Cad standby battery. The regulated 9.6 V is also used as the positive supply for the analog switch. The 9.6 V can be measured at TP6 and at J1 pin 16 with respect to TP9. The maximum allowable ripple voltage is 200 millivolts peak to peak.

The output of the Ni-Cad battery is regulated by a 5 volt regulator, VR4 which outputs 5±0.2 volts D.C. at TP5 and J1 pins 1 and 2 with respect to TP9.

The maximum allowable ripple voltage is 150 millivolts peak to peak. The battery is connected through R23 to the output of VR3 and the input of VR4 by means of a pair of normally open contacts on the main power switch. These switch contacts are connected to the board at J3 pins 7 and 8.

The opto-isolator U5 is used to furnish the timing-interrupt signal to the microprocessor. The output of U5 is available at J1 pin 4. Figure 1-5 is representative of what this output should look like (With respect to TP9).

This signal should be a square wave of 5 volt amplitude with a frequency equal to the input supply.

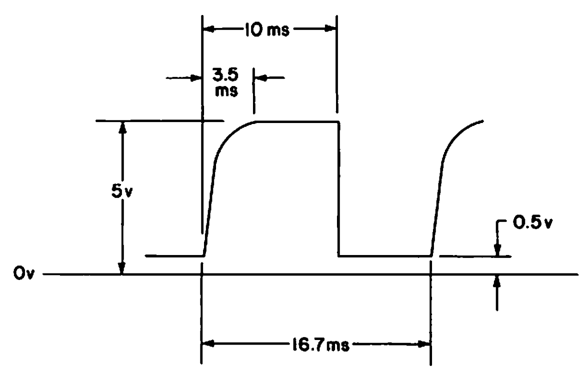


Figure 1-5
Output Signal of U-5

Triac driver U3 and Triac Q1 are the major components used to control the power to the incubator air heater. The microprocessor provides a logic "low" voltage of 0.45 Vdc maximum at J1 pin 6 when the heater is required to be on. Transistor Q3 is used as a buffer between the microprocessor and U3. A low signal at U3 pin 2 turns on the LED which activates the zero voltage crossing Triac driver. The A.C. power should turn on not later than 3 degrees after the zero crossing of the A.C. line.

1/Functional Description

The Heater is turned off by the microprocessor providing a logic "high" of 2.4V minimum at J1 pin 6.

The remainder of the circuits on the power supply board are used to comprise the air safety system. The main function of this circuit is to provide a safety back-up in the event of a failure (short circuit) of Triac Q1 or a malfunction of the microprocessor.

The output of voltage regulator VR5 sets a voltage reference of 2.5 V±1%. The output of a comparator U4 pin 1 will go low if the thermistor connected to J2 pins 2 and 3 becomes an open circuit, allowing U4 pin 6 to rise to 2.5 volts.

For 37.5°C units Pot R17 should be set so comparator output U4-14 goes low at a thermistor resistance of 50,800 ohms. This should be set using a precision resistor of 50,800 ohms±0.1%. After the adjustment is made the trip point should be between 50.7K and 50.9K when the resistance is decreased slowly using a multi-turn test pot.

There is about 1.7°C hysteresis built into this comparator. The comparator normally resets between 54.0K and 56.0K.

If either comparator U4 pin 1 or U4 pin 14 trips TP1 will go low which will cause Q2 to turn off. This turns off the LED in U2 and the Triac driver opens relay K1. This opens the neutral line to Triac Q1 which turns the heat off.

When RELAY K1 opens, the LED in U1 also turns off. This causes the signal at J1-8 (TP3) to go high which signals the microprocessor that there is an alarm. Figure 1-6 shows the signal present at TP3 when there is no alarm condition (with respect to TP9).

The same board can be used in both 100 volt and 120 volt units. The only differences between the 120 volt, 220 volt and 240 volt are the relay (K1) and resistors R1 and R2.

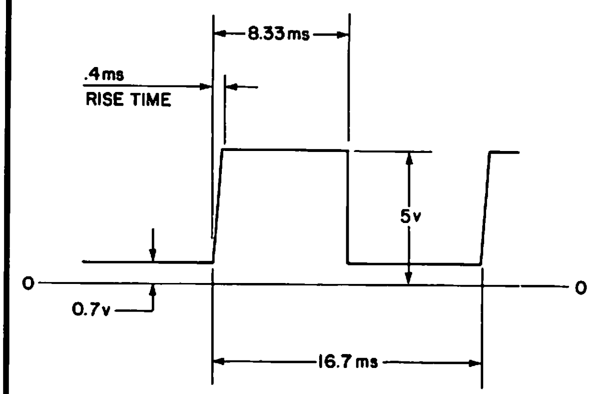


Figure 1-6
Output Signal of U-1

1/Functional Descriptions

C. Control Board

The control board contains the single-chip microprocessor (8039) plus all the peripheral devices required to enable the microcomputer to perform all of its measurement, control, and decision-making functions. The single-chip microprocessor consists of a central processing unit (CPU), data memory (RAM), and input/output ports (I/O). The program memory is stored externally in a four (4)* kilobyte erasable, programmable, read only memory (EPROM). An octal transparent latch (74LS373) is connected to the address inputs of the EPROM to permit use of the bi-directional data bus port of the microprocessor for addressing the EPROM and receiving program instructions. A temperature measurement bridge, analog switch, analog to digital converter, and several logic chips comprise the remainder of the circuitry on the control board.

The double wall construction of the I.C. incubator has necessitated a different temperature measurement scheme than that used in the incubators manufactured in the past. Heated air is circulated principally between the double walls of the incubator hood to minimize infant radiant and convective heat losses. For this reason, the environmental temperature within the incubator is determined by averaging the temperature of the air where it enters the hood (inlet wall) and the temperature of the air exiting the hood (outlet wall). A NTC thermistor is used at each of these locations with identical Resistance vs. Temperature characteristics as the thermistor used to measure infant skin temperature (patient probe). The three thermistors plus a fixed 0.1% calibration resistor are continuously sampled to monitor each temperature and perform a self calibration check of the temperature measurement system.

The applicable drawings for the following functional description are schematic #0176-0104-001 and circuit board assembly Figure 12-32.

The temperature measurement system starts with a Wheatstone bridge (R1, R2, R3, and R4) with an open leg for insertion of the temperature sensing thermistor. Regulated bridge voltage is derived from U-10, a three terminal low drift voltage reference source and a voltage divider R5 and R6. The output of U-10 is 2.5V ± 1%, the nominal output of the divider (bridge voltage) is 1.1 Vdc, the limits are 1.07V to 1.13 volts.

The thermistor sensors interface with the control board at J-5, a 10 pin Mate-N-Lok header. The 0.1% resistor used for calibration purposes is mounted on the control board. Coded information from the microprocessor is fed into the four pole analog switch U-2 (AD-7511) to consecutively sequence the thermistors and the calibration resistor into the open leg of the bridge.

The bridge output (drop across R2) is fed into the analog to digital converter U-1, (AD-2020) on pins 10 and 11, the input LO and input HI terminals.

The AD-2020 is essentially a DPM chip for conversion of a millivolt signal at the input (-99 to +999 mv) to a 3 digit, serial BCD output. The output of the bridge is quite linear over the range of 25-40°C and is tailored to the A/D chip so that each millivolt within the useful range corresponds to 0.1°C (i.e., 300 mv=30.0°C). The multiplexed character, serial BCD outputs of the A/D chip are fed into the microprocessor on four lines of port 1. Three additional lines of port 1 are used to identify MSD, LSD, and NSD and to activate the "hold" function of the A/D converter.

Application of a voltage of 0.8 V minimum to 1.6 V maximum to the control (HOLD) pin (pin #6) of the A/D converter will cause it to stop conversion after the last valid conversion is completed, however, multiplexing of the BCD output data will continue. This feature of the A/D converter is utilized to reduce the amount of "jitter" or instability of the BCD data when it is being read into the microprocessor. When not on "HOLD", the voltage applied to pin 6 is 3.2-5.0V which causes the AD-2020 to run at its maximum rate of 48 to 168 conversions/second.

The analog switch (U-2), AD-7511, consists of four dielectrically isolated single pole CMOS switches. The switches are "ON" (closed) when their address lines are low (0.8V maximum), a voltage 3.0V minimum on the address line will turn the switches "OFF". The AD-7511 is the only component of the I.C. Incubator that requires both positive and negative power supplies. U-3, a 74LS42, 1 of 10 decoder is used to select the address lines of the switches in the analog switch U-2. The 74LS42 produces only one output low for any valid input combination. For all invalid input codes, all outputs will be high. Therefore, the 74LS42 is used to conserve output lines from the microprocessor, only two are needed to select the four sensors used in the bridge circuit.

The sequence of events that transpires to determine the temperature of any sensor are as follows:

The microprocessor outputs a 2 bit binary code on port 2 bits 6 and 7 which are used to select the sensor to be read. Let's assume the code is P26=0 and P27=1. Because A-2 and A-3 inputs of U-3 (1 of 10 decoder) are grounded, the complete input code is: A0=1, A1=0, A2=0, an A3=0. This is a valid input combination, so the result is the $\overline{01}$ output is low and all other outputs remain high. The $\overline{01}$ output of U-3 is connected to input A-3 of the analog switch, U-2. This will cause switch S3-D3 to be "ON", connecting the outlet wall sensor to the open leg of the bridge.

The A/D converter (U-1) is normally free-running and is asynchronous with the microprocessor clock. In this mode conversions are continuous and occurring at a rate of approximately 96 Hz; BCD is always present on the output lines. When the program reaches that portion which is involved with reading the output of the A/D converter, a "HOLD" command is given by outputting a logic high on port 1 bit 5 (P15). This positive voltage will turn on NPN transistor Q-1 which

* 2K EPROM on earlier version of control board.

effectively forms a voltage divider consisting of R13 and R14. The output of the voltage divider (1.2V normal, 0.8V minimum, and 1.6V maximum) is applied to the "HOLD" pin of the A/D converter. Conversion immediately ceases at that value determined by the last valid conversion. The BCD value of the last conversion will be continuously, serially outputted at a rate of approximately 167 Hz or about 5.9 ms for the three digit string.

The microprocessor identifies each digit of the BCD data by the binary code on bits 6 and 7 of port 1 (P16 and P17). U-9, a quad 2-input nand gate, is used along with Q-2 to encode the 3 digit strobe signals to a 2 bit binary code. After all three BCD digits have inputted and stored in RAM, the microprocessor releases the "HOLD" on the A/D converter by sending a logic 0 out on P15. The entire hold-read-store operation is then repeated after the next sensor has been selected.

The 8039 is a single component 8 bit microcomputer with a 128 x 8 internal RAM data memory, 27 I/O lines, an on-board oscillator and clock circuits. An external EPROM (U-6) a 2732 is used for program storage. An earlier version of the control board uses a 2716 EPROM for program storage.

Timing generation for the microprocessor is completely self-contained with the exception of the frequency reference source crystal (Y-l). The crystal provides the feedback and phase shift required for oscillation and has a nominal frequency of 3.579 MHz. The crystal is connected to pins 2 and 3 on the processor (XTAL 1 and XTAL 2). The output of the oscillator is then divided by 3 in the state counter to create a clock which defines state times of the machine (CLK). CLK is then divided by 5 in the cycle counter to provide another clock that defines a machine cycle which consists of 5 machine states. This clock is called address latch enable (ALE) because it is used with external memory. It may be monitored on the ALE output (pin 11) of the microprocessor. The nominal period of ALE in this system is 4.19 microseconds. The waveform present at ALE (pin 11) is shown in Figure 1-5.

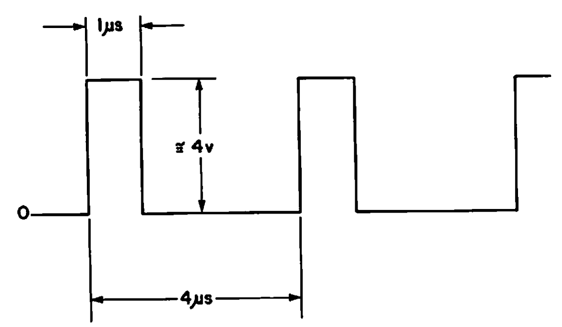


Figure 1-5
Address Latch Enable Signal

The 8039 has 27 lines which can be used for input or output functions. These lines are grouped as 3 ports of 8 lines each which can serve as either inputs or outputs and 3 testable inputs which can alter program sequences. Ports 1 and 2 have identical characteristics. Data written to these ports is statically latched and will remain unchanged until rewritten. When used as inputs, these lines are *non-latching. The structure* of ports 1 and 2 allows inputs and outputs on the same pin and also allows a mix of input and output lines on the same port.

The bus is also an 8-bit port which is a true bi-directional port with associated input and output strobes. The bus can also serve as a statically latched output or non-latched input port. Input and output lines cannot be mixed on this port.

The three remaining lines (T0, T1, and $\overline{INT}$) serve as inputs which are testable by the program. This feature permits program conditional branches without the necessity of reading an input port to the accumulator. $\overline{INT}$ is used to initiate a program interrupt on each positive half cycle of the input A.C. power line. The interrupt is used primarily as a "real time" timer with several intervals available up to a maximum of 15 minutes.

When the 2732 EPROM is used the $\overline{INT}$ signal is also used by the microprocessor at startup to determine if the machine is running at 50 Hz or 60 Hz. A different heat control program is used for 50 Hz operation because the lower fan speed results in less air flow.

U-6 on the earlier version power supply board (or U5 on the later version PS) is an opto-isolator used to provide square wave pulses at J-4 pin 4. Each cycle of the A.C. power line results in a high to low transition as shown on Figure 1-1 of the earlier version power supply board (or Figure 1-5 of the later version PS). U-9, a quad 2-input nand Schmitt trigger is used to square up the wave shape and clock U-4 a dual D edge triggered flip-flop. The $\overline{Q}$ output of the flip-flop is fed into this $\overline{INT}$ and T1 of the microprocessor. A low signal on the $\overline{INT}$ line causes an immediate vector to the interrupt routine. T1 (pin 39) on the processor is connected to the same signal as $\overline{INT}$ and used by the program for other timing functions. When the interrupt routine is complete, the microprocessor will issue a command to output a 0 on the $\overline{RD}$ Line (pin 8) which is connected to the clear input of the flip-flop; this flips the $\overline{Q}$ output to the high state until the next positive cycle of the A.C. power line. The interrupt waveform (pin 6) is shown in Figure 1-6.

1/Functional Descriptions

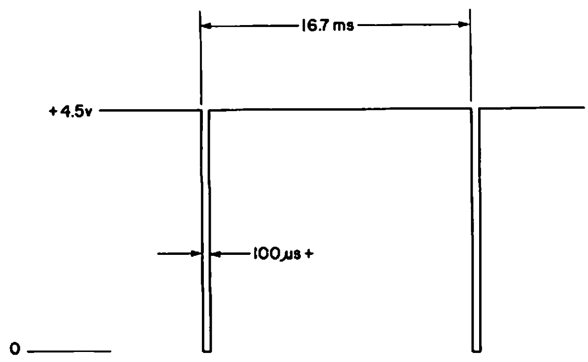


Figure 1-6
Interrupt Signal

T0 is used to monitor the status of the air safety relay. Under normal conditions, with the relay contacts closed, A.C. is fed into U-3 (or U1 on the later version PS), an opto-isolator on the power supply board which causes a pulsing input to U-8, a retriggerable multivibrator. As long as the pulses occur regularly, the $\bar{Q}$ output of U-8 will be low. If an overtemperature condition occurs, the relay will open the A.C input to the opto-isolator with a resultant logic high (+5V) on J-4 pin 8. The multivibrator will time out, and T0 will go to a logic high which is interpretted by the microprocessor as an alarm condition.

The $\overline{\text{RESET}}$ (pin 4) of the 8039 is used to initialize the program upon turn-on of the A.C. power to the incubator. Capacitor C-4 is used to provide a reset pulse of sufficient time to insure that the microprocessor is reset and starts with the program counter at 000.

VCC and VDD (pins 26 and 40) of the microprocessor are tied to the +5V standby power source which enters this board on J-4 pins 1 and 2 and J-6 pins 6, 7, and 8. Also connected to the standby power source are the EPROM (U-6), the address latch (U-7), and U-8, the watchdog timer. This was done to maintain the continuity of the program memory and data memory in the event of a momentary power outage.

For control boards with the 2716 EPROM: port 1, bit 4, pin 31 of the microprocessor, is used to inhibit (turn-off) the air safety circuit if the inlet wall temperature exceeds 45C or the average wall temperature exceeds 39C. A logic high (+2.4 minimum) will be outputted on this line if the alarm condition is present.

For control boards with the 2732 EPROM: port 1, bit 4, pin 31 of the microprocessor is not used. On older style boards updated to use the 2732 E-Proms pin 7 on connector J4 must be tied to circuit ground. This must be done so new control boards will work with old power supply boards.

Port 2, bit 5, (pin 36), is used as the heat control output line. To turn the heat on a logic low (0V normal, +.45V maximum) will be present on this line. Heat off is commanded by a logic high (+5V normal, 2.4V minimum).

Port 2, bit 4, (pin 35), serves to pulse U-8 (74LS123) retriggerable multivibrator which is used as the "watchdog timer". Under normal, no alarm conditions during the interrupt sequence (which occurs every 16.67 milliseconds), a high to low pulse approximately 17 microseconds wide is present on this pin. This pulse triggers U-8, keeping Q at a logic high level. If an alarm occurs or any other of several possible internal failures occur, the pulse will not be present and U-8 will time out. Q will now be at a logic low level with the result that the audible alarm will now sound off. If it is not possible to silence the alarm with the "alarm silence" switch, a major malfunction of the control system is indicated.

Port 2, bits 0, 1, and 2 are used for the highest order address bits of the external program memory (2716). Along with bit 3, these lines are also used for the I/O expander (8243) on the display board. A complete description of how these lines are used with the 8243 is contained in the functional description for the display board. The PROG line (pin 25) is also used with the I/O expander.

ALE, pin 11, is the address latch enable output. This signal occurs once during each machine cycle (approximately 4.2 microseconds). The negative edge of ALE strobes address information into external data and program memory.

PSEN, Pin 9, called program store enable. This output (active low) occurs only during a fetch to external program memory.

To calibrate the A/D converter precision resistances are entered through the patient probe jack. The procedure for calibration is as follows:

1. Input a resistance of 7686 ohms±0.1% (thermistor nominal value at 31.0°C).

2. Adjust the zero pot (R17) to get a displayed value of 31.0°C.

3. Input a resistance of 5496 ohms±0.1%.

4. Adjust the gain pot (R-16) to get a displayed value of 39.0°C.

5. Repeat steps 1 thru 4 until readings are exact at 31.0°C and 39.0°C. Blinking ±0.1 is acceptable.

6. Input a resistance of 5900 ohms.

7. Verify that readout is 37.3°C±0.1°C.

NOTE: All readings must be taken and adjustments made while in the patient mode with the increase touch switch depressed.

To check the reading of the calibrate resistor depress the control temperature decrease touch switch while in the patient temp mode. This should read 37.3°±0.1°C.

D. IC and GC Display Boards

The display board provides for all of the communications between the microprocessor and the person operating the incubator. This board contains the digital display packages and their associated driver/latch packages; the LED indicators for mode (IC Incubator only), alarms, and displayed parameter; the circuitry that interfaces with the touch panel switches; and the I/O expander to interface all of the preceding with the microprocessor. Selection of Servo or Manual mode is accomplished by toggling a TTL flip-flop (IC Incubator only). Current drain on the power supply is kept low by intensity modulation of the digital display. The 8243 I/O expander was placed on this board to keep the number of conductors between the microprocessor and this display at a minimum (only five leads are used).

Refer to the I.C. Display Board schematic (0176-0104-000) and the G.C. Display Board schematic (0176-0103-005) and Figures 12-30 and 12-31 for ease in tracing the circuits as they are described in the following explanation of specific circuit details:

The display board interfaces with the touch-switch panel and the control board. Regulated +5 VDC is connected to this board at J-7 pins 11, 12, 13, 14, and 15, D.C, common is brought in at J-7 pins 2, 3, 24, 25, and 26, and the +5 VDC standby (battery) supply is connected to J-7 pins 6, 7, and 8.

The touch panel consists of eight (six for G.C. Incubator) normally open, momentary contact, single pole switches and is connected to the display board at J-8 pins 1 through 9 (3 through 9 for G.C. Incubator). Pin 9 is common to all the switches. All of the switches are tied to +5 Vdc through 10K ohm pull-up resistors. Actuation of any switch will ground the pin of J-8 to which the switch is connected.

•The two mode switches (Servo and Manual) are connected to a TTL low power Schottky, D type, flip-flop, U-7 (74LS74). The outputs of U-7, Q and $\bar{Q}$ are connected to the mode indicator lamps DS-8 (Manual) and DS-7 (Servo), respectively. The manual mode switch is connected to the "clear" (Pin 1) input of U-7 and a large capacitor C-3. This is done to make certain that flip-flop will always come up in the "manual" mode (Q low and $\bar{Q}$ high) upon application of primary power. $\bar{Q}$ is also tied to #1 input of U-6 (74147) priority encoder. Therefore, the status of the mode flip-flop is determined by the microprocessor reading the voltage level of the $\bar{Q}$ output. $\bar{Q}$ low would indicate Servo mode, and $\bar{Q}$ high would occur in the manual mode.

•Note that VCC of U-7 is connected to the 5 volt standby power source. This was done to maintain the mode as selected in the event of a power outage or glitch on the A.C. line. This flip-flop is the only component on the display board connected to the standby power source.

•This paragraph applies to I.C. Incubator Display Boards only.

The priority encoder U-6 (74147) outputs a 3 bit binary coded signal in response to input line with the highest priority that is held low. In other words, regardless of how many switches are depressed simultaneously, the output code on the A-B-C output lines will be determined by the single input line with the highest priority. In this particular instance, the alarm silence switch (Input #7) has the highest priority and the Q line from the mode flip-flop (control temperature decrease switch for G.C. Incubator) Input #1 has the lowest priority.

The input/output expander U-5 (8243) provides the main data link between the microprocessor and the display board. The purpose of the 8243 is to increase the number of I/O lines available to feed data into the microprocessor and output information from the microprocessor. The 8243 consists of four 4-bit bi-directional I/O ports and one 4-bit port to interface with the microprocessor. Therefore, the 8243 provides a net gain of twelve (12) I/O lines.

The 8243 interfaces with Port 2 bits 0 thru 3 of the microprocessor. These lines are available on the display board at J-7 pins 16, 17, 18, and 19. Another input line to the 8243 designated PROG is required to indicate whether data or address and command informaton is at port 2 of the microprocessor. The PROG signal enters the display board at J-7 pin 1. The four available I/O ports of the 8243 are called ports 4, 5, 6, and 7. In this application, port 4 is used as an input port and ports 5, 6, and 7 are used solely as outputs.

Three data lines from the priority encoder U-6 are tied to port 4 of the I/O expander. The fourth bit of port 4 is tied to logic high (+5 V through a 10K ohm resistor).

Normally under software control the input or read operation of the 8243 I/O expander could be exercised by applying proper logic levels to the four input lines plus correct wiggling of the PROG line Using this type of operational check would also test the functions of U-6 (priority encoder) and flip-flop U-7.

The following example will show how these three components can be easily checked, and it will also serve as a functional description of their operation:

> The status of each front panel switch and the state of the mode flip-flop (I.C. Incubator only) can be determined by placing the 8243 in the "Read Port 4" mode. All four input lines of the 8243 are placed at the logic low mode (0 Vdc nominal, - 0.45V maximum). PROG was in the high state (5 Vdc nominal, 2.4 V minimum). The address code (P21&20=00) means - port 4 and the instructor code (23&22=00) means - "READ" are latched upon the high to low transition of the PROG pin. As soon as the read operation and port address are decoded, the appropriate outputs are tri-stated, and the input buffers switched on.

1/Functional Descriptions

As long as the strobe input (PROG) is held low, it would be possible to read at P20-23 the status of the port 4 inputs. In this configuration there would be a particular 4-bit code on P20-23 for each position of the switches on the touch panel and the two states of the mode flip-flop (U-7) (I.C. Incubator only). The "read" mode of the 8243 can be terminated by a low to high transition of the PROG pin.

Each of the twelve output lines of the 8243 can be functionally checked in a similar manner to the input port check described previously. Operation code and port address are latched from the input port 2 on the high to low transition of the PROG pin. On the low to high transition of PROG, data on port 2 is transferred to the logic block of the specified output port. After the logic manipulation is performed, the data is latched and outputted. The data will remain latched until new valid outputs are entered.

This type of selective operation of the 8243 would permit testing of each bit of each output port of the 8243 using the on-board indicator LED's and seven segment displays. Obviously the LED's, displays, and drivers would be exercised by the same operation.

An example of the "write mode" static operation of the 8243 is as follows:

Port 2 is preloaded with a code of 0101 and the PROG line given a high to low transition. This instructs the 8243 to "write" to port 5. The data on port 2 could now be set at 1110 and the PROG pin toggled from low to high. This would result in P50 line going low and P51, 52, and 53 going high. With this configuration of port 5, the environmental temperature LED would be on and all other LED's connected to Port 5 would be off. Table 1-1 lists the read and write data codes input to the 8243 and the correct input and outputs for this application.

U-2, U-3, and U-4 are 9374 display drivers which are connected to Port 7 of the 8243 for their BCD data input. Individual drivers are selected by the three highest order bits of Port 6 (P-61 is used for the MSD, P-62 for the NSD, and P-63 for the LSD). The 9374 is a seven segment decoder/driver with latches on the address inputs and active low constant current outputs to drive LED's directly. This device accepts a 4-bit binary code and produces output drive to the appropriate segments of the 7-segment display.

Latches on the four data inputs of U-2, U-3 and U-4 are controlled by an active low on latch enable $\overline{LE}$. When $\overline{LE}$ is low, the state of the outputs is determined by the input data. When $\overline{LE}$ goes high, the last data present at the input is stored in the latches, and the outputs remain stable. The decimal point of the LSD is hardwired to D.C. common thru a 200 ohm resistor and therefore is "ON" whenever 8 Vac power is applied to the board.

Diodes D1, D2, D4, and D5 are used for intensity modulation of the LED displays. These diodes rectify the 8 Vac in and drop the voltage to keep the maximum peak voltage to the 9374's in the on state to less than 8 volts.

DS-1, 2, and 3 are 0.43 inch high red seven-segment displays of the common mode type with left-hand decimal poins.

Tables 1-1 through 1-4 provide operational information about the 8243 Input/Output Expander.

Table 1-1
8243 I/O Operational Check Information

1 READ OPERATION

Input to Port 2	**Prog**	**Input to Port 4**	**Switch**	**Output from Port 2**
23-22-21-20		43-42-41-40	ON	23-22-21-20
0 0 0 0	Hi to Lo	1 1 1 1	- -	- - - -
	Lo	1 1 1 1	None	1 1 1 1
	Lo	1 0 0 0	Alarm Sil.	1 0 0 0
	Lo	1 0 0 1	Cont. Temp.	1 0 0 1
	Lo	1 0 1 0	Pat. Temp.	1 0 1 0
	Lo	1 0 1 1	Env. Temp.	1 0 1 1
	Lo	1 1 0 0	Up	1 1 0 0
	Lo	1 1 0 1	Down	1 1 0 1
	*Lo	1 1 1 0	Servo	1 1 1 0
	Lo	1 1 1 1	Manual	1 1 1 1

*Applies to I.C. Incubator

1/Functional Descriptions

Table 1-2
8243 I/O Operational Check Information

2 WRITE (OUTPUT) OPERATIONS

Input to Port 2	Program	Output to Port 5	Indication
23-22-21-20		53-52-51-50	
0 1 0 1	High to Low	- - - -	- -
1 1 1 0	Low to High	1 1 1 0	Env. Temp. LED On
0 1 0 1	High to Low	- - - -	- -
1 1 0 1	Low to High	1 1 0 1	Pat. Temp. LED On
0 1 0 1	High to Low	- - - -	- -
1 0 1 1	Low to High	1 0 1 1	Cont. Temp. LED On
*0 1 0 1	High to Low	- - - -	- -
*0 1 1 1	Low to High	0 1 1 1	Pat. Temp./Sensor LED On

*Applies to I. C. Incubator Only

Table 1-3
8243 I/O Operational Check Information

Input to Port 2	Program	Output to Port 6	Indication
23-22-21-20		63-62-61-60	
0 1 1 0	High to Low	- - - -	- -
1 1 1 0	Low to High	1 1 1 0	Sys. Fail LED On
0 1 1 0	High to Low	- - - -	- -
1 1 0 1	Low to High	1 1 0 1	MSD Strobe Low
0 1 1 0	High to Low	- - - -	- -
1 0 1 1	Low to High	1 0 1 1	NSD Strobe Low
0 1 1 0	High to Low	- - - -	- -
0 1 1 1	Low to High	0 1 1 1	LSD Strobe Low

Table 1-4
8243 I/O Operational Check Information

WRITE (OUTPUT) OPERATIONS

Input to Port 2	Prog	Output to Port 7	Display
23-22-21-20		73-72-71-70	
0 1 1 1	Hi to Lo	- - - -	- -
0 0 0 0	Lo to Hi	0 0 0 0	0
0 1 1 1	Hi to Lo	- - - -	- -
0 0 0 1	Lo to Hi	0 0 0 1	1
0 1 1 1	Hi to Lo	- - - -	- -
0 0 1 0	Lo to Hi	0 0 1 0	2
0 1 1 1	Hi to Lo	- - - -	- -
0 0 1 1	Lo to Hi	0 0 1 1	3
0 1 1 1	Hi to Lo	- - - -	- -
0 1 0 0	Lo to Hi	0 1 0 0	4
0 1 1 1	Hi to Lo	- - - -	- -
0 1 0 1	Lo to Hi	0 1 0 1	5
0 1 1 1	Hi to Lo	- - - -	- -
0 1 1 0	Lo to Hi	0 1 1 0	6
0 1 1 1	Hi to Lo	- - - -	- -
0 1 1 1	Lo to Hi	0 1 1 1	7
0 1 1 1	Hi to Lo	- - - -	- -
1 0 0 0	Lo to Hi	1 0 0 0	8
0 1 1 1	Hi to Lo	- - - -	- -
1 0 0 1	Lo to Hi	1 0 0 1	9
0 1 1 1	Hi to Lo	- - - -	- -
1 0 1 0	Lo to Hi	1 0 1 0	-
0 1 1 1	Hi to Lo	- - - -	- -
1 0 1 1	Lo to Hi	1 0 1 1	E
0 1 1 1	Hi to Lo	- - - -	- -
1 1 0 0	Lo to Hi	1 1 0 0	H
0 1 1 1	Hi to Lo	- - - -	- -
1 1 0 1	Lo to Hi	1 1 0 1	L
0 1 1 1	Hi to Lo	- - - -	- -
1 1 1 0	Lo to Hi	1 1 1 0	- -
0 1 1 1	Hi to Lo	- - - -	- -
1 1 1 1	Lo to Hi	1 1 1 1	Blank

NOTE: Strobe for each digit must be actuated to change display. See information on Port 6 outputs.

E. Phototherapy Lamp and Controller

Refer to the phototherapy lamp schematic 0176-0102-002 for the following description of the specific operating characteristics of the phototherapy lamp.

The unregulated 20 volts DC is applied to the input of the inverter between the positive red lead and the negative black lead. The inverter converts the 20 volts DC to approximately 1000 volts AC±200 volts AC @20 KHz with no load. The voltage drops to approximately 140 volts RMS @20 KHz with the lamps connected. The output voltage is present between the red and orange leads of the inverter. The output voltage of the inverter is applied to the three fluorescent lamps connected in series.

The high frequency (18 to 20 KHz) excitation output provides efficient lamp irradiance, fast starting and quiet operation.

2/Specifications

A. Electrical Characteristics

1. IC Incubator
Power Requirements:
Domestic
120V 60 Hz 0304-3256-910
Export
220 V 50 Hz 0304-3256-911
240 V 50 Hz 0304-3256-912
100 V 50/60 Hz 0304-3256-913

2. GC Incubator
Power Requirements:
Domestic
120V 60 Hz 0304-3255-910
Export
220 V 50 Hz 0304-3255-911
240 V 50 Hz 0304-3255-912
100 V 50/60 Hz 0304-3255-913

Power Consumption: 500 watts

Power Failure Alarm Battery: Rechargeable Nickel Cadmium for 9V applications

3. Phototherapy Lamp
Power Requirements:
Domestic
120V 60 Hz 0304-3300-900
Export
220 V 50 Hz 0304-3300-901
240 V 50 Hz 0304-3300-902
100 V 50/60 Hz 0304-3300-903

Power Consumption: 60 watts

Inverter Specifications:
Input: 22-28 VDC
Input Current: 2.8 amp
Output E: 140V RMS nominal @ 24 VDC input
Output I: 425 ma nominal @ 24 VDC input
Efficiency: 85%
Power Dissipation: 9 watts nominal
Frequency: 20KHZ nominal
Load: 3-20 watt fluorescent lamps in series
No Load Output: 1300 - 1700V peak

4. Radiant Warmer
Power Requirements:
Domestic
120V 60 Hz 0304-3310-800
Export
220 V 50 Hz 0304-3310-802
240 V 50 Hz 0304-3310-801
100 V 50/60 Hz 0304-3310-803

Power Consumption: 130 watts

B. Performance Characteristics

1. IC Incubator
a. Patient Temperature Measurement
Range: 15°C to 50°C
Accuracy: ±0.3°C within range
Resolution: 0.1°C

b. Control Temperature Range
Servo Mode: 35.0°C to 37.5°C
Manual Mode:
37.5C Incubator, 28.0 to 37.5 degrees C.
39.0C Incubator, 28.0 to 39.0 degrees C.
41.0C Incubator, 28.0 to 41.0 degrees C.

c. Alarm Functions:
1. ENVIRONMENTAL TEMP
37.5C Incubator, > or = to 39.0 degrees C.
39.0C Incubator, > or = to 40.5 degrees C.
41.0C Incubator, > or = to 42.5 degrees C.
2. Inlet Wall Temperature Sensor
37.5C Incubator, > or = to 45.0 degrees C.
39.0C Incubator, > or = to 46.5 degrees C.
41.0C Incubator, > or = to 48.5 degrees C.
3. Infant Compartment Air Temperature (Air Safety Adjustment)
37.5C Incubator, > or = to 39.5 ± 0.5 degrees C.
39.0C Incubator, > or = to 41.0 ± 0.5 degrees C.
41.0C Incubator, > or = to 43.0 ± 0.5 degrees C.
4. Wall temperature sensors are electrically open or short circuited.
5. Patient temperature sensor opens, shorts, or is disconnected from the incubator while in the servo mode.
6. Calibration drift is greater than ±0.5°C (The controller compensates for error within ±0.5C).
7. The microprocessor timed pulse is absent from the program.
8. The difference between the patient temperature and the control temperature exceeds ±1.0°C in the SERVO MODE.
9. Power failure alarm activates when power is lost or if the power cord is disconnected.

d. Proportional Heat Control
Features zero voltage switching which minimizes electromagnetic interference (EMI).

e. Air Filter Effectiveness
Removes airborne particles down to 0.5 microns.

f. Infant Compartment Fresh Air Flow Rate
Over 80 liters per minute.

g. Maximum Humidity Control Setting
50% ± 10%

2/Specifications

2. GC Incubator

a. Patient Temperature Measurement
Range: 15°C to 50°C
Accuracy: ±0.3°C within range
Resolution: 0.1°C

b. Control Temperature Range
28.0°C to 37.5°C

c. Alarm Functions:
1. ENVIRONMENTAL TEMP ≥ 39°C
2. Inlet wall temperature sensor ≥ 45°C
3. Infant compartment air temperature >39.5±0.5°C
4. Wall temperature sensors are electrically open or short circuited.
5. Calibration drift is greater than ±0.5°C (The controller compensates for error within ±0.5°C).
6. The microprocessor timed pulse is absent from the program.
7. Power failure alarm activates when power is lost or if the power cord is disconnected.

d. Proportional Heat Control
Features zero voltage switching which minimizes electromagnetic interference (EMI).

e. Air Filter Effectiveness
Removes airborne particles down to 0.5 microns.

f. Infant Compartment Fresh Air Flow Rate
Approximately 60 to 80 liters per minute depending on barometric pressure and line voltage frequency.

g. Maximum Humidity Control Setting
50%±10%

3. Phototherapy Lamp
Output
Minimum of 4 μW/cm^2/nm in the 425 to 475 nm spectrum at bed level.

C. Safety Characteristics

1. Isolation voltage
2500 Vrms @ 60 Hz from the patient probe to phase and neutral lines for one minute.

2. Leakage Current
From enclosure to ground with ground wire open and with UL, CSA, or AAMI test loads.

a. Less than 100 microamps for equipment rated at 120 V, 60 Hz, 100 V, 50 Hz; and 100 V, 60 Hz.

b. Less than 200 microamps for equipment rated at 220 V, 50 Hz and 240 V, 50 Hz.

c. From patient lead to ground with ground wire open is less than 50 microamps with UL, CSA, or AAMI test loads.

3. Self Test
The microprocessor performs a self test and software verification at power on.

D. Environmental Characteristics

1. Ambient Operating Temperature: 21°C to 30°C

2. Storage Temperature: -25°C to 60°C

3. Noise level within hood:
58 dBA maximum with 45 dBA or less ambient.

E. Physical Characteristics

Infant Compartment Volume: Approximately 90 liters

Maximum shelf load: 22 kg (48.4 lbs.)

Dimensions: 67 x 56 x 28 inches

3/Check-Out Procedure

WARNING: Do not perform the Check-Out Procedure while a patient occupies the incubator.

CAUTION: Operate the incubator at an ambient temperature between 20-29°C (68-85°F). If the incubator is operated below 60°F the SYSTEM FAIL-OVERTEMP alarm activates and prevents normal operation.

A. Mechanical Checks

WARNING: Disconnect the power to the incubator for this portion of the Check-Out Procedure.

1. Incubator Hood

a. Check the condition of the hood. The hood should be free of cracks or other signs of deterioration.
b. Check the rotation of the hood for smooth operation.
c. Check that the hood remains stationary in any open position. Open the front hood section to the detent position. Open the back hood section an equal amount.
d. Check the condition of the hood wipers (felt and rubber).
e. Check the condition of the hood bumpers on the lower base, the rear upper retainer and the ends of the incubator hood. The bumpers should be free of cracks or other signs of deterioration.
f. Close the incubator hood. Verify that front and rear hood extrusions are centered on each wall sensor tip (Figure 3-1). Refer to Section 7 if adjustment is required.

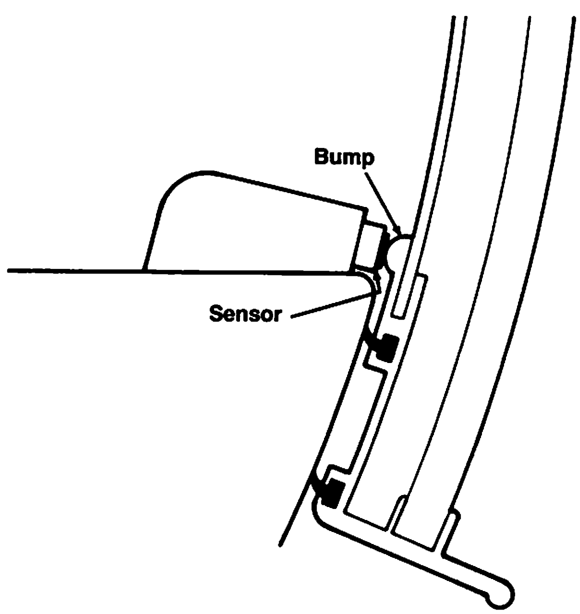


Figure 3-1.
Proper Hood Alignment

g. Check the hood thermometer if present for cracked glass and separation of the liquid column. Replace the thermometer if it is cracked or separated.

CAUTION: Mercury vaporizes readily when heated. Hazardous concentrations of mercury vapor could result if the thermometer is accidently broken. For safety the thermometer (obsolete accessory) is completely encapsulated in a Teflon® sheath. If the thermometer is broken remove it from service immediately. Be careful not to allow the broken glass to puncture the Teflon sheath and allow the mercury to escape. If the thermometer and Teflon sheath are broken be sure to thoroughly clean and remove all traces of mercury from the incubator. Wear protective handware or take other measures to guard against cuts in case of thermometer breakage.

h. Check the condition of the tube support clamps if present.

2. Tilt Mechanism

a. Check the tilt mechanism for smooth operation.
b. Check the five locking positions; horizontal, 5 and 10 degrees left and right of horizontal.

3. Blower Wheel Operation

Connect the power cord for this step only. Switch the power ON and check the blower wheel operation in the five tilted positions; horizontal, 5 and 10 degrees left and right of horizontal. Verify that the blower wheel does not rub against the housing in any position. If the blower wheel is rubbing refer to the blower motor replacement procedure of Section 9.

4. Bed Platform

a. Remove the mattress and check its condition.
b. Release the four latches which hold the bed in position and remove the bed. Check the operation of the four latches.
c. Check the condition of the infant partition.
d. Check that the refresher instructions and all warning labels are in place and legible.
e. Check the condition of the conductive rubber bumper on the bottom of the bed platform.

5. Lower Unit

a. Remove the air filter and humidifier reservoir cover.
b. Close the incubator hood.
c. Lift the cover of the humidifier fill port and drain any water in the humidifier reservoir into a container by turning the humidifier fill mechanism down. If the humidifier has water in it, tilt the incubator with the tilt mechanism.
d. Remove the humidifier fill mechanism by pulling it out. **The humidifier fill mechanism must be in the open position for installation and removal.**

®Teflon is a registered trademark of E.J. DuPont de Nemours Company.

e. Check the condition of the O-Ring and rubber seals of the fill mechanism.
f. Open the incubator hood.
g. Remove the humidifier reservoir and check it for structural damage.
h. Remove the blower wheel by holding the blower wheel and turning the blower wheel nut counterclockwise.
i. Inspect the blower wheel for structural damage.
j. Reinstall the blower wheel and tighten the blower wheel nut securely on the motor shaft. (Make sure blower wheel turns freely.)
k. Reinstall the humidifier reservoir and cover.
l. Close the incubator hood.
m. Reinstall the humidifier fill mechanism. **The humidifier fill mechanism must be in the open position for installation and removal.**
n. Check the operation of the humidity control by rotating the control between the fully open and fully closed positions.
o. Open the incubator hood.
p. Inspect the air filter for dust and lint. The air filter must be changed at least every two months; longer use may result in a restriction of the air flow. Replace the air filter if necessary and record the installation date on the filter.
q. Reinstall the bed and close the four latches.
r. Reinstall the mattress.
s. Close the incubator hood.

6. Shelf and Rail Mounting system

a. Check that the rail mounting upright fastens securely to both sides of the incubator.
b. Check that the shelf mounts securely on the rail mounting brackets. Check that the locking thumb nuts tighten properly and hold the brackets in place.

7. Cabinet

a. Check that the mounting bolts that hold the lower unit to the cabinet are securely fastened.
b. Check the operation of the drawers if present.

8. Casters

a. Check for free operation of the casters.
b. Lock the two front casters and check if the incubator is held in place.

9. Power Cord

Inspect the power cord for cracks, cuts or other damage. A damaged power cord must be replaced.

10. Overall Inspection

Make an overall visual inspection of the incubator and accessories for damaged or missing parts.

Refer to Section 6 for operational and safety checks.

4/Static Control

(Figure 4-1)

CAUTION: Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

The Static Control Work Station (Part No. 0175-2311-000) contains the following:
1–24" by 24" piece of Velostat® material
1–15' ground cord with a one megohm safety resistor
1–4-1/2' ground cord with a one megohm safety resistor
1–wrist strap

CAUTION: The Velostat material is conductive. Do not place electrically powered circuit boards on it.

1. Remove all non-conductive items (cellophane tape, foam coffee cups, polyester materials, etc.) from the work station, and if you are wearing a long sleeve shirt, roll up your sleeves. Keep all ungrounded personnel away from your work area.

2. Open the static control work station fully and lay it out on the top of the incubator cabinet.

3. Attach the 15 foot ground cord (located in one of the pouches of the static control work station) to the snap fastener on the Velostat material.

WARNING: The ground cord includes a one megohm current limiting resistor. Do not remove this resistor from the ground cord.

4. Attach the alligator clip end of the ground cord to a reliable electrical ground.

5. After completing the ground connection, check the resistance between the Velostat material and ground, and the Velostat material and the wrist strap. A resistance of less than one megohm indicates alternate current paths to ground which must be corrected.

6. Connect one end of a 24 inch jumper wire (not included in the work station) to the Velostat material and the other end to the metal flange of the incubator's main control unit.

WARNING: Do not connect the alligator clip of the ground cord to the inside of the control unit.

7. Wrap the wrist band around your wrist so that the Velostat plastic section contacts your skin. Press the hook and loop fastener together for a comfortable fit.

8. Attach the wrist strap ground cord to your wrist band with the snap fastener and to the Velostat material with the alligator clip.

® Velostat is a registered trademark of the 3M Company.

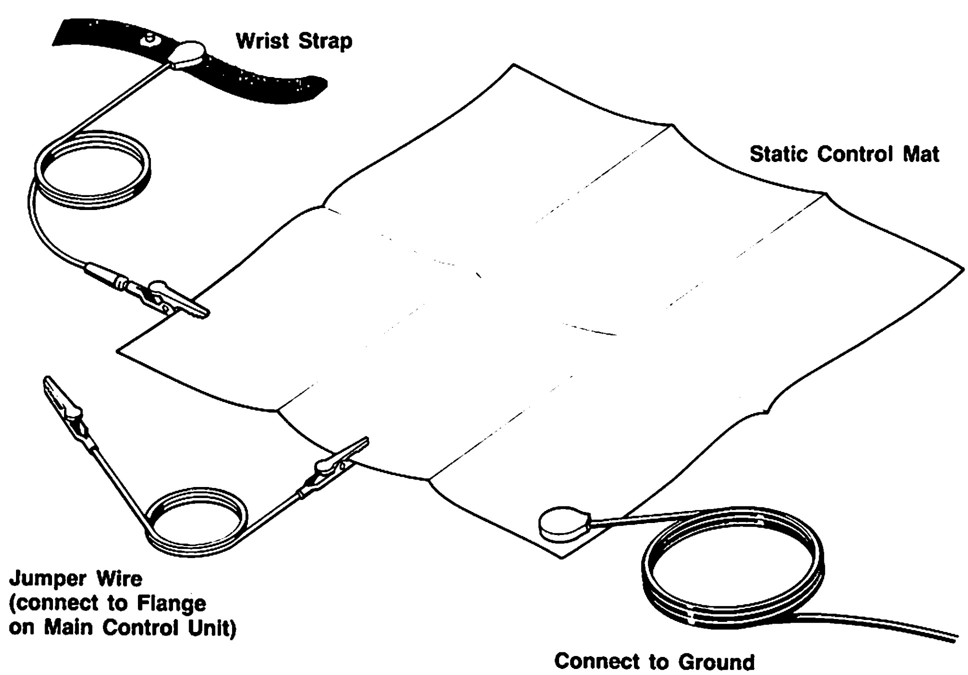


Figure 4-1
Static Control Work Station

5/Temperature Simulator Setup

A. Description:

The Ohmeda Temperature Simulator is a precision instrument for the calibration and adjustment of the Ohmeda Intensive Care (IC) Incubator. The simulator can also be used for temperature related troubleshooting. A test cable is used to connect the simulator to the IC Incubator. Precision resistors are substituted for the thermistor sensors which are used to gather temperature information for the control circuits. The temperature simulator substitutes resistance values for the front wall sensor, rear wall sensor, air safety sensor, and patient probe sensor in the incubators.

Table 1 indicates the resistance values that are connected to the incubator's control unit for each S2 switch position. The temperatures indicated next to the resistance values are temperatures that are displayed on the control panel. For example, when the S2 switch is in the I5 position, the PATIENT TEMP displayed will be 37° C. The ENVIRONMENTAL TEMP will be 35° C (the average of the inlet and the outlet wall temperatures), the inlet wall temperature will be 39° C and the outlet wall temperature will be 31° C.

A checkout procedure for the Ohmeda Temperature simulator and test cable is described later in this section. When the operation of the temperature simulator or test cable is in question, use the checkout procedure to verify proper operation. A schematic is also included in this manual.

Table 5-1

S2 Switch Position	Patient Temperature P5 (Pins 1, 2)	Inlet Wall Sensor P5 (Pins 5, 7)	Outlet Wall Sensor P5 (Pins 9, 10)	Air Safety Sensor P2 (Pins 2, 3)
I 1	7,686 (31°C)	7,686 (31°C)	7,686 (31°C)	See Note
I 2	5,496 (39°C)	5,496 (39°C)	7,686 (31°C)	82000
I 3	7,060 (33°C)	5,496 (39°C)	7,686 (31°C)	82000
I 4	36000 (open)	5,496 (39°C)	7,686 (31°C)	82000
I 5	5,970 (37°C)	5,496 (39°C)	7,686 (31°C)	82000
I 6	3000 (short)	5,496 (39°C)	7,686 (31°C)	82000
I 7	5,900 (37.3°C)	4,120 (45.5°C)	7,686 (31°C)	82000
I 8	5,900 (37.3°C)	5,496 (39°C)	7,686 (31°C)	82000
I 9	5,900 (37.3°C)	4,990 (41.3°C)	5,900 (37.3°C)	82000
I 10	5,900 (37.3°C)	5,496 (39°C)	7,686 (31°C)	82000
I 11	6,190 (36.2°C)	5,496 (39°C)	7,686 (31°C)	82000
I 12	5,900 (37.3°C)	3,900 (47.2°C)	7,686 (31°C)	82000
I 13	5,900 (37.3°C)	4,120 (45.9°C)	5,900 (37.3°C)	82000

NOTE: A meter reading of 90.2K ohms will be shown with switch S1 in the INC position and the air safety switch fully counterclockwise (CCW). A reading of 40.2K ohms will be shown with switch S1 in the INC position and the air safety switch fully clockwise (CW). With switch S1 in the DVM CAL position the circuit will be open.

5/Temperature Simulator Setup

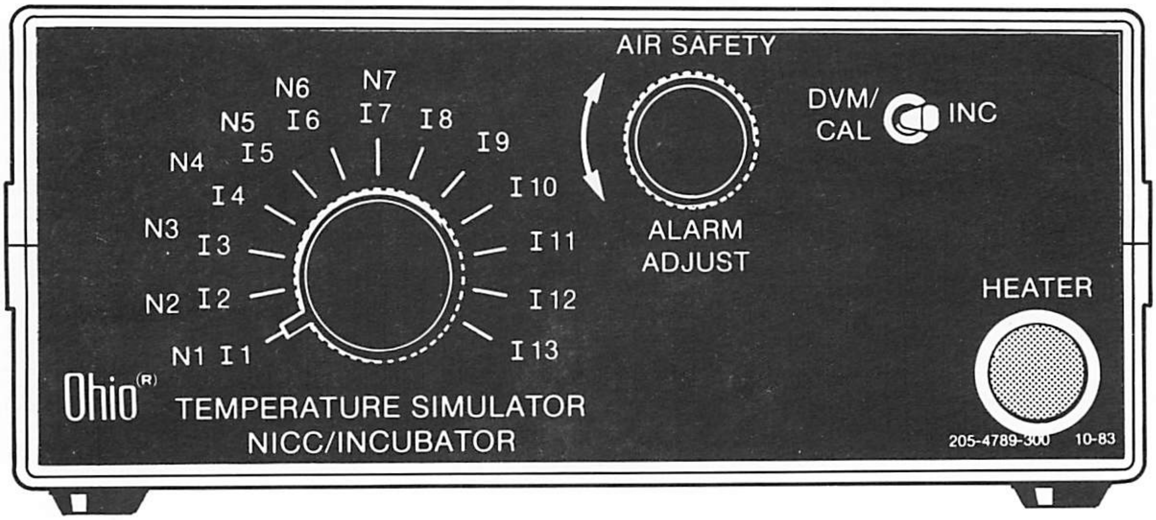


Figure 5-1
Front Panel of Temperature Simulator

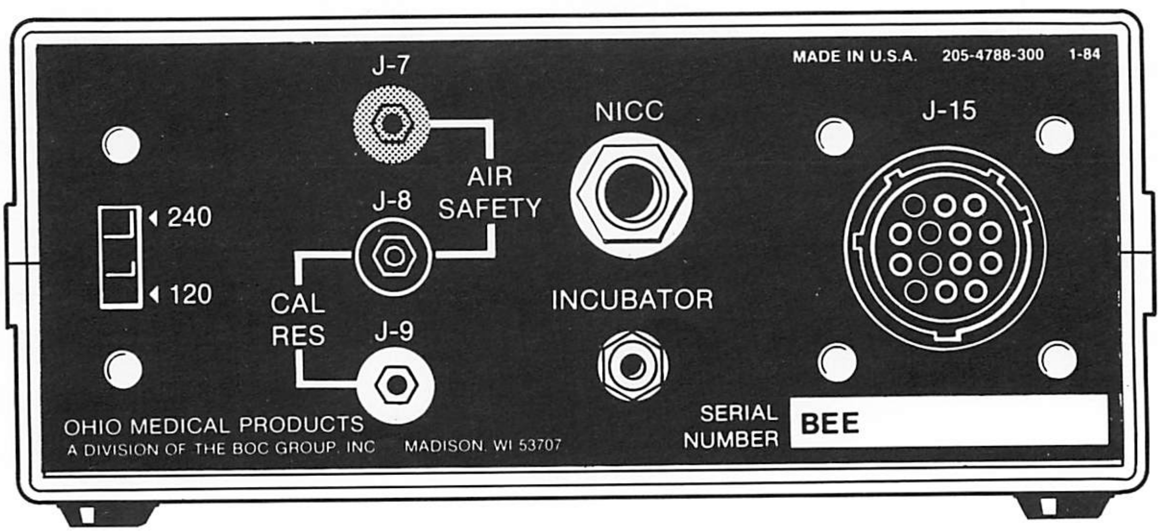


Figure 5-2
Back Panel of Temperature Simulator

5/Temperature Simulator Setup

B. Temperature Simulator Connection

Figure 5-3

WARNING: Disconnect power to the incubator before connecting or disconnecting the temperature simulator.
CAUTION: Use the static control work station (Ohmeda Stock No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive electrical components. Do not use the static control work station when working on an energized unit.

NOTE: Allow the incubator to warm up for five minutes before calibrating the unit.

1. Disconnect the incubator power cord from the electrical receptacle.

2. Connect the round 14-pin connector (P15) on the test cable to J-15 at the rear of the temperature simulator as shown in Figure 5-2.

3. Remove the cable connector P-2 from J-2 on the power supply board of the incubator.

4. Connect the 4-conductor male Mate-N-Lok connector from the test cable into J-2 of the power supply board.

5. Reconnect the cable connector P-2 which was disconnected above, into the female Mate-N-Lok connector on the test cable.

6. Disconnect P-5 from J-5 on the control board and set aside.

7. Connect the 10-pin Make-N-Lok connector on the test cable to the J-5 connector on the control board of the incubator.

8. Connect the single red wire (audible alarm line) on the test cable to pin 3 of P-5.

9. Connect the power cord to an appropriate power source and turn the incubator power switch to the ON position.

C. Temperature Simulator Removal

1. Switch the power switch on the incubator to the OFF position.

2. Disconnect the incubator power cord from the power source.

3. Remove the single red wire of the test cable from pin 3 of P-5.

4. Remove the test cable connector from the control board connector J-5.

5. Reconnect P-5 to the J-5 connector on the control board.

6. Remove the test cable connector which is connected to J-2 on the power supply board.

7. Reconnect P-2 to the J-2 connector on the power supply board.

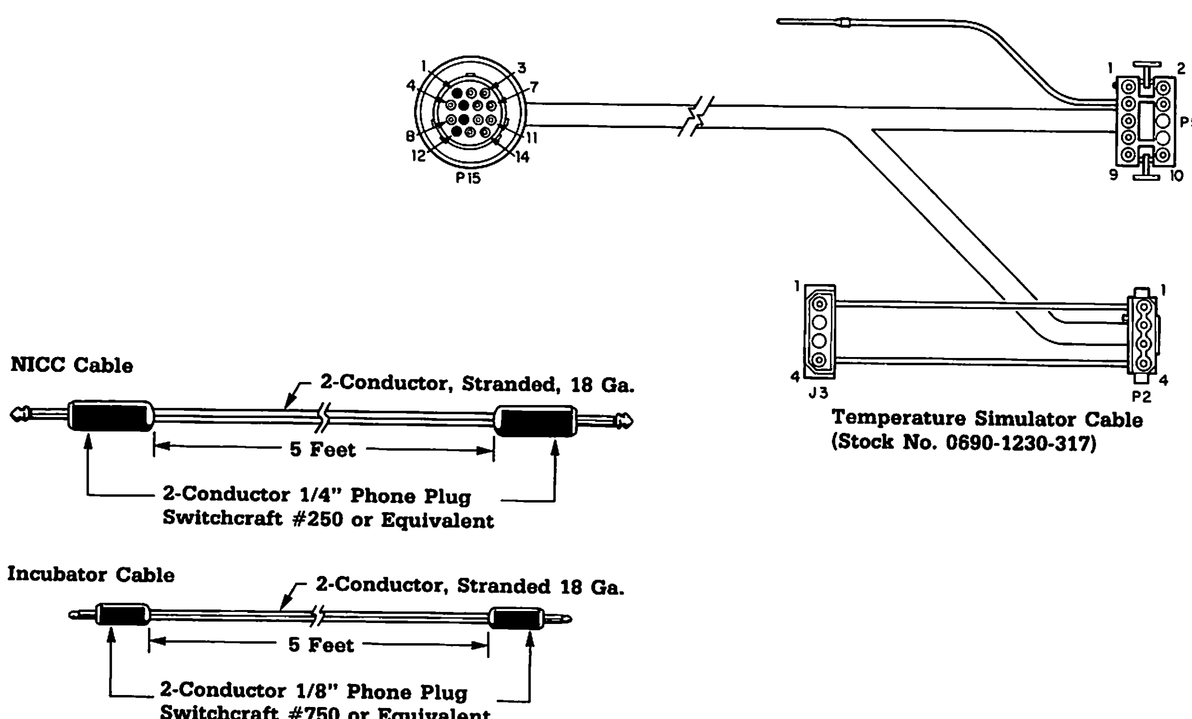


Figure 5-3
Temperature Simulator Test Cables

5/Temperature Simulator Setup

D. Checkout Procedure

This checkout procedure is for the Ohmeda Temperature Simulator (0217-2788-800) and the Test Cable (0690-1230-317). Use this procedure to verify proper operation of the simulator and the test cable.

1. Perform the resistance checks as outlined in Table 5-2. Take the resistance measurements at the rear of the simulator or at the end of the test cable when it is attached to the simulator.

2. Measure the resistance from the tip and the sleeve of the INCUBATOR phone jack to J15-3 and J15-7. The resistance measured must be less than 0.15 ohms.

3. Apply 120 VAC between J3-1 and J3-4 or P2-1 and P2-4 and verify that the neon lamp is on.

4. Measure the resistance of the test cable terminals listed in Figure 5-3. The resistance measured must be less than 0.15 ohms.

- **a.** P15-3 to P5-1
- **b.** P15-7 to P5-2
- **c.** P15-11 to P5-5
- **d.** P15-14 to P5-7
- **e.** P15-2 to P5-9
- **f.** P15-6 to P5-10
- **g.** P15-10 to P2-2
- **h.** P15-13 to P2-3*
- **i.** P15-4 to P2-1
- **j.** P15-8 to P2-4
- **k.** Tip of red wire to P-3

*NOTE: Verify that the shield covering these conductors is tied to P2-3 at the P2 end of the cable. The shield must not be connected to P15.

Table 5-2
Acceptable Simulator Resistance Values

S-2 Switch	SW S1	SW R1	Min Ohms	Max Ohms	Connection Points	Connection Points
I1-8, 10-12	-	-	7678	7694	J15-2 & J15-6	P5-9 & P5-10
I9, 13	-	-	5894	5907	J15-2 & J15-6	P5-9 & P5-10
I1	-	-	7678	7694	J15-3 & J15-7	P5-2 & P4-1
I2	- -		5490	5501	J15-3 & J15-7	P5-2 & P5-1
I3	-	-	7053	7067	J15-3 & J15-7	P5-2 & P5-1
I4	- -		34200	37800	J15-3 & J15-7	P5-2 & P5-1
I5	- -		5910	6030	J15-3 & J15-7	P5-2 & P4-1
I6	-	-	2970	3030	J15-3 & J15-7	P5-2 & P5-1
I7-10, 12, 13	-	-	5894	5907	J15-3 & J15-7	P5-2 & P5-1
I11	-	-	6128	6252	J15-3 & J15-7	P5-2 & P5-1
N1	-	-	1466	1469	NICC Jack	NICC Jack
N2	- -		1198	1201	NICC Jack	NICC Jack
N3	-	-	1161	1164	NICC Jack	NICC Jack
N4	-	-	1332	1335	NICC Jack	NICC Jack
N5	-	-	1302	1305	NICC Jack	NICC Jack
N6	-	-	1215	1218	NICC Jack	NICC Jack
N7	-	-	2970	3030	NICC Jack	NICC Jack
I1	-	-	7678	7694	J15-11 & J15-14	P5-7 & P5-5
I2-6, 8, 10	-	-	5490	5501	J15-11 & J15-14	P5-7 & P5-5
I7, 13	-	-	4116	4124	J15-11 & J15-14	P5-7 & P5-5
I9	-	-	4985	4995	J15-11 & J15-14	P5-7 & P5-5
I12	-	-	3861	3939	J15-11 & J15-14	P5-7 & P5-5
I1	DVM	-	40159	40240	J8 & J9	N/A
I1	DVM	CCW	87660	92740	J7 & J8	N/A
I1	DVM	CW	40159	40240	J7 & J8	N/A
I1	INC	CCW	87660	92740	J15-10 & J15-13	P2-3 & P2-2
I1	INC	CW	40159	40240	J15-10 & J15-13	P2-3 & P2-2
I2-13	-	-	77900	86100	J15-10 & J15-13	P2-2 & P2-2

5/Temperature Simulator Setup

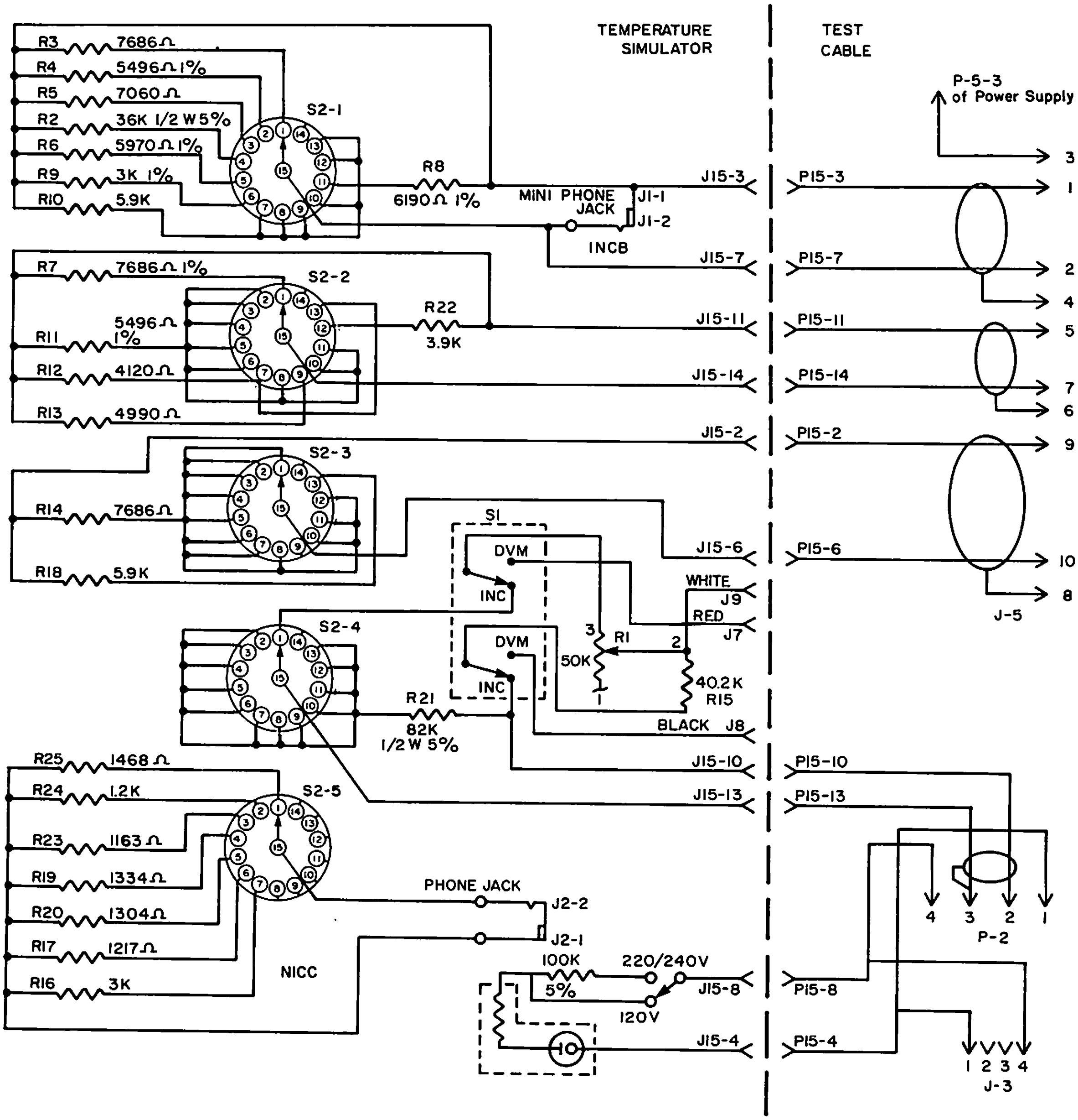


Figure 5-4
Temperature Simulator with Cable Schematic

6/Calibration and Adjustments

CAUTION: Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

NOTE: The Intensive Care and General Care Incubators are similar in design. Calibration of the Intensive Care and General Care Incubators is covered in this section. When the wording "IC Incubator Only" appears in a step title the entire step does not pertain to the GC Incubator. In addition some sections are written for only the IC or the GC Incubator.

Note: The three Intensive Care Incubators are referred to in this procedure as the 37.5 IC Incubator, the 39.0 IC Incubator, and the 41.0 IC Incubator.

The Control Temperature range for the 37.5 IC Incubator is from 28.0 to 37.5 degrees C.

The Control Temperature range for the 39.0 IC Incubator is from 28.0 to 39.0 degrees C.

The Control Temperature range for the 41.0 IC Incubator is from 28.0 to 41.0 degrees C.

Refer to the Specifications Section for more information.

Note: Allow up to 20 seconds for the alarm light to cancel for some procedures.

A. Static Control Integrity Check

Check the conductive bumpers (located on the front upper hood retainer) and neoprene wipers (located on hood retainers) for less than 100K ohms of resistance.

B. Isolation and Shielding Check

1. Patient Probe Isolation Check
Use an ohmmeter and check for infinite resistance between the metal disc and the mini-connector tip and sleeve of the patient probe. A very low resistance reading means the patient probe is not isolated and must be replaced.

2. EMI Shielding Check
Use an ohmmeter and measure the resistance between the metal retainer on the left front bed latch and the ground pin of the power cord. The resistance should be less than 100K ohms.

C. Power Supply Board Check (Board Layout-Section 12, Schematic Section 13)

WARNING: When performing service procedures with the power connected, extreme care must be taken to avoid direct or indirect contact with any of the electrical circuitry because of existing shock hazard.

1. Control Unit Access

a. Place the power switch in the OFF position.
b. Disconnect the power cord from the power source.
c. Remove the two screws which mount the control unit to the incubator.
d. Slide the control unit out. For easy removal make sure the power cord is not wrapped tightly on the cord holder.

Table 6-1

Test Points on Power Supply Bd.	D.C. Voltage
1. TP 7 (earlier version only)	+8.0V (Min +7 Max +12) (Unregulated voltages)
2. TP 8	5±0.2V
3. TP 4	-9±1V
4. TP 6	+9.6±0.05V
Adjust pot R18 on P.S. Bd. if necessary	
5. TP 5	5±0.2V
6. With the meter attached to TP 5, remove the power cord from the power source and check for 5±0.2V. (This checks the standby battery supply).	

2. Power Supply Voltage Check

a. Connect the negative lead of a DMM to TP-9 (ground) on the power supply board.
b. Connect the positive lead of a DMM to the test points listed in Table 6-1, one at a time.
c. Connect the power cord to the proper power source and turn the power switch ON. Allow the unit to warm up for five minutes before taking readings. Verify that the supply voltage is present at all test points. Switch OFF the power before making connections to the other test points (line voltage is still present at some points).
d. Disconnect the power cord and then disconnect the DMM from the power supply board.

D. Temperature Simulator Connection

(Figure 5-1)

WARNING: Disconnect power to the incubator before connecting or disconnecting the temperature simulator.

NOTE: Allow the incubator to warm up for five minutes before performing this procedure. Incubators with a control temperature range of 28 degrees C to 39 or 41 degrees C require different procedures which have been included and noted. Perform the alternate steps required when necessary. Determine the incubators control temperature range before starting this procedure.

1. Disconnect the incubator power cord from the electrical receptacle.

2. Connect the round 14-pin connector (P15) on the test cable to J-15 at the rear of the temperature simulator.

3. Remove the cable connector P-2 from J-2 on the power supply board of the incubator.

4. Connect the 4-conductor female Mate-N-Lok connector from the test cable into J-2 of the power supply board.

5. Reconnect the cable connector P-2 which was disconnected above, into the female Mate-N-Lok connector on the test cable.

6. Disconnect P-5 from J-5 on the control board and set aside.

7. Connect the 10-pin Make-N-Lok connector on the test cable to the J-5 connector on the control board of the incubator.

8. Connect the single red wire (audible alarm line) on the test cable to pin 3 of P-5.

9. Connect the power cord to an appropriate power source and turn the incubator power switch to the ON position.

E. Air Safety Circuit Check and Adjustment (Schematic Section 13)

1. DVM Accuracy Check

a. Place the air safety switch of the temperature simulator in the DVM/CAL position.

NOTE: If the incubator alarm activates press the alarm silence touch switch.

b. Connect the DVM to connectors J-8 and J-9 (CALS RES) on the back of the temperature simulator.
c. For the B & K Model 2815 meter (or equivalent) use the 100K range and the ohms function position. The resistance reading should be between 39.8K ohms and 40.6K ohms (nominal 40.2K ohms).

IMPORTANT: If your meter is out of calibration return it to the manufacturer for calibration. The air safety circuit check and calibration depends on the accuracy of the DVM.

2. Air Safety Check:

a. Connect the DVM to connectors J-7 and J-8 (AIR SAFETY) on the back of the temperature simulator.
b. Place the selector switch of the temperature simulator in the I1 position, the air safety switch in the INC position, and the alarm adjust control fully CCW.
c. Verify that the incubator is in the manual mode (IC Incubator only).
d. Set the CONTROL TEMP to 33.0 degrees C.
e. If no alarm is present proceed to the next step.

NOTE: If an alarm is present the alarm must be cancelled before the check procedure can be completed. First refer to the calibration procedure in step 4 to cancel the air safety alarm. If the alarm does not cancel refer to Section F, A/D Converter Check and Adjustment. After silencing the alarm return back to this section and continue with this procedure. If the alarm is still present after completing Section F. refer to the troubleshooting section.

3. Heater ON Check:

a. Set the incubator CONTROL TEMP to 37.5 degrees C.
b. Verify that the heater lamp indicates full heat. This may take approximately 20 seconds.
c. Verify that no alarm condition is present at this time.
d. SLOWLY rotate the ALARM ADJ control clockwise until the alarm just trips. Be careful not to overshoot the alarm trip point.
e. After the SYSTEM FAIL/OVERTEMP alarm activates, switch the air safety switch to the DVM position.
f. Verify the resistance measurements as follows:

1. The resistance measurement for the 37.5 IC Incubator should be between 50,700 ohms and 50,900 ohms. If not, go to the Calibration Procedure.

2. The resistance measurement for the 39.0 IC Incubator should be between 47,760 ohms and 47,960 ohms. If not, go to the Calibration Procedure.

3. The resistance measurement for the 41.0 IC Incubator should be between 43,740 ohms and 43,940 ohms. If not, go to the Calibration Procedure in step 5.

NOTE: If you repeat the test make sure the heater lamp indicates full heat. Replace the power supply board when the specified resistance readings are not attainable after calibration.

4. Reset with Heater ON - Operational Check

a. Place the air safety switch on the simulator in the incubator (INC) position.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm activates.
c. SLOWLY rotate the ALARM ADJ control counterclockwise until the alarm just resets. Listen for the relay to reset and watch for the alarm light to extinguish.
d. If steps 2, 3, and 4 are completed as stated no calibration is required. Proceed to the A/D Converter Check & Adjustment in step F.

5. Calibration Procedure:

a. Place the air safety switch in the DVM position.
b. Set the incubator CONTROL TEMP to:
1. 37.5 degrees C for the 37.5 IC Incubator.
2. 39.0 degrees C for the 39.0 IC Incubator.
3. 41.0 degrees C for the 41.0 IC Incubator.

c. Rotate the ALARM ADJ control for a DVM resistance reading of:
1. 50,800 ohms for the 37.5 IC Incubator.
2. 47,860 ohms for the 39.0 IC Incubator.
3. 43,840 ohms for the 41.0 IC Incubator.

d. Place the air safety switch in the incubator (INC) position.

IMPORTANT: There are two versions of the power supply board which have been used in incubators. You must determine which of the two versions you have before adjusting R17. The newer board has two physical features that distinguish it from the older board. All test points (TP) are located along the top edge of the new board for easy access. Also both adjustment potentiometers (R17 and R18) are located together, next to the test points.

Older Version Power Supply Board
ALARM PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board clockwise (CW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the older version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R-17 on the power supply board counterclockwise (CCW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

Newer Version Power Supply Board
ALARM PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is present adjust R17 on the power supply board counterclockwise (CCW) to reset the alarm. Wait for the heater lamp to indicate full heat. Slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

ALARM NOT PRESENT: The following adjustment procedure is for the newer version of the power supply board. If the SYSTEM FAIL/OVERTEMP alarm is not present wait for the heater lamp to indicate full heat then slowly adjust R17 on the power supply board clockwise (CW) until the alarm just activates. Replace the power supply board if adjustment is not possible.

e. Perform steps 2, 3, and 4 of Section E. Air Safety Circuit Check and Adjustment.

F. A/D Converter Check and Adjustment (Control Board Layout Section 12)

1. A/D Converter Check

a. Place incubator in the manual mode (IC Incubator Only).
b. Place the selector switch in position I1, the air safety switch in the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).
c. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 31.0 ± 0.1 degrees C, if not go to step 2, A/D Zero Adjustment.
d. Select simulator switch position I2.
e. Press PATIENT TEMP and press and hold the increase touch switch. Verify that the digital display indicates 39.0 ± 0.1 degrees C, if not go to step 3, A/D Gain Adjustment, if correct proceed to step 4, A/D Converter Final Check.

2. A/D Zero Adjustment

a. Place the selector switch in position I1, the air safety switch in the INC position, and the ALARM ADJUST control fully counterclockwise (CCW).
b. Press and hold the increase touch switch.
c. Adjust potentiometer R17 on the control board for a digital display of 31.0 ± 0.1 degrees C.
d. Return to Section F1, A/D Converter Check, and repeat steps d and e.

3. A/D Gain Adjustment

a. Place the selector switch in position I2.
b. Press and hold the increase touch switch.
c. Adjust potentiometer R16 on the control board for a digital display of 39.0 ±0.1 degrees C.
d. Repeat Section F2, A/D Zero Adjustment, and Section F3, A/D Gain Adjustment, until both the A/D Zero and A/D Gain are properly adjusted.

4. A/D Converter Final Check

a. Select simulator switch position I3.
b. Press the PATIENT TEMP touch switch.
c. Press and hold the increase touch switch.
d. Verify that the digital display indicates 33.0 ± 0.1 degrees C, if not return to Section F. A/D Converter Check and Adjustment.

G. Calibration Resistor Check

1. Press the PATIENT TEMP touch switch.

2. Press and hold the CONTROL TEMP decrease touch switch. The displayed temperature should be 37.3 ± 0.1 degrees C, if not return to Section F. A/D Converter Check and Adjustment.

H. Final Incubator Checks with Temperature Simulator:

1. PATIENT-TEMP/SENSOR Alarm Check (IC Incubator Only)

a. Set temperature simulator switch to position I3.
b. Press the MANUAL MODE touch switch.
c. Set the control temperature for 37.5° C.
d. Press the SERVO MODE touch switch.
e. Set the control temperature for 37.5° C.
f. Verify that the PATIENT-TEMP/SENSOR alarm activates (both audible and visual) within 20 seconds (24 seconds for the 50 Hz models).
g. Verify that the heater light remains ON or flashing.
h. Press the ALARM SILENCE touch switch.

2. Check for Open Patient Probe Alarm (IC Incubator Only)

a. Press the PATIENT TEMP touch switch.
b. Select simulator switch position I4.
c. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates. The PATIENT-TEMP/SENSOR alarm light should still be lit.
d. Verify that the simulator heater lamp is OFF.
e. Verify that the displayed temperature is less than 5 degrees C or HH.H is indicated.
f. Select simulator switch position I5.
g. Verify that the alarms reset, and that the simulator heater lamp is ON or flashing.

3. Check for Shorted Patient Probe Alarm (IC Incubator Only)

a. Select simulator switch position I6.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the simulator heater lamp is OFF.
e. Verify that the displayed temperature is greater than 45 degrees C or HH.H is indicated.

4. Inlet and Outlet Sensor Temperature Display Check

a. Place the incubator in the MANUAL MODE (IC Incubator Only).
b. Verify that all alarm conditions are cancelled.
c. Press the ENVIRONMENTAL TEMP touch switch.
d. With the simulator switch in position I6, verify an ENVIRONMENTAL TEMP display of 35.0 ± 0.1 degrees C.
e. Press and hold the increase touch switch to display the inlet wall temperature.
f. Verify that the displayed temperature is 39.0 ± 0.1 degrees C.
g. Press and hold the decrease touch switch to display the outlet wall temperature.
h. Verify that the displayed temperature is 31.0 ± 0.1 degrees C.

5. Inlet Wall Temperature Greater than 45 degrees C Alarm Check for the 37.5 IC Incubator

a. With the simulator switch in position I6, place the incubator in MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 37.5 degrees.
b. Press the ENVIRONMENTAL TEMP touch switch.
c. Verify that the simulator heater lamp is ON or flashing.
d. Select simulator switch position I7.
e. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
f. Press the ALARM SILENCE touch switch.
g. Press the hold the increase touch switch to display the inlet wall temperature.
h. Verify that the displayed temperature is greater than 45 degrees C and that the simulator heater lamp is OFF.
i. Select simulator switch position I8.
j. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

6. Inlet Wall Temperature Greater than 45.0C Alarm Check for the 39.0 and 41.0 IC Incubators.

Note: When the control temperature is between 37.6 degrees C and 39.0 or 41.0 degrees C., in the manual mode, the alarms are increased by the CONTROL TEMP minus 37.5.

a. With the simulator switch in position I6, place the incubator in the MANUAL MODE (IC Incubator Only) and set the CONTROL TEMP to 38.5 degrees C.
b. Press the ENVIRONMENTAL TEMP touch switch.
c. Verify that the simulator heater lamp is ON or flashing.
d. Select simulator switch position I12.
e. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
f. Press the ALARM SILENCE touch switch.
g. Press the hold the increase touch switch to display the inlet wall temperature.
h. Verify that the displayed temperature is greater than 46.5 degrees C and that the simulator heater lamp is OFF.
i. Select simulator switch position I8.
j. Verify that the SYSTEM FAIL/OVERTEMP alarm resets and the simulator heater lamp is ON or flashing (may take approximately 20 seconds to activate).

6/Calibration and Adjustments

7. Environmental Temperature Greater Than 39 degrees C Alarm Check for the 37.5 IC Incubator

a. Select simulator switch position I9.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the ENVIRONMENTAL TEMP display is greater than 39 degrees C and that the simulator heater lamp is OFF.

8. Environmental Temperature Greater Than 39.0C Alarm Check for the 39.0 and 41.0 IC Incubator

Note: When the control temperature is between 37.6 degrees C and 39.0 or 41.0 degrees C., in the manual mode, the alarms are increased by the CONTROL TEMP minus 37.5.

a. Select simulator switch position I13.
b. Verify that the SYSTEM FAIL/OVERTEMP alarm (both audible and visual) activates.
c. Press the ALARM SILENCE touch switch.
d. Verify that the ENVIRONMENTAL TEMP display is greater than 40.5 degrees C and that the simulator heater lamp is OFF

9. Check for SERVO MODE Low End Alarm (IC Incubator Only)

a. Select simulator switch position I10.
b. Place the incubator in the SERVO MODE.
c. Press the PATIENT TEMP touch switch and record the temperature displayed.
d. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C below the noted patient temperature.
e. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).
f. Verify that the heater is OFF.
g. Increase the CONTROL TEMP 0.4 degrees C. Be careful not to overshoot
h. Verify that the alarm cancels.

10. Check for SERVO MODE High End Alarm (IC Incubator Only)

a. Select simulator switch position I11.
b. Press the PATIENT TEMP touch switch and record the temperature displayed.
c. Press the CONTROL TEMP touch switch and adjust the control temperature 1.2 degrees C above the noted patient temperature. Be careful not to overshoot.
d. Verify that the PATIENT-TEMP/SENSOR alarm (both audible and visual) activates in 20 seconds (24 seconds for 50 Hz models).
e. Decrease the CONTROL TEMP 0.4 degrees C. Be careful not to undershoot.
f. Verify that the alarm cancels and the simulator heater lamp is ON or flashing. This may take approximately 20 seconds.

I. Temperature Simulator Removal

1. Switch the power switch on the incubator to the OFF position.

2. Disconnect the incubator power cord from the power source.

3. Remove the single red wire of the test cable from pin 3 of P-5.

4. Remove the test cable connector from the control board connector J-5.

5. Reconnect P-5 to the J-5 connector on the control board.

6. Remove the test cable connector which is connected to J-2 on the power supply board.

7. Reconnect P-2 to the J-2 connector on the power supply board.

J. Air Safety Checks

1. Air Safety Thermistor Resistance Check
a. Connect the DVM between the cable end of P2-2 and P2-3 (2 inside pins of 4 pin connector P-2).
b. Check for an open (infinite resistance) or low resistance) condition. Typical resistance values for the air safety sensor are shown in the Appendix Page A-4. If an open or short condition exists check the air safety mate-n-lok connector located behind the control panel. Also check the cable continuity between J-2 and the mate-n-lok connector.
c. Place your finger on the air safety thermistor located behind the outlet wall sensor (front wall sensor).
d. Verify a change in the resistance measurement as the thermistor temperature changes. If the resistance does not change or is out of specification change the air safety sensor.
e. Disconnect the DVM and reconnect P-2 to J-2 on the power supply•board.

2. Final Air Safety Check (37.5C Incubator Only)

NOTE: This test must be conducted in an ambient room temperature between 68 and 80 degrees F.
a. Allow the incubator to stabilize at a room temperature between 68 and 80 degrees F.
b. Reconnect the power cord and switch the power on.
c. Set the incubator to a control temperature of 37.5C in the manual mode (IC Incubator Only).
d. Set the humidity control to minimum humidity.
e. Place the incubator in the environmental temperature mode.
f. Allow the incubator to heat to 37.5C.
g. Verify that an air safety alarm does not occur during this initial warm up period. A 39.0 degree C environmental temperature alarm may occur during this test. The 39.0 degree C alarm may be distinguished from the air safety alarm by observing the environmental temperature at which the alarm condition cancels. If the alarm cancels at an environmental temperature of exactly 38.8 degrees C the alarm was the 39.0 degree environmental temperture alarm. If the alarm cancels at an environmental temperature lower than 38.8 degrees C the alarm was an air safety alarm.
h. Allow the incubator to stabilize at 37.5C.
i. Verify an ENVIRONMENTAL TEMP display of 37.5±0.5C.

K. Patient Probe

1. Examination

a. Examine the patient probe, lead wire and miniature phone plug for damage and wear.
b. Connect the patient probe to the incubator.
c. Place the incubator in the MANUAL MODE.
d. Press the PATIENT TEMP touch switch.
e. Gently flex the patient probe lead wire and watch for an HHH temperature display. An open or shorted patient probe is indicated by an HHH temperature display. Replace the patient probe if an open or shorted condition exists.

2. Accuracy Check

a. Fill a styrofoam cup with warm water (approximately 37.0C).
b. Attach the patient probe to the calibration thermometer (OMP #0217-2999-800) tip using a rubber band to hold it in place. The metal disk of the probe must be contacting the thermometer.
c. Place the patient probe and calibration thermometer in the cup of water. Gently, stir the water with the thermometer while performing the next step.
d. Check that the thermometer and temperature displayed in the patient temperature mode agree within ±0.5C.

L. Control Unit Closure and Static Control Work Station Removal

1. Slide the control unit in. Keep the control unit to the left side as far as possible.

2. Replace the two screws which mount the control unit to the incubator cabinet.

3. Remove the wrist strap and ground cords. Place them in the static control work station pouches.

4. Fold up the static control work station.

M. IC Incubator Control Unit Check

1. Connect the incubator power cord to an appropriate power source (see rating plate for proper voltage, etc.). Place the power switch in the ON position and verify the following:
a. The unit is operating in the MANUAL MODE and the respective yellow indicator lamp is lit.
b. The CONTROL TEMP is at 33.0C.

2. Press the ALARM SILENCE touch switch and verify that all the indicator lamps are lit with the exception of the SERVO MODE indicator. The display should indicate three number eights (88.8).

3. Connect the patient temperature probe to the incubator.

4. Press the SERVO MODE touch switch and verify the following:
a. The yellow indicator light for the servo mode is lit.
b. A short beep tone is heard from the alarm.
c. The CONTROL TEMP is at 36.5C.
d. The PATIENT-TEMP/SENSOR alarm will activate if the patient temperature is more than 1C from the control temperature.

5. Press the ALARM SILENCE touch .switch.

6. Remove the patient temperature probe from the connector and verify that the SYSTEM FAIL/OVERTEMP alarm sounds and the red indicator lamp is lit.

7. Press the ALARM SILENCE touch switch and verify that the alarm is silenced and the indicator lamp remains ON.

8. Connect the patient temperature probe and verify that the SYSTEM FAIL/OVERTEMP indicator lamp is extinguished.

9. Press the ENVIRONMENTAL TEMP touch switch and verify that the respective indicator lamp is lit and the temperture displayed is between 20.0C and 40.0C.

10. Press the PATIENT TEMP touch switch and verify that the respective indicator lamp is lit and the temperature displayed is between 20.0C and 40.0 C.

11. Hold the patient temperature probe between your fingers and verify that the displayed temperature changes.

12. Press the MANUAL MODE touch switch and verify that a short beep tone is heard and the respective indicator lamp is lit.

13. Press the CONTROL TEMP touch switch and verify that the respective indicator lamp is lit.

14. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum manual control temperature attainable is 37.5C, 39.0C or 41.0C depending on the type of incubator you have.

15. Press the CONTROL TEMP touch switch.

16. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum manual control temperature attainable is 28.0C.

17. Press the CONTROL TEMP touch switch and verify that the control temperature may not be increased or decreased approximately 30 seconds (36 seconds for 50 Hz models) after pressing the CONTROL TEMP touch switch.

18. Press the SERVO MODE touch switch. If necessary, press the ALARM SILENCE touch switch.

19. Press the CONTROL TEMP touch switch.

20. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum servo control temperature attainable is 37.5C.

21. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum servo control temperature attainanble is 35.0C.

N. GC Incubator Control Unit Check

1. Connect the incubator power cord to an appropriate power source, (see rating plate for proper voltage etc.) and switch the power ON. The CONTROL TEMP should be at 33.0C.

2. Press the ALARM SILENCE touch switch and verify that all the indicator lamps are lit. The display should indicate three number eights (88.8).

3. Connect the patient temperature probe to the incubator.

4. Press the ENVIRONMENT TEMP touch switch and verify that the respective indicator lamp lights and the temperature displayed is between 20.0C and 40.0C.

5. Press the PATIENT TEMP touch switch and verify that the respective indicator is lit and the temperature displayed is between 20.0C and 40.0C.

6. Hold the patient temperature probe between your fingers and verify that the displayed temperature changes.

7. Press the CONTROL TEMP touch switch and verify that the respective indicator lamp is lit.

8. Press and hold the CONTROL TEMP ↑ increase touch switch and verify that the maximum control temperature attainable is 37.5C.

9. Press the CONTROL TEMP touch switch.

10. Press and hold the CONTROL TEMP ↓ decrease touch switch and verify that the minimum control temperature attainable is 28.0C.

11. Press the CONTROL TEMP touch switch and verify that the control temperature may not be ↑ increased or ↓ decreased approximately 30 seconds (36 seconds for 50 Hz models) after pressing the CONTROL TEMP touch switch.

O. Inlet and Outlet Sensor Check

1. Rotate the incubator hood to the fully retracted position.

2. Press the ENVIRONMENTAL TEMP touch switch.

3. Press and hold the CONTROL TEMP ↑ increase touch switch. The displayed temperature is the inlet wall (rear wall) surface sensor temperature.

4. Place your index finger on the back inlet wall surface sensor and verify a change in the displayed temperature.

5. Press and hold the CONTROL TEMP ↓ decrease touch switch. The displayed temperature is the outlet wall (front wall) surface sensor temperature.

6. Place your index finger on the front outlet wall surface sensor and verify a change in the displayed temperature.

7. Close the incubator hood.

P. Calibration Resistor Check

1. Press the PATIENT TEMP touch switch.

2. Press and hold the CONTROL TEMP ↓ decrease touch switch. The displayed temperature should be 37.3C±0.1C. When the displayed temperature is 37.3C±0.5C or greater a SYSTEM FAIL/OVERTEMP alarm activates.

Q. IC Incubator Power Failure Alarm and Memory Test

NOTE: The battery (located on the power supply board) must be in a fully charged condition to pass the 10 minute test or partially charged to pass the two minute test.

Replace the battery every 2 years or when it is defective. There is no maintenance required for the battery.

1. Place the incubator in the SERVO MODE and adjust the control temp for 35.5C.

2. Place the Incubator in the MANUAL MODE and adjust the CONTROL TEMP for 30.5C.

3. Place the incubator in the SERVO MODE.

4. Disconnect the power cord (do not turn the power switch OFF) and verify that the power failure alarm sounds and all display indicators are extinguished. Allow the alarm to sound for 2 minutes.

WARNING: If the power failure alarm is tested for 10 minutes the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient.

5. Reconnect the power cord and verify that the incubator returns to a control temperature of 35.5C in the SERVO MODE of operation.

6. Place the incubator in the MANUAL MODE and verify a control temperature of 30.5C.

R. GC Incubator Power Failure Alarm and Memory Test

NOTE: The battery (located on the power supply board) must be in a fully charged condition to pass the 10 minute test or partially charged to pass the two minute test.

Replace the battery every 2 years or when it is defective. There is no maintenance required for the battery.

1. Record the control temperature.

2. Disconnect the power cord (do not turn the power switch OFF) and verify that the power failure alarm sounds and all display indicators are extinguished. Allow the alarm to sound for 2 minutes.

WARNING: If the power failure alarm is tested for 10 minutes the incubator must be connected to the appropriate power source and operated for 24 hours to recharge the battery before allowing the incubator to be occupied by a patient.

3. Reconnect the power cord and verify that the incubator returns to the recorded control temperature.

S. IC Incubator Audible Alarm Timer Check

1. With the patient probe disconnected, press the SERVO MODE touch switch. Verify an audible alarm and the SYSTEM FAIL/OVERTEMP indicator is lit.

2. With a stopwatch begin timing the audible alarm silence when the ALARM SILENCE touch switch is pressed.

3. Wait approximately 13 minutes and record the time that the audible alarm activates. The alarm should sound in 13±2 minutes.

T. Operational Check

CAUTION: Placing the incubator close to external heating and cooling devices can cause incorrect temperature readings.

1. Place the incubator in an area that is relatively free from air currents and has an ambient temperature between 70F and 85F.

2. Place a calibrated mercury thermometer about four inches above the center of the mattress.

3. Connect the power cord to the power source.

4. Switch the incubator power ON.

5. Adjust the CONTROL TEMP to 34C in the MANUAL MODE. Set the humidity control to minimum with no water in the reservoir.

6. Allow approximately 1 hour warmup time. (May need more or less time depending on ambient temperature.)

7. Compare the temperature on the mercury thermometer (the air temperature in incubator) with the displayed environmental temperature. The temperatures should be 34±1.0C.

U. Servo Mode Operational Check (IC Incubator Only)

1. Disconnect the main test cable and ground wire from the temperature simulator.

2. Connect a 2 conductor cable with 1/8 inch miniature phone plugs (obtain locally) on each end to the temperature simulator and to the patient probe jack on the incubator.

3. Select simulator switch position I11.

4. Press the PATIENT TEMP touch switch and note the temperature displayed.

5. Place the incubator in the SERVO MODE.

6. Adjust the control temperature to 0.5 degrees C above the noted patient temperature.

7. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

8. Use a stop watch and start timing when you place the incubator in the SERVO MODE.

9. After 11 minutes have passed, press the MANUAL MODE touch switch.

10. Verify that the control temperature has increased to 33.3 degrees C.

11. Press the PATIENT TEMP touch switch and note the temperature displayed.

12. Place the incubator in the SERVO MODE.

13. Adjust the control temperature 0.5 degrees C below the noted temperature.

14. Place the incubator in the MANUAL MODE and set the control temperature to 33.0 degrees C.

15. Use a stop watch and start timing when you place the incubator in the SERVO MODE.

16. After 11 minutes have passed, press the MANUAL MODE touch switch.

17. Verify that the control temperature has decreased to 32.7 degrees C.

18. Disconnect the 2 conductor cable from the temperature simulator and the incubator.

V. Phototherapy Lamp Check

1. Check the overall condition of the phototherapy lamp and controller. The lamp cover should be free of cracks or other signs of deterioration.

2. When the Phototherapy Lamp is mounted in the upright the swivel mount should hold the lamp in position.

3. Check the phototherapy control unit for bent power plug pins.

4. Check the control unit power cord connector for bent pins (earlier version only).

5. Check the strain relief on the power cord.

6. Check the power cord for cuts or worn insulation and replace it if necessary.

7. Connect the power cord from the phototherapy lamp housing to the controller (earlier version only).

8. Connect the incubator to the appropriate power source. Install the controller into one of the accessory slide positions next to the incubator main control unit. Check for easy installation and removal.

9. Switch the phototherapy controller power ON and verify the lamps light.

W. Radiant Warmer Check

Refer to the Radiant Warmer Operation and Maintenance Manual for the Check-Out Procedure (Section 4.3)

X. Electrical Safety Check

1. Power Cord Inspection

a. Examine the power cord for damage and wear.

b. Examine the power plug for loose or bent pins. Replace the power cord if the cord or plug is damaged.

2. Fuses

Check for the correct value and type of fuses on the incubator and phototherapy lamp control unit if present.

3. Power Outlets and Accessory Outlets

Check for correct polarity and proper tension on all outlets present on the incubator.

Y. Ground Resistance Check

Perform a ground resistance check on the incubator accessory outlets and each individual electrical accessory. Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and the main control unit accessory outlets, Phototherapy Lamphouse and Phototherapy control unit. Tug and flex each end of the power cord during the measurement. The ground resistance **must** be less than 0.15 ohms. Higher readings may indicate loose or oxidized connections in the power cord or the incubator grounding circuits.

Z. Leakage Current Tests

Perform separate electrical safety and leakage current tests on the incubator and each electrical accessory. Perform the test on each individual device, not as a system.

Measure the leakage current in all wiring configurations both ON and OFF, grounded and ungrounded, and normal and reverse polarities. Make sure the heater is ON full during the test. Set the Control Temperature to 37.5C on the incubator and set the intensity control to maximum on the radiant warmer.

Use the leakage current tester OMP #0175-2284-000 and digital multimeter (DMM) for the following procedure:

1. Connection (Figure 6-1)

a. Connect the device under test to the outlet on the leakage current tester.

b. Make sure the polarity switch on the leakage tester is in the OFF Position then plug the line cord into a grounded 115-120 volt 60 Hz wall outlet.

c. Connect the positive lead of the DMM to the positive +METER OUT output.

d. Connect the negative lead of the DMM to the negative - METER OUT output.

e. Set the DMM on the millivolt scale.

f. Connect one end of the test cable to the EXTERNAL GROUND jack on the Leakage Current Tester.

g. Use the other end of the test cable (needle probe tip) to contact the exposed conductive surface of the device under test.

2. Normal Polarity Leakage Current Test

a. Place the polarity switch of the Leakage Current Tester in the NORMAL position. (This is in the grounded mode).

b. Switch ON the power of the device under test.

c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps, (i.e., 100 mv is equivalent to a leakage current of 100 ua).

d. Record the leakage current measured in the appropriate space on the Leakage Current Form.

e. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.

f. Record this measurement in the appropriate space on the Leakage Current Form.

g. Switch the power switch of the **device under test** OFF and then repeat steps 2c through 2f.

3. Reverse Polarity Leakage Current Test

a. Place the polarity switch on the Leakage Current Tester in the REVERSE position. (This is the grounded mode.)

b. Switch ON the power of the device under test.

c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps, (i.e., 100 mv is equivalent to a leakage current of 100 ua).

d. Record the leakage current measured in the appropriate space on the Leakage Current Form.

e. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.

f. Record this measurement in the appropriate space on the Leakage Current Form.

g. Switch the power switch of the device under test OFF and then repeat steps 2c through 2f.

6/Calibration and Adjustments

The leakage current must not exceed 500 µa (1000 µa for export units) when measuring from heater to ground.

NOTE: Bed should be in place. Attach jumper with alligator clips on both ends between heater and test probe.

The leakage current must not exceed 100 µa (200 µa for export units) when measuring from chassis to ground. The leakage current must not exceed 50 µa when measured between the non-isolated patient probe tip and ground.

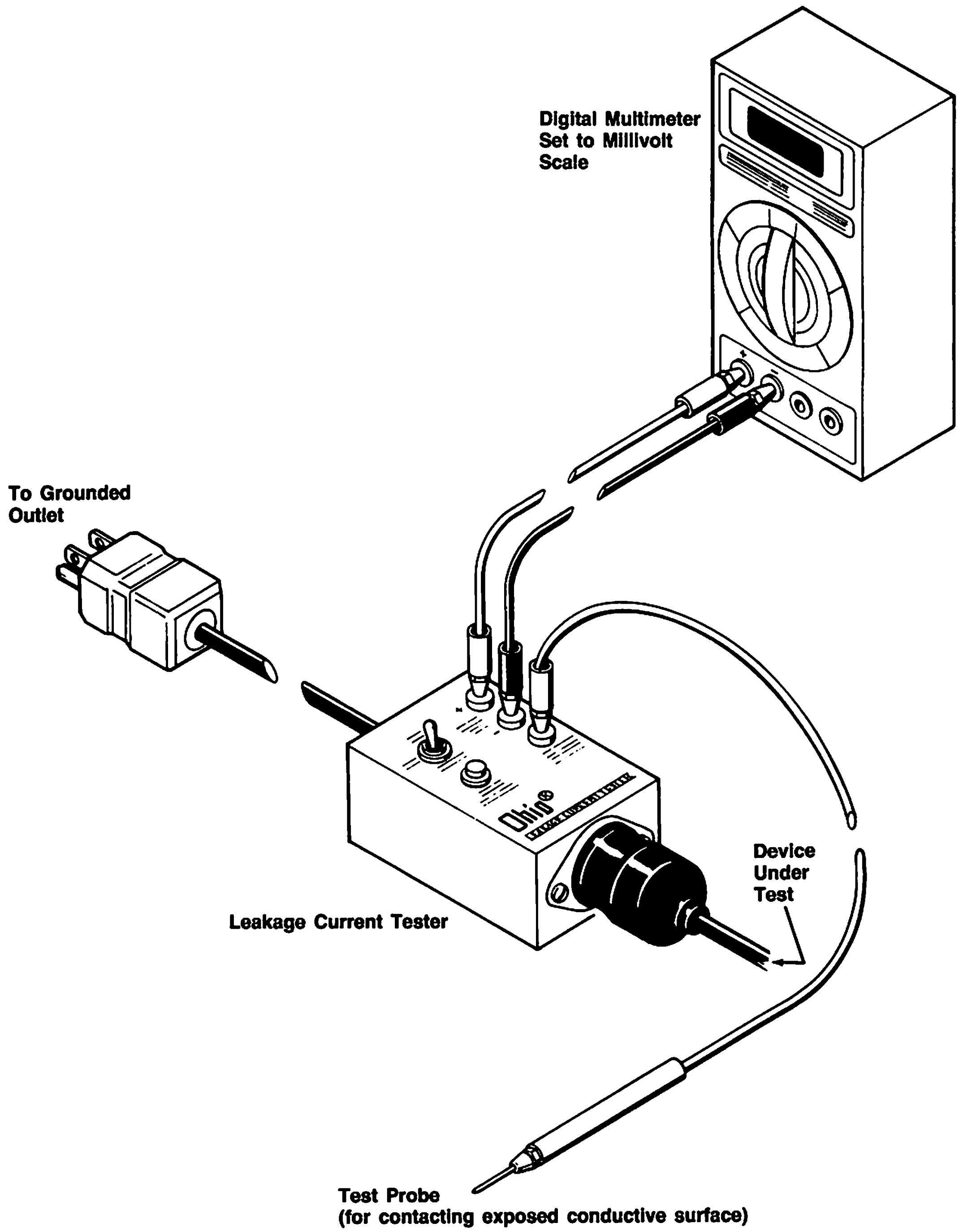


Figure 6-1
Leakage Current Tester Setup

7/Incubator Hood Repairs

Incubator hood repairs and the alignment procedure are explained in this section. Refer to Table 7-1 for the correct procedure.

A. Incubator Hood Alignment

NOTE: Retainers and inner walls must be in place.

1. Pry off the two end caps which cover the hood mounting bolts with a small screw driver.

2. Rotate the rear hood completely forward (Fig. 7-3).

3. Loosen the two mounting bolts (approximately 180 degrees counterclockwise). **Do not** remove the mounting bolts.

4. While holding the front hood section stationary, slowly rotate the rear hood section toward its closed position until the detent notch is engaged (Fig. 7-10).

5. While maintaining the same relative position between front and rear hood sections, rotate both hood sections until the top of the black sensor button aligns with the center of the rear retainer bump (Figure 7-1).

NOTE: If the correct detent position is not maintained throughout step 6, proper hood operation will not be attained. If the hood slips out of its proper position, return to step 2.

6. Securely tighten the mounting bolts (approximate torque 150 in. lb.) to prevent the splines from slipping.

7. Rotate the incubator hood completely underneath the lower unit.

8. Close the incubator hood.

9. Verify the following:
- **a.** The front and rear retainer bumps contact the center of the sensors in the closed position (Figure 7-2). If the alignment is not correct repeat the procedure from step 2 on.
- **b.** The hood wipers are in contact with and parallel to the lower unit.
- **c.** The hood operates smoothly and stays in any open position.

10. Replace the end caps.

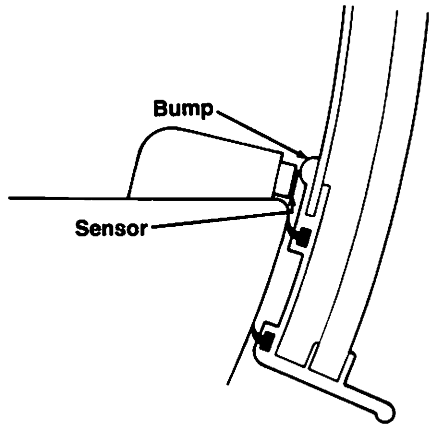


Figure 7-1
Rear Hood Position before Tightening Mounting Bolts

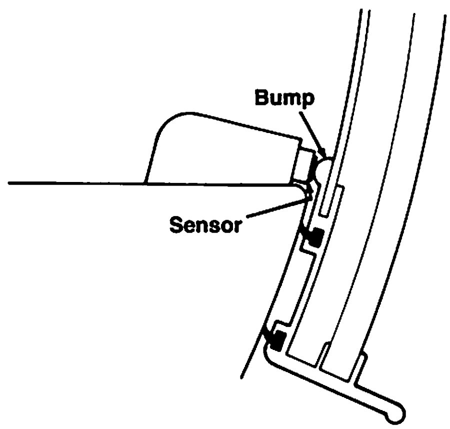


Figure 7-2
Rear Hood Position after Tightening Mounting Bolts

Table 7-1

Repairs Required	**Procedure Required**
Incubator Hood Alignment	
a. Front sensor not touching.	*Perform Sections B through H. Align front hood counterbalances.
b. Front sensor not centered.	Check front bumpers (Figure 12-12, Item 28).
c. Rear sensor not touching.	*Perform Sections B through H. Align rear hood counterbalances.
d. Rear sensor not centered.	Perform Section A.
Complete Hood Replacement	Obtain Hood Replacement Kit Part No. 0217-2986-300. Perform Section B steps 1-6. Perform Section H steps 1-11.
Front or Rear Hood Shell Replacement	*Perform Sections B through H.
Counterbalance Replacement	*Perform Sections B through H.

* Incubator Hood Alignment Tool Required

B. Incubator Hood Removal

CAUTION: When the two mounting bolts are removed from the incubator hood, the incubator hood must be realigned as described in this section.

CAUTION: An incubator hood alignment tool is required for the replacement of a counterbalance. Be sure to follow the counterbalance replacement procedure in this section.

1. Disassemble the incubator hood (retainers and inner walls) as described in the disassembly secton of the O&M Manual.

2. Rotate both incubator hood sections to the front of the incubator (Figure 7-3).

3. Pry off the two end caps which cover the hood mounting bolts with a small screwdriver.

CAUTION: Two people are required to support the incubator hood at each end before removing the mounting bolts.

4. While supporting the hood, remove the hood mounting bolts with a 9/16" socket. Hold the disc with one hand while turning the mounting bolt counterclockwise.

5. Carefully lift the incubator hood off the incubator.

6. Place the hood on a table or work bench large enough to support the entire hood and provide access from both sides.

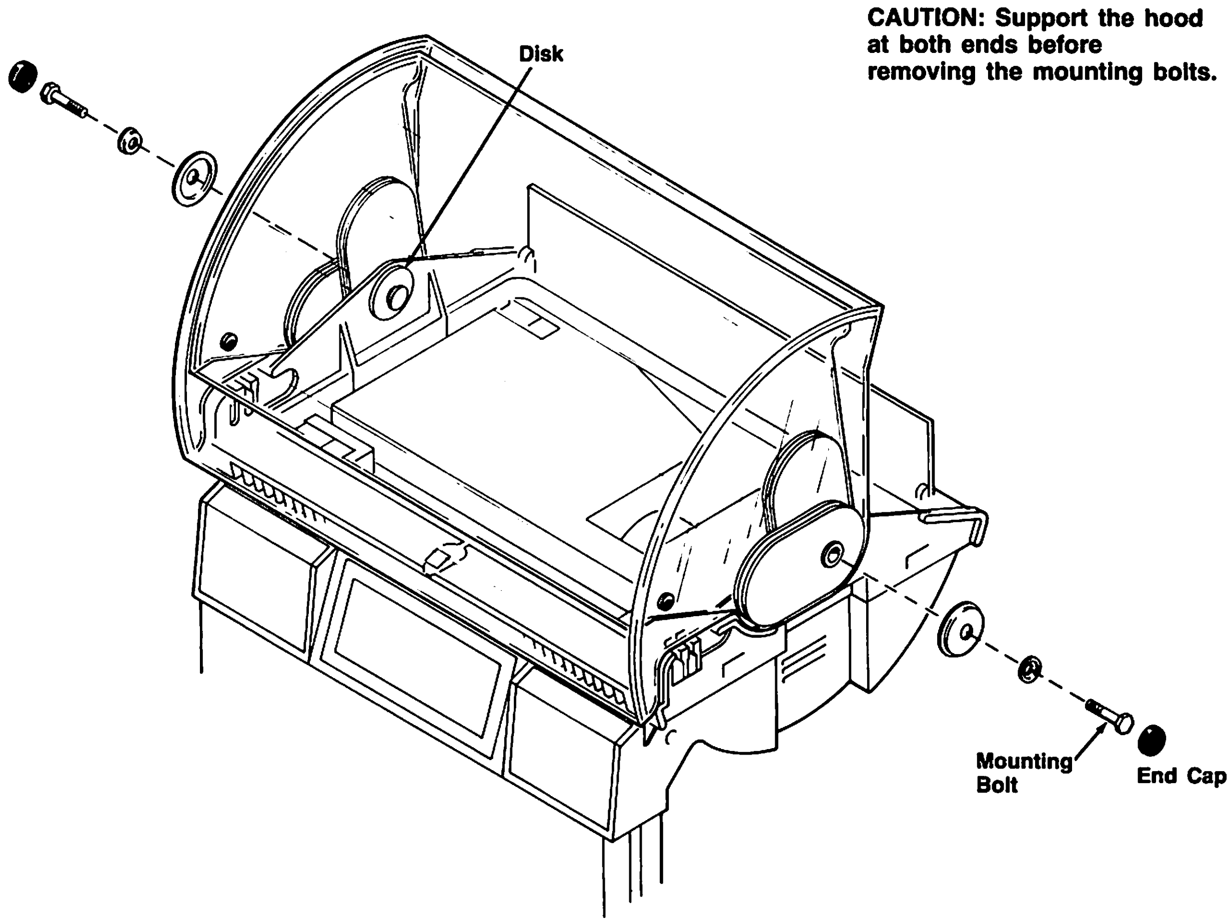


Figure 7-3
Removal of Incubator Hood

7/Incubator Hood Repairs

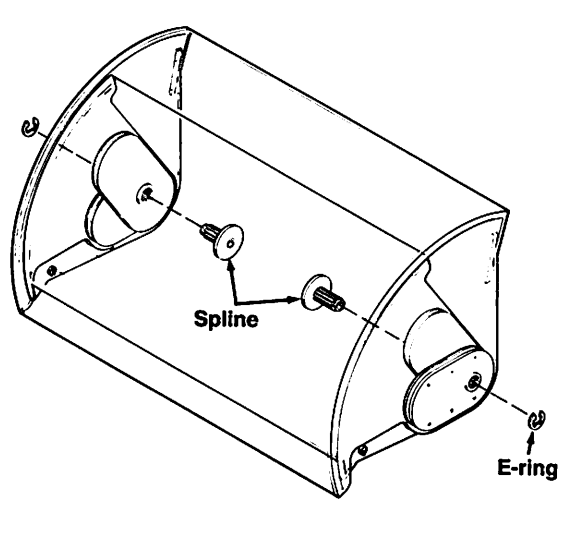


Figure 7-4
Removal of the E-Ring and Spline

C. Hood Disassembly

1. Remove the E-ring from the spline (Figure 7-4) with a 1/4" flat blade screwdriver.

2. While supporting the inside counterbalance push in on the spline.

3. Grasp the spline from the inside of the hood and pull it out of the counterbalance.

4. Remove the other spline. Repeat steps 1-3.

5. Lift the front hood (larger hood section) away from the rear hood section and place it off to the side.

D. Hood Bumper Transfer or Replacement

1. Remove the hood bumpers from the rear hood section (Figure 7-5).

2. Install the hood bumpers on the replacement hood.

E. Counterbalance Disassembly

CAUTION: Work with one counterbalance assembly at a time to avoid confusion of parts.

1. Position the rear hood section as shown in Figure 7-5.

2. Remove the 6 mounting screws of the counterbalance assembly (Figure 7-5).

3. Remove the counterbalance assembly.

NOTE: On the **right** counterbalance of the **rear** hood section (facing the unit from the front), the **"R"** (rear) appears on the **inside** of the hood. On the **left** counterbalance of the **rear** hood section, the **"R"** appears on the **outside** of the hood.

NOTE: On the **right** counterbalance of the **front** hood section, the **"F"** (front) appears on the **outside** of the counterbalance (as viewed from the front). On the **left** counterbalance of the **front** hood section the **"F"** appears on the **inside** of the hood.

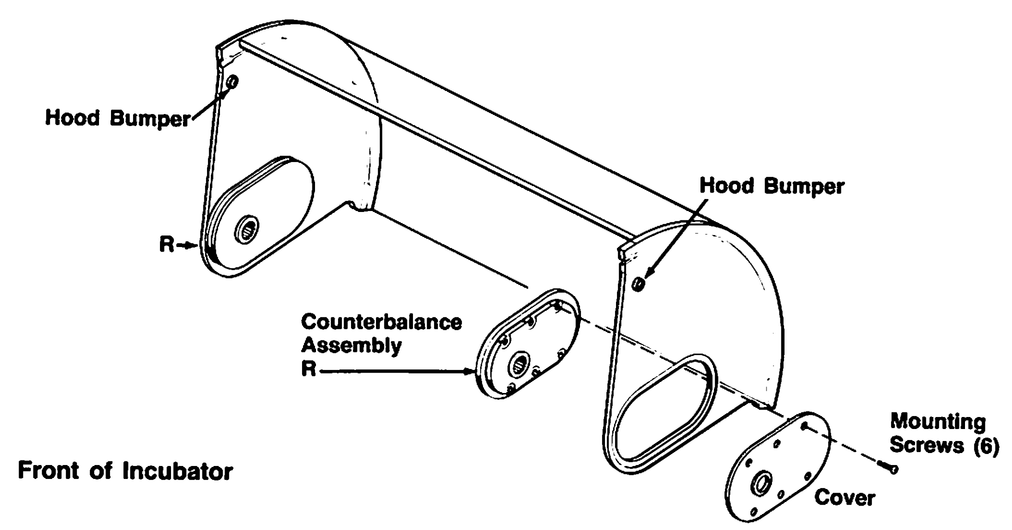


Figure 7-5
Removal of the Counterbalance Assembly from the Rear Hood

7/Incubator Hood Repairs

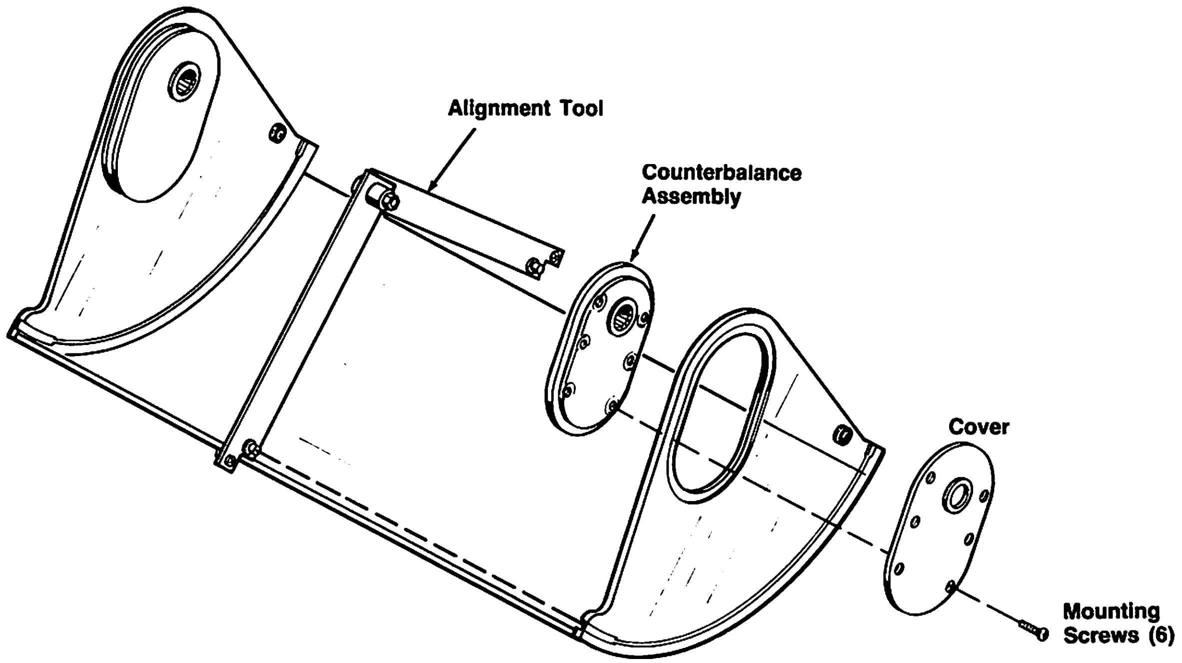


Figure 7-6
Counterbalance Assembly with Hood Alignment Tool on Rear Hood

F. Counterbalance Assembly

1. Place a clean bath size towel on the table or work bench to prevent scratching the hood.

2. Place the replacement hood on the table or work bench and rest it on its outer wall (Figure 7-6).

3. Place the counterbalance assembly on the hood alignment tool. Correctly position the R or F stamped on the counterbalance assembly (Figure 7-5).

The hood alignment tool has two sides. The side with the shorter radius from the guide pins to the pivot point is used for the rear hood section. The side with the longer radius from the guide pins to the pivot point is used for the front hood section (Figure 7-7).

4. Place the guide pins of the counterbalance tool into the grooves in the end of the hood (Figure 7-6).

5. Place the counterbalance assembly in position.

6. Place the cover of the counterbalance assembly in position.

7. Insert the six cover mounting screws and secure the assembly in position. Do not tighten completely at this time.

8. Position the counterbalance assembly parallel to the lower edge of the hood (Figure 7-8).

9. Check the position of the guide pins and counterbalance assembly. Tighten the six assembly screws securely (approximately 10 in. lb.).

10. Remove the counterbalance alignment tool.

11. Replace the remaining counterbalances one at a time, repeating sections C and D,

NOTE: On the **right** counterbalance of the **front** hood section, the **"F"** (front) appears on the **outside** of the counterbalance (as viewed from the front). On the **left** counterbalance of the **front** hood section, the **"F"** appears on the **inside** of the hood.

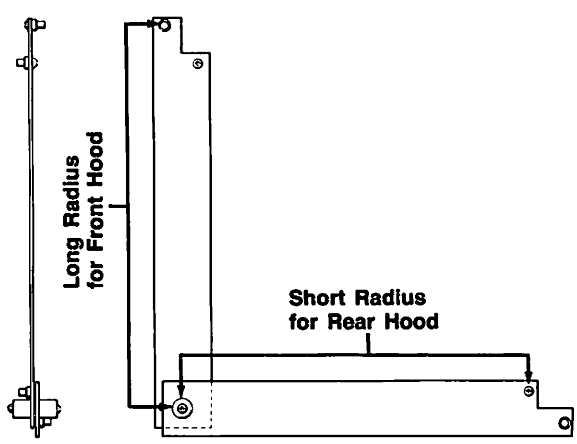


Figure 7-7
Counterbalance Alignment Tool

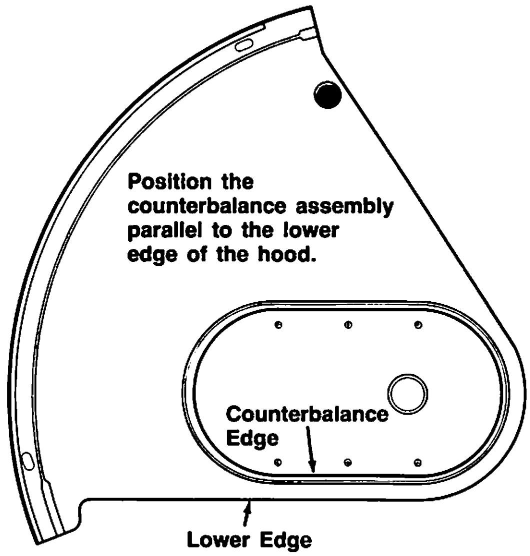


Figure 7-8
Counterbalance Alignment Tool

G. Front and Rear Hood Section Assembly and Alignment

1. Place the rear hood counterbalances in the latched position as described in the next three steps.

a. Position the rear hood section as shown in Fig. 7-5.

b. Insert the spline in the right counterbalance (as viewed from the front) from the inside of the hood. Turn the counterbalance clockwise into the latched position.

c. Insert the spline in the left counterbalance from the inside of the hood. Turn the counterbalance counterclockwise into the latched position.

2. Place the rear hood section in position with the outside edge extended over the edge of the table by approximately two inches (Figure 7-9).

3. Place the front hood section over the rear hood section so that the two counterbalance holes line up (Figure 7-9).

4. Rotate the front hood about seven inches (approximately a 30° angle) above the table top (Figure 7-9).

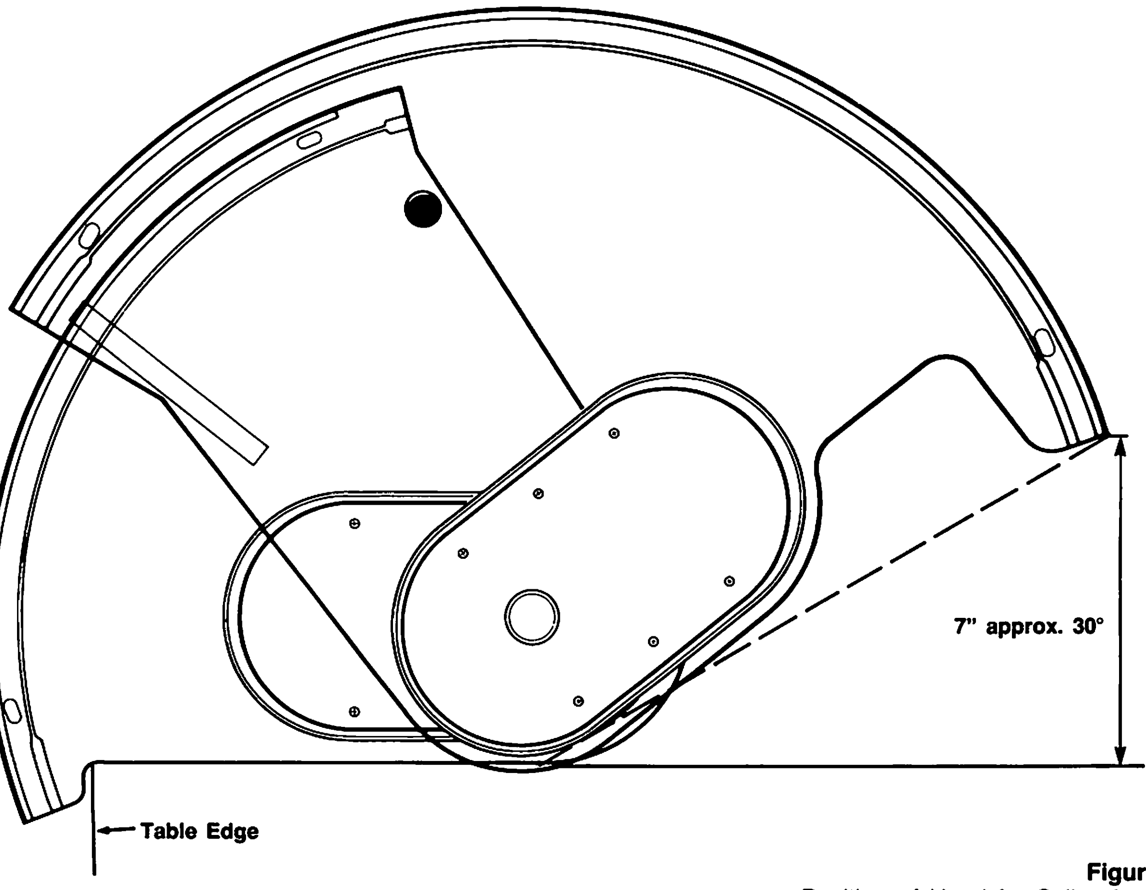


Figure 7-9
Position of Hood for Spline Insertion

5. While holding the hood at approximately 30°, insert the spline from the inside of the hood through the two counterbalances.

6. While holding the hood at approximately 30°, insert the other spline from the inside of the hood through the other two counterbalances.

NOTE: If the alignment of the splines is not done correctly the front incubator hood will not have the correct detent position after final assembly.

7. Rotate the hood to the closed position.

8. Open and close the rear hood section to verify that only one detent position is present.

NOTE: If more than one detent position is present separate the two hood halves and repeat the procedure from step 1.

9. Replace both E-rings with a long nose pliers.

H. Hood Installation and Alignment

1. Install the inner walls and retainers and position the two hoods as shown in Figure 7-9.

2. With the assistance of someone supporting the hood, position the hood on the incubator, insert the mounting bolts and tighten them enough so that the incubator hood splines will still rotate.

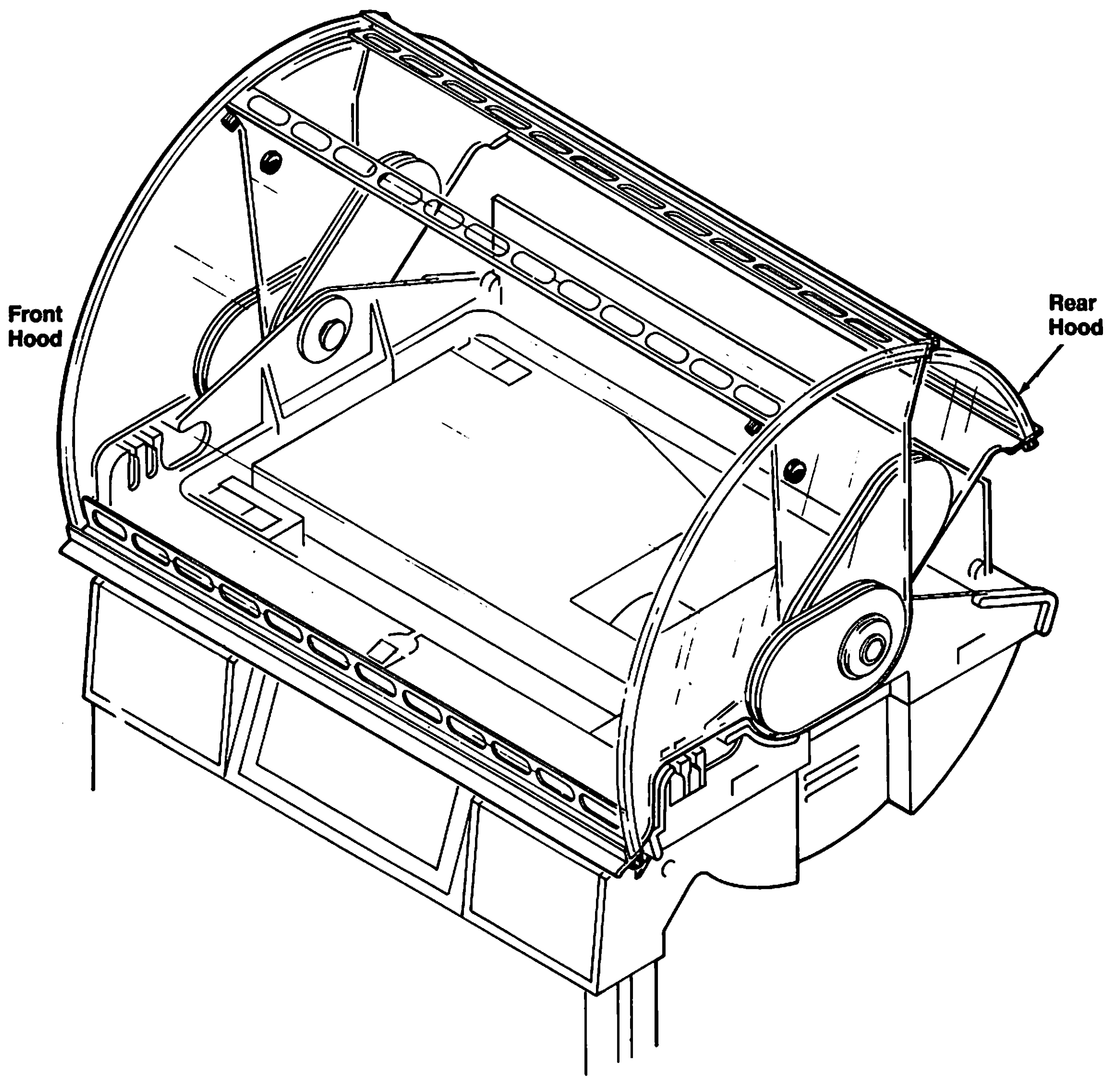


Figure 7-10
Detent Alignment

7/Incubator Hood Repairs

CAUTION: Be careful not to allow the hoods to slip and rotate quickly under the lower unit. Damage to the hoods may result.

3. While maintaining the same relative position between front and rear hood sections, rotate both hood sections until the top of the black sensor button aligns with the center of the rear retainer bump (Fig. 7-11).

NOTE: If the correct detent position is not maintained throughout step 3, proper hood operation will not be attained. If the hood slips out of its proper position, return to step 1.

4. Securely tighten the mounting bolts (approximate torque 150 in. lb.) to prevent the splines from slipping.

5. Rotate the incubator hood completely underneath the lower unit.

6. Close the incubator hood.

7. Verify the following:
- **a.** The front and rear retainer bumps contact the center of the sensors in the closed position (Figure 7-12). If the alignment is not correct loosen the mounting bolts and repeat the procedure from step 4 on.
- **b.** The hood wipers are in contact with and parallel to the lower unit.
- **c.** The hood operates smoothly and stays in any open position.
- **d.** The front hood opening in the detent position measures 5 inches ±1/4 inch. See Figure 7-12A.

8. Replace the end caps.

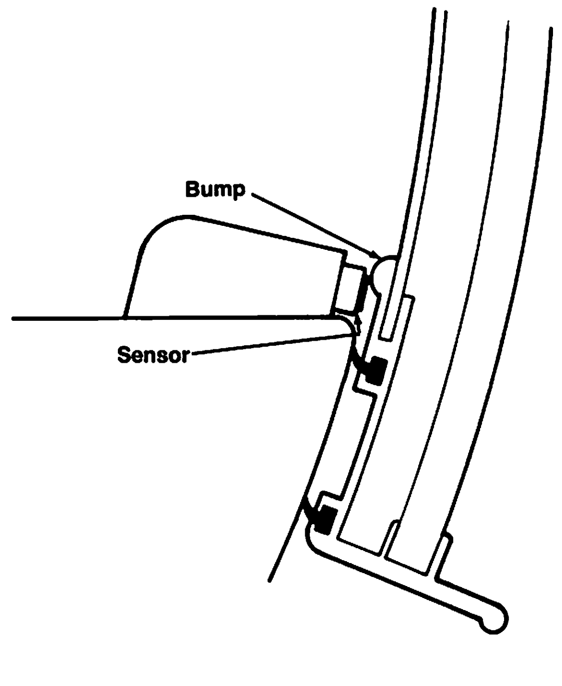


Figure 7-11
Rear Hood Position before Tightening Mounting Bolts

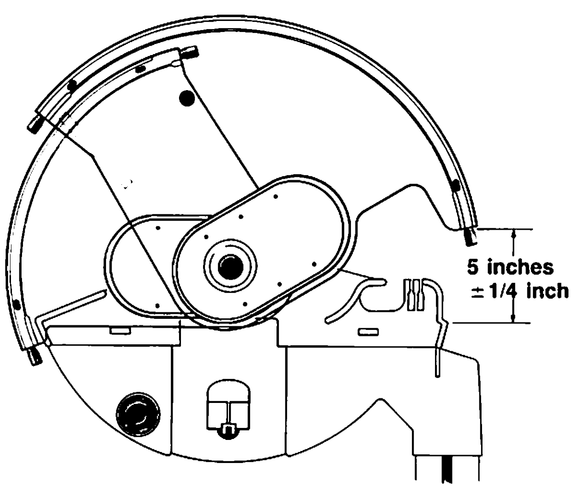


Figure 7-12A

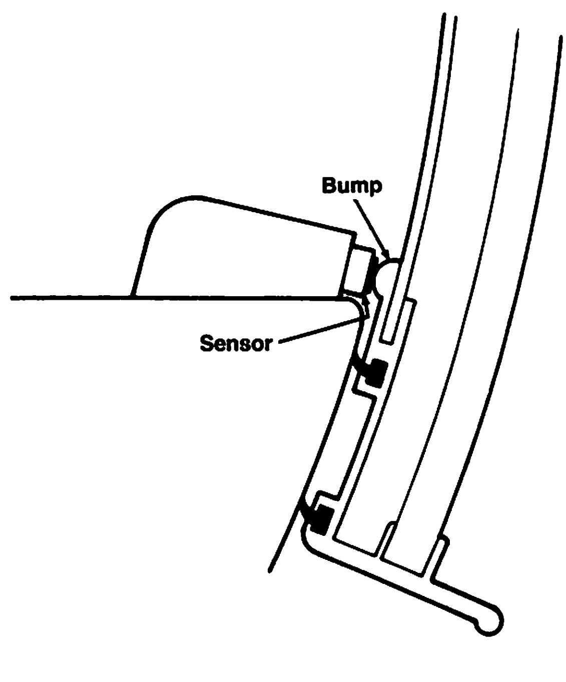


Figure 7-12
Rear Hood Position after Tightening Mounting Bolts

7/Incubator Hood Repairs

I. Latch and Captive Knob Replacement Procedure

Parts Required:

Captive Knob Update Kit	0217-2784-880
Left Latch	0217-2776-700
Right Latch	0217-2775-700
Knob (Captive)	0212-1949-100
Retaining Ring	0203-5313-300

Tools Required:
Needle Nose Pliers
2mm Blade Screwdriver

Installation:

(Figures 7-13 and 7-14)

1. Remove the existing latch if necessary. Refer to the removal procedure if the latch has a captive knob.

2. Use a needle nose pliers and carefully force the retaining ring onto the smooth portion of the latch shaft. (Figure 7-13).

NOTE: Be sure you have the correct latch for the end of the retainer you are working with.

3. Insert the shaft of the latch (with retaining ring) through the mounting hole of the retainer (Figure 7-14).

4. Thread the captive knob onto the shaft of the latch approximately 2 turns.

5. Use a screwdriver to force the retaining ring into the recess in the knob.

6. Tighten the knob to the latch. Loosen the knob and verify that the knob is captive.

Removal:

(Figure 7-15)

1. Position the retainer and latch assembly as shown in Figure 7-15.

2. Insert the small screwdriver into the knob and carefully pry out the retaining ring.

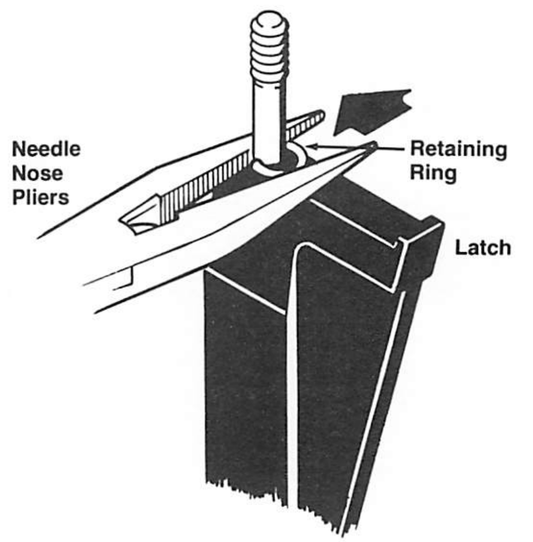


Figure 7-13
Retaining Ring Installation

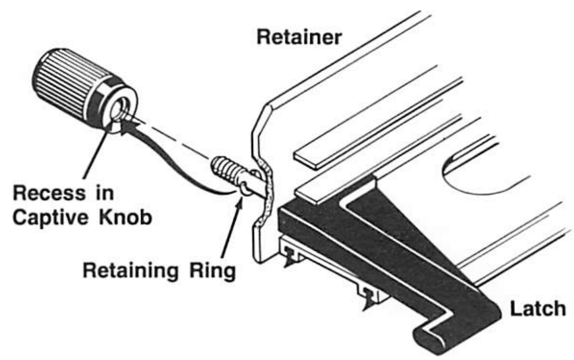


Figure 7-14
Captive Knob and Latch Assembly

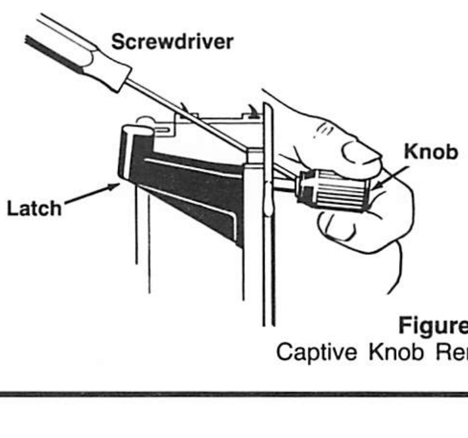


Figure 7-15
Captive Knob Removal

8/Lower Unit Disassembly

A. Bed Platform, Humidifier and Blower

(Figure 8-1)

Removal:
WARNING: Power MUST be disconnected prior to removing the bed platform. The air heater is NOT GROUNDED; an electrical shock hazard could exist.

WARNING: Allow the unit to cool for 15 minutes before disassembly of the lower unit.

1. Disconnect the power cord.

2. Open the humidifier fill port and drain any water in the humidifier reservoir into a container by turning the humidifier fill mechanism down.

3. Lower the humidifier reservoir side of the incubator with the tilt mechanism and drain any remaining water from the unit.

4. Return the incubator to the level position with the tilt mechanism.

5. Remove the humidifier fill mechanism by pulling it out. The humidifier fill mechanism must be in the open position for installation and removal.

6. Open the incubator hood to the fully retracted position.

7. Remove the tube support clamp and hood thermometer if present.

8. Remove the infant mattress.

9. Slide open the four latches that hold the bed to the lower unit.

10. Remove the bed platform.

11. Remove the air filter.

12. Remove the humidifier reservoir and cover.

13. Remove the blower wheel by holding the blower wheel and turning the blower wheel nut counterclockwise.

Installation:
WARNING: Power MUST be disconnected for reassembly of the lower unit.

1. Disconnect the power cord.

2. Open the incubator hood.

3. Replace the blower wheel and turn the blower wheel nut clockwise on the motor shaft. Tighten the nut securely. Make sure the blower wheel turns freely.

4. Replace the humidifier reservoir.

5. Replace the humidifier reservoir cover (be sure the stem of the control rod fits in the hole of the cover).

6. Check the operation of the humidifier control by rotating the control between the fully open and fully closed positions.

7. Replace the air filter; insure proper orientation.

8. Replace the bed.

9. Close the four latches that lock the bed in position.

10. Close the incubator hood.

11. Replace the humidifier fill mechanism. **The humidifier fill mechanism must be in the open position for installation and removal.**

B. Bottom Panel

(Figure 8-2)

Removal:
1. Close the incubator hood.

2. Disconnect the power cord.

3. Place a support under the bottom panel that just makes contact with the panel.

4. Remove the 16 Phillips-head mounting screws.

5. Lower the bottom panel.

6. Remove the ground wire if necessary with a 5/16" nut driver and remove the panel.

Installation:
1. Close the incubator hood.

2. Make sure all cables and harnesses are connected and in their proper positions.

3. Replace the ground wire to the panel with a 5/16" nut driver.

4. Place a support under the bottom panel to hold the panel in position.

CAUTION: Do not allow the bottom panel to pinch any of the rear sensor wiring. The rear sensor leads must be routed to the left of the center support rib (when viewed from the rear of the incubator). Make sure the sensor cable is routed in the cut outs on the support webbing.

5. Replace the 16 Phillips head mounting screws.

8/Lower Unit Disassembly

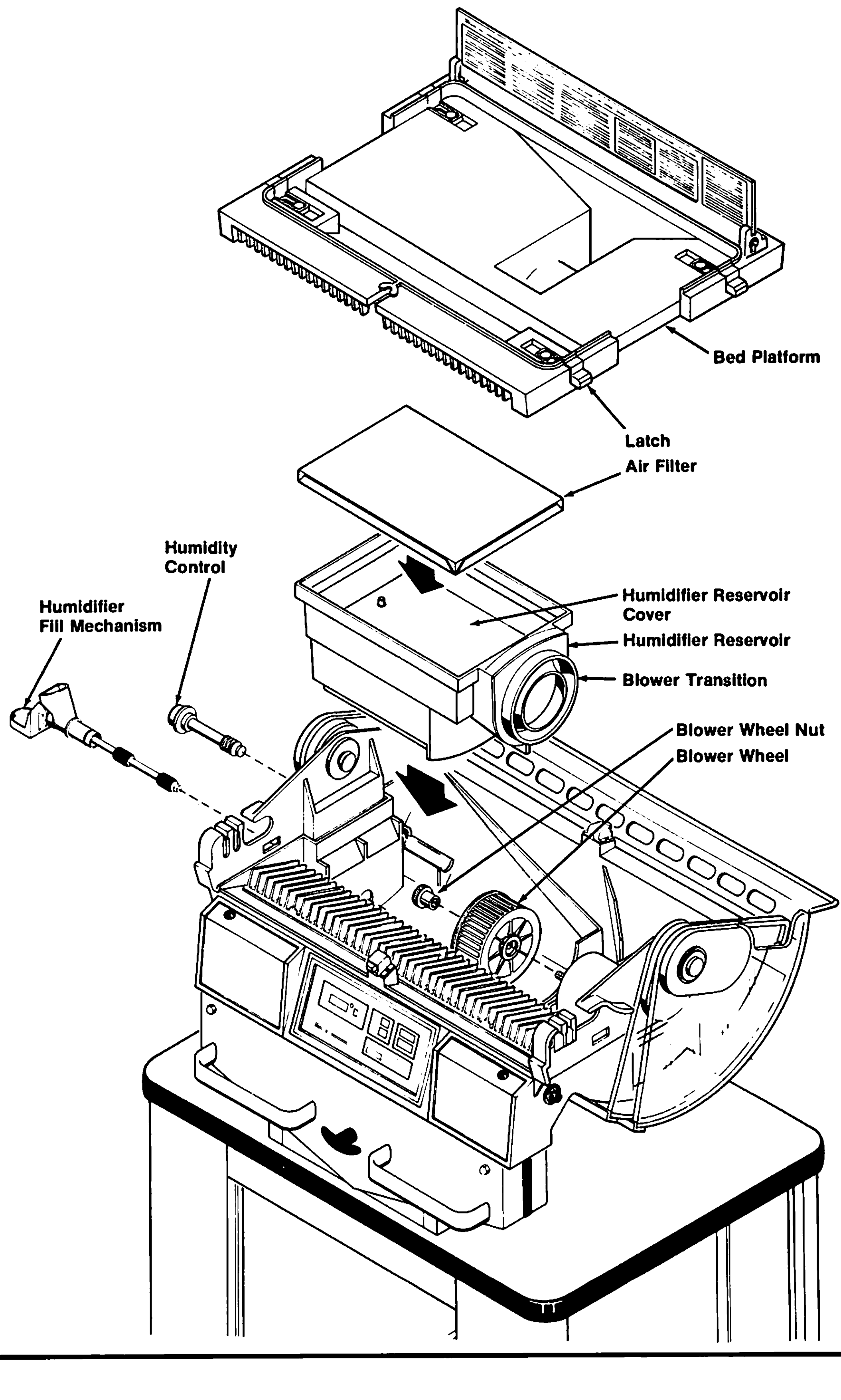


Figure 8-1
Bed Platform, Humidifier and Blower Disassembly

8/Lower Unit Disassembly

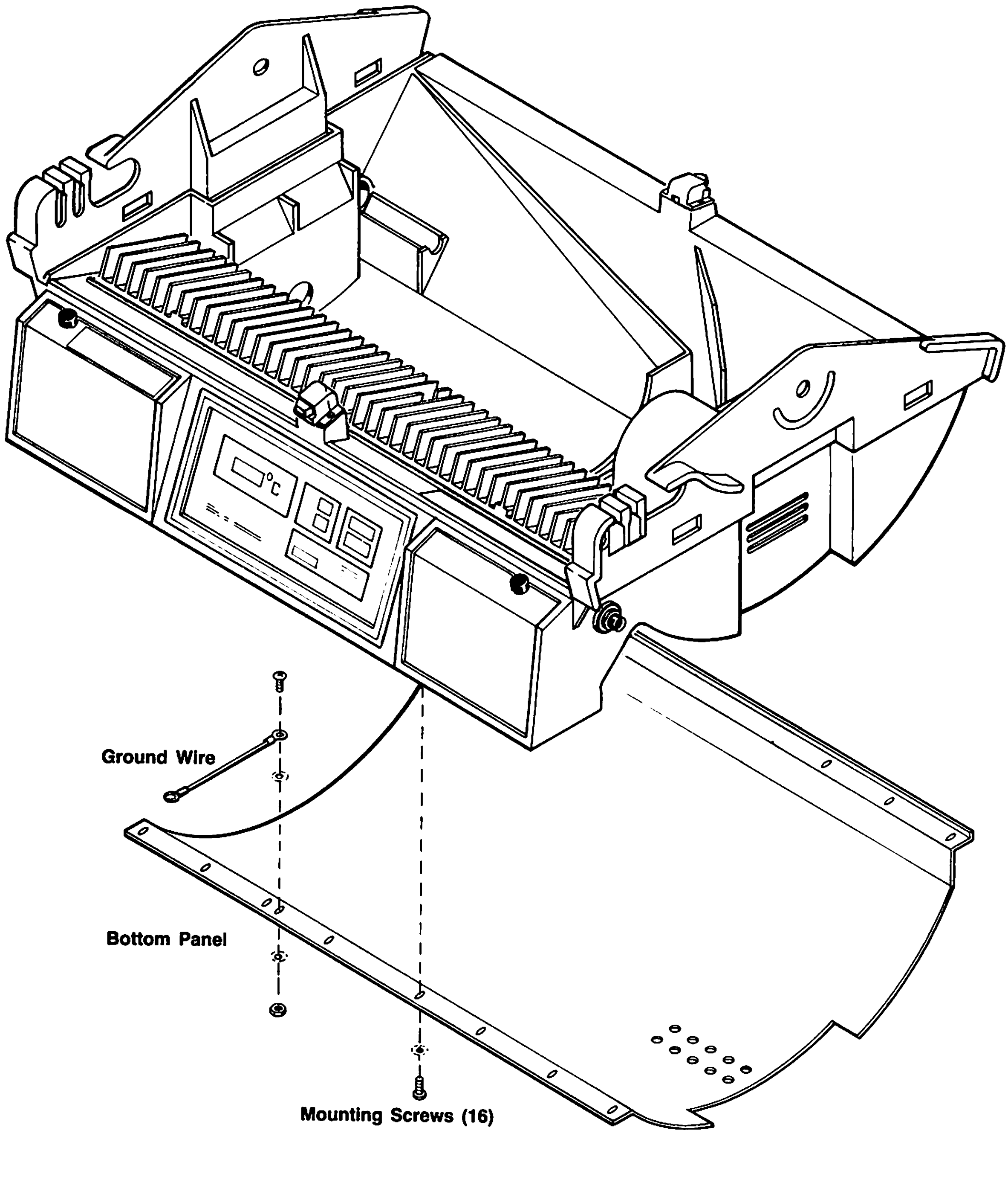


Figure 8-2
Bottom Panel Disassembly

8/Lower Unit Disassembly

C. Display Panel Cover

(Figure 8-3)

Removal:
Remove the 5 Phillips-head screws from the display panel cover. Do not remove the ground wire located near the front center of the panel.

Installation:

1. Make sure all cables and harnesses are connected and in their proper positions. The ground wire must be attached to the cover.

2. Place the cover in position and replace the 5 Phillips-head screws.

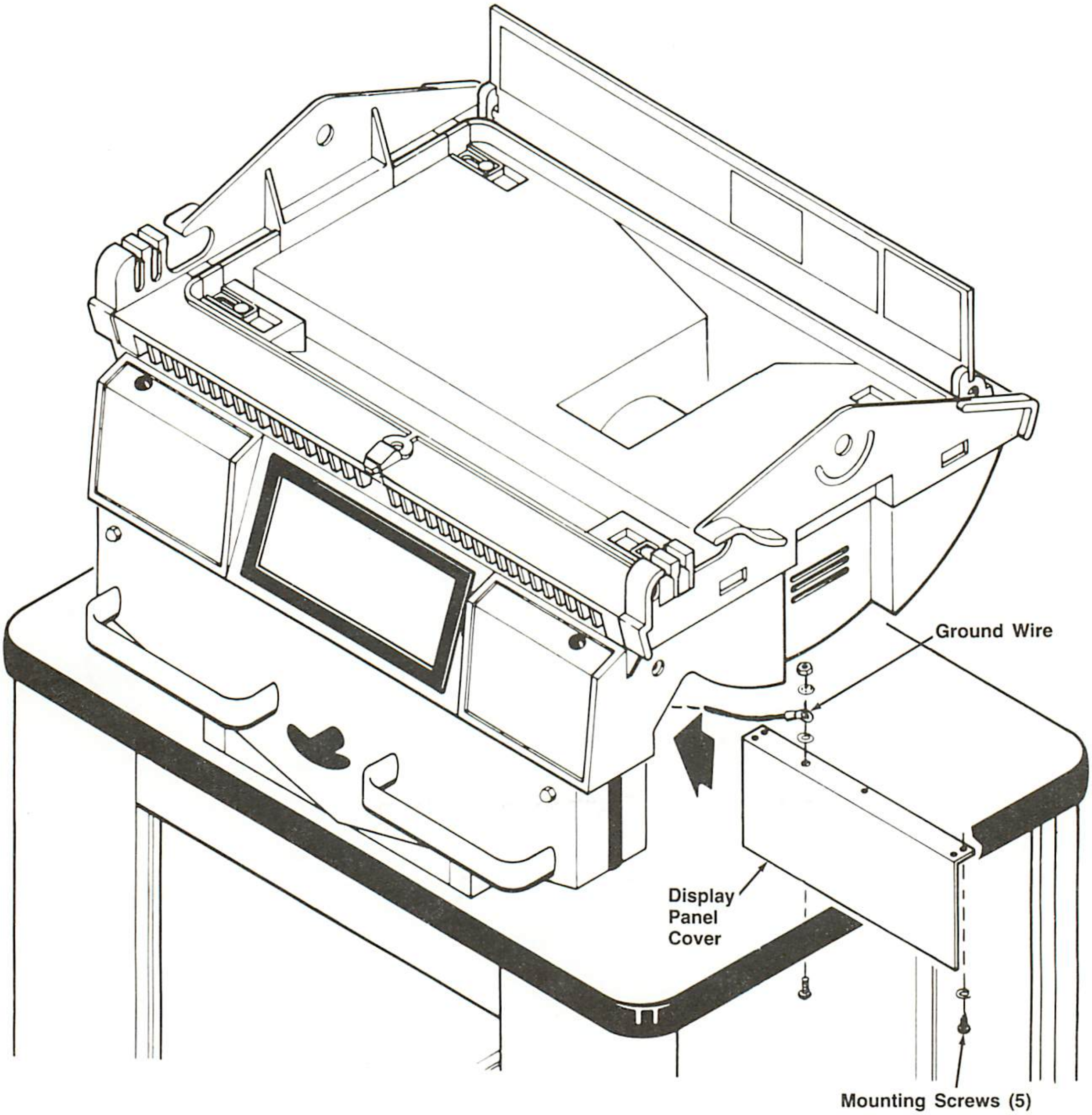


Figure 8-3
Display Panel Cover Removal

8/Lower Unit Disassembly

D. Display Panel

(Figure 8-4)

Removal:

1. Remove the two 11/32 display panel mounting brace nuts.

2. Open the front incubator hood half way.

3. Remove the display panel from the front and place it inside the incubator on the bed. Disconnect the 26 conductor cable if necessary.

4. Remove the display panel mounting brace from the front.

Installation:

1. Place the display panel mounting brace in position from the front.

2. Reconnect the display panel if necessary. Line up the arrows of each connector for correct connection.

NOTE: Some connectors are not pin indexed to prevent improper connection. Be sure to line up the arrows on the connectors for proper connection. In some cases, it may be necessary to remove pin 14 from the J7 connector for proper pin indexing.

3. Place the display panel in position. The 26 pin cable connector must be positioned to the rear of the display panel mounting brace.

CAUTION: Do not over-tighten the two mounting nuts for the display panel. The touch panel switches may become inoperative.

4. Replace the two 11/32 display panel mounting nuts. Hand tighten the nuts then use a nut driver and tighten them an additional 1/2 turn. Tilt the incubator if desired for easier access.

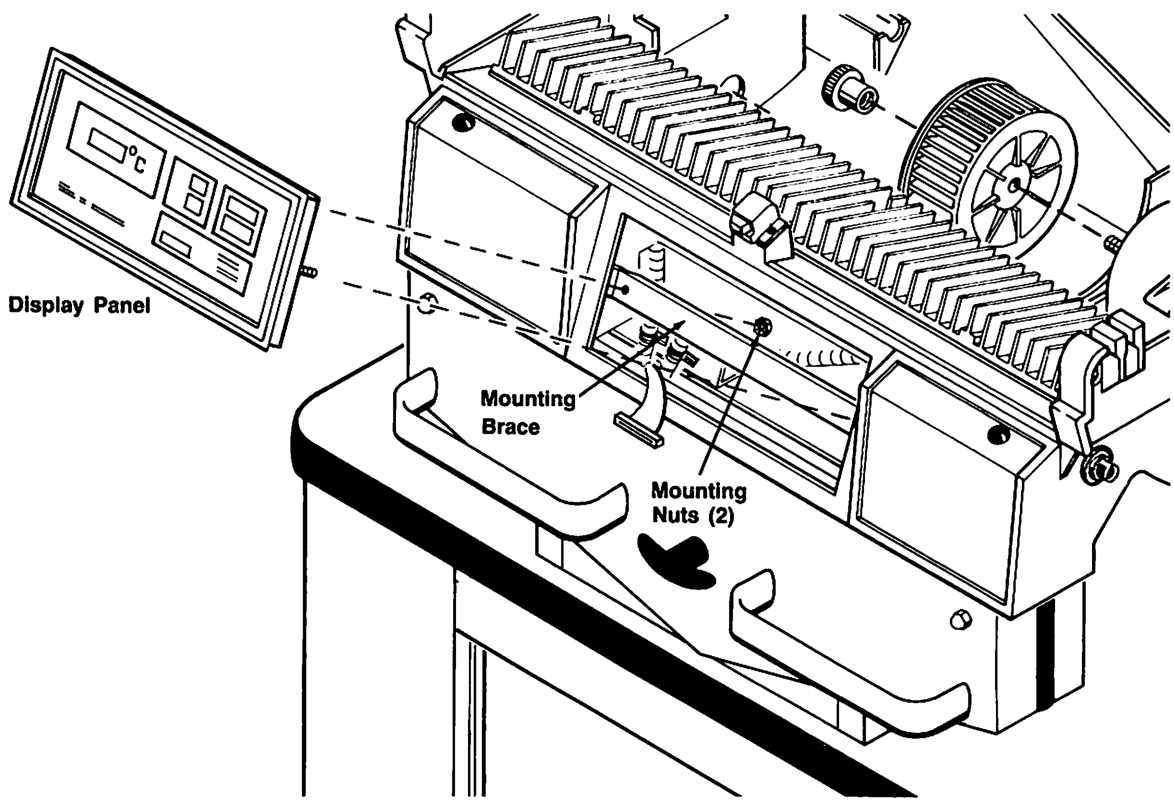


Figure 8-4
Display Panel Removal

9/Lower Unit Repairs

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

A. Rear (Inlet) Wall Sensor Replacement

(Figures 9-1, 9-2 and 9-3)

Removal:

1. Switch the power off and disconnect the power cord.

2. Open the incubator hood.

3. Remove the bed platform.

4. Close the incubator hood and open the rear hood section half way.

5. Remove the bottom panel. See Section 8B.

6. Disconnect the Mate-N-Lok connector from the inlet wall sensor.

7. Remove the two Phillips-head mounting screws.

8. Lift the sensor up and pull the connector through the housing.

9. Transfer the small square air sensor blank, located at the rear bottom of the sensor, to the new sensor.

Installation:

NOTE: A styrene insulation plug is not used on the rear sensor.

1. Use a pencil and mark the plunger on the sensor at .050 inch (1.27 mm or approximately the thickness of one U.S. dime). See Figure 9-1.

2. Correctly position a lock plate (round edges on the outside of sensor housing) on each Phillips head mounting screw (Figure 9-2).

3. Loosely mount the sensor on the incubator housing.

4. Connect the wall sensor.

5. Close the incubator hood so the bump on the retainer lines up with the sensor (Figure 9-2).

6. Open the front hood section.

7. Adjust the sensor so the plunger on the sensor is pushed in as far as the pencil mark on the plunger.

8. Tighten the sensor mounting screws.

9. Open and close the incubator hood and check for proper operation of the sensor.

10. Replace the bottom panel. See Section 8B.

11. Open the incubator hood.

12. Install the bed platform.

13. Close the incubator hood.

14. Check the alignment of the wall sensor with the bump on the metal extrusion (Figure 7-10). If not aligned properly see Section 7.

15. Perform the Control Unit Check of Section 6.

B. Front (Outlet) Wall Sensor and Air Safety Sensor Replacement

(Figures 9-1, 9-2 and 9-3)

Removal:

1. Switch the power off and disconnect the power cord.

2. Open the incubator hood.

3. Remove the bed platform.

4. Close the incubator hood and open the front hood section half way.

5. Remove the display panel cover. See Section 8C.

6. Remove the display panel. See Section 8D.

7. Remove and discard the styrene plug located under the front sensor housing.

8. Sensor Replacement

- a. Wall sensor replacement
  - **1.** Replace the front wall sensor by disconnecting the Mate-N-Lok connector with the white leads and shielded grey cable.
  - **2.** Remove the two Phillips head mounting screws.
  - **3.** Lift the wall sensor up and pull the connector through the housing.
  - **4.** Transfer the air safety sensor to the new wall sensor by sliding the air sensor out of the wall sensor housing.
- b. Air safety sensor replacement
  - **1.** Replace the air safety sensor by disconnecting the Mate-N-Lok connector with black lead and red fiberglass shielded cable.
  - **2.** Remove the two Phillips-head mounting screws.
  - **3.** Lift the wall sensor up and pull the air sensor connector through the housing.
  - **4.** Remove the air sensor by sliding the air sensor out of the wall sensor housing.
  - **5.** Slide the new air safety sensor on the wall sensor housing.

9/Lower Unit Repairs

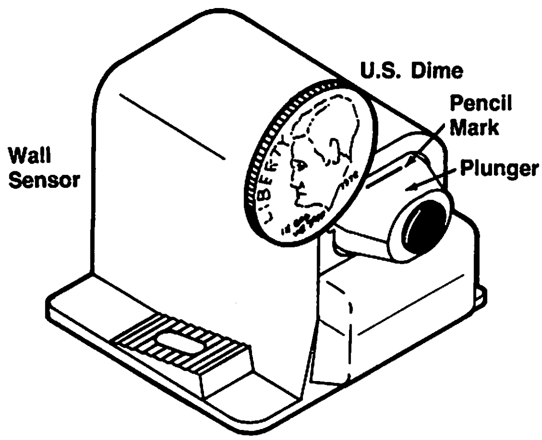


Figure 9-1
Plunger Movement Measurement

Installation:

1. Use a pencil and mark the plunger on the sensor at .050 inch (1.27 mm or approximately the thickness of one U.S. dime). See Figure 9-1.

2. Correctly position a lock plate (round edges on the outside of sensor housing) on each Phillips head mounting screw (Figure 9-2).

3. Loosely mount the sensor on the incubator housing.

4. Connect the air and wall sensor wires.

5. Place the air and wall sensor wires to the rear of the housing.

6. Position the styrene plug so that the small end is at the tapered of the cavity and the top end side is facing the rear of the unit.

7. Slide the plug into the housing for a snug fit.

8. Close the incubator hood so the bump on the retainer lines up with the sensor (Figure 9-2).

9. Open the rear hood section.

10. Adjust the sensor so the plunger on the sensor is pushed in as far as the pencil mark on the plunger.

11. Tighten the sensor mounting screws.

12. Open and close the incubator hood and check for proper operation of the sensor.

13. Replace the display panel. See Section 8D.

14. Replace the display panel cover. See Section 8C.

15. Open the incubator hood.

16. Install the bed platform.

17. Close the incubator hood.

18. Check the alignment of the wall sensor with the bump on the metal extrusion (Figure 7-10). If not aligned properly see Section 7.

19. Perform the Control Unit Check of Section 6.

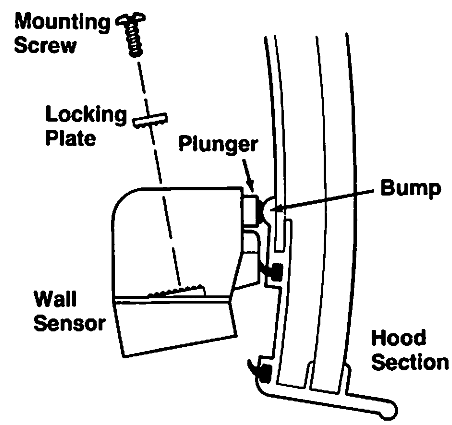


Figure 9-2
Wall Sensor Mounting

C. Blower Motor Replacement

(Figure 9-4)

Removal:

1. Switch the power off and disconnect the power cord.

2. Remove the bed platform, humidifier and blower. See Section 8A.

3. Remove the E-ring from the blower motor shaft.

4. Remove the bottom panel. See Section 8B.

5. Raise the right side of the incubator with the tilt mechanism for easier access to the blower motor.

6. Disconnect the Mate-N-Lok connector for the blower motor.

7. Remove the four #8 round head Phillips screws, lock washers, and flat washers.

8. Remove the blower motor from the incubator.

Installation:

1. Place an external lockwasher and flat washer on each of the four #8 round head Phillips screws.

2. Place the blower motor and mounting bracket assembly in position.

3. Replace the four #8 round head Phillips screws with washers and tighten securely.

4. Reconnect the Mate-N-Lok connector for the blower motor.

5. Replace the E-ring on the blower motor shaft.

6. Replace the blower wheel.

7. Test the blower motor for proper operation, proceed to Blower Motor and Blower Wheel Operation Check.

8. Replace the bottom panel. See Section 8B.

9. Perform an electrical safety test and the Control Unit Check in Section 6.

9/Lower Unit Repairs

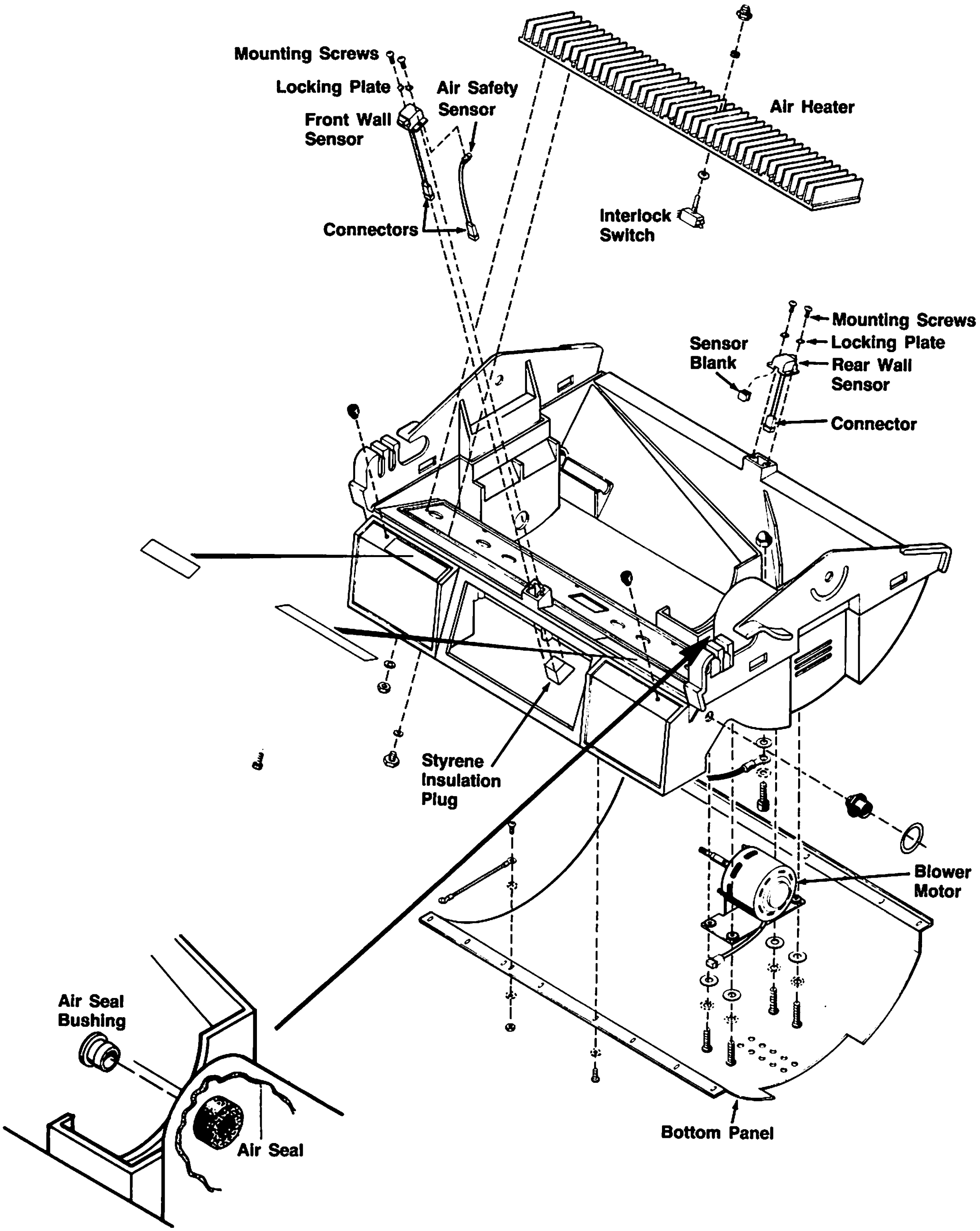


Figure 9-3
Lower Unit Exploded View

9/Lower Unit Repairs

Blower Motor and Blower Wheel Operation Check:

1. Plug in the incubator and switch the power on.

2. Press the bed interlock switch located on the heater and observe the blower operation. The blower wheel must not touch the housing area.

3. Switch the power off.

4. Replace the humidifier, humidifier cover, air filter, bed platform and humidifier fill mechanism.

5. Switch the power on.

6. Check the blower operation in the five tilted positions; horizontal, 5 and 10 degrees left and right of horizontal. Verify that the blower wheel does not rub against the housing in any position. If the blower wheel is not rubbing return to step 8 of installation. If the blower wheel rubs when the left end of the incubator is tilted down follow step a. If the blower wheel rubs when the right end of the incubator is tilted down follow step b.

a. If the blower wheel rubs with the left end tilted down.

1. Switch the power off.

2. Remove the fill mechanism, humidity chamber and blower wheel.

3. Remove the motor assembly.

4. Disassemble the motor from the bracket (Figure 9-5).

5. Add a #8 brass flat washer to each motor mounting stud between the stud and the rubber grommet.

6. Reinstall the motor assembly.

7. Install the blower wheel, humidity chamber and fill mechanism assembly.

8. Repeat steps 5 and 6 of the Blower Wheel Operation Check.

b. If the blower wheel rubs with the right end tilted down.

1. Switch the power off.

2. Remove the fill mechanism, humidity chamber and blower wheel.

3. Remove the motor assembly.

4. Disassemble the motor from the bracket.

5. Remove a #8 brass flat washer from each motor mounting stud.

6. Reinstall the motor assembly.

7. Install the blower wheel, humidity chamber and fill mechanism assembly.

8. Repeat steps 5 and 6 of the Blower Wheel Operation Check.

9. If the blower motor was replaced, return to the blower motor replacement installation, step 8.

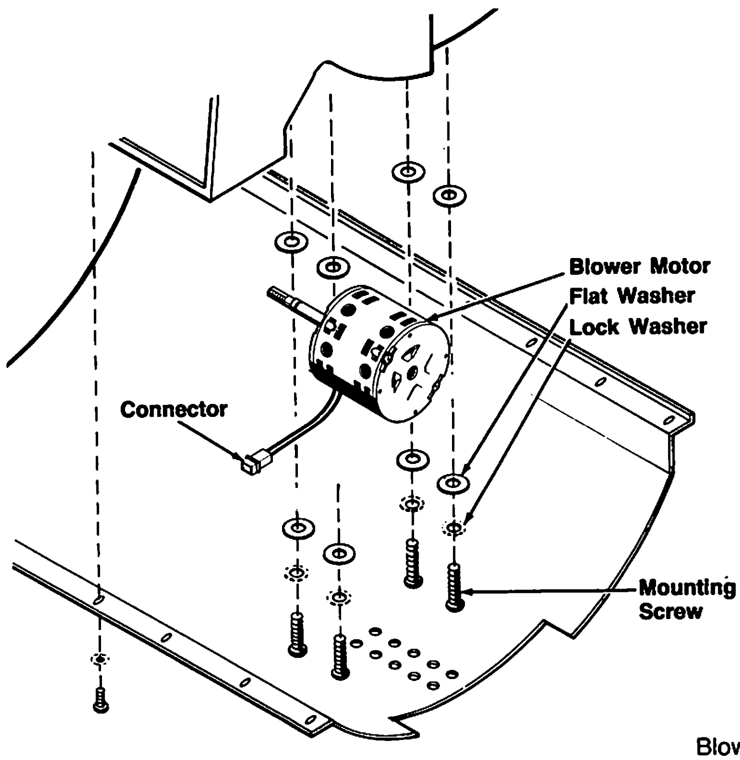


Figure 9-4
Blower Motor Replacement

9/Lower Unit Repairs

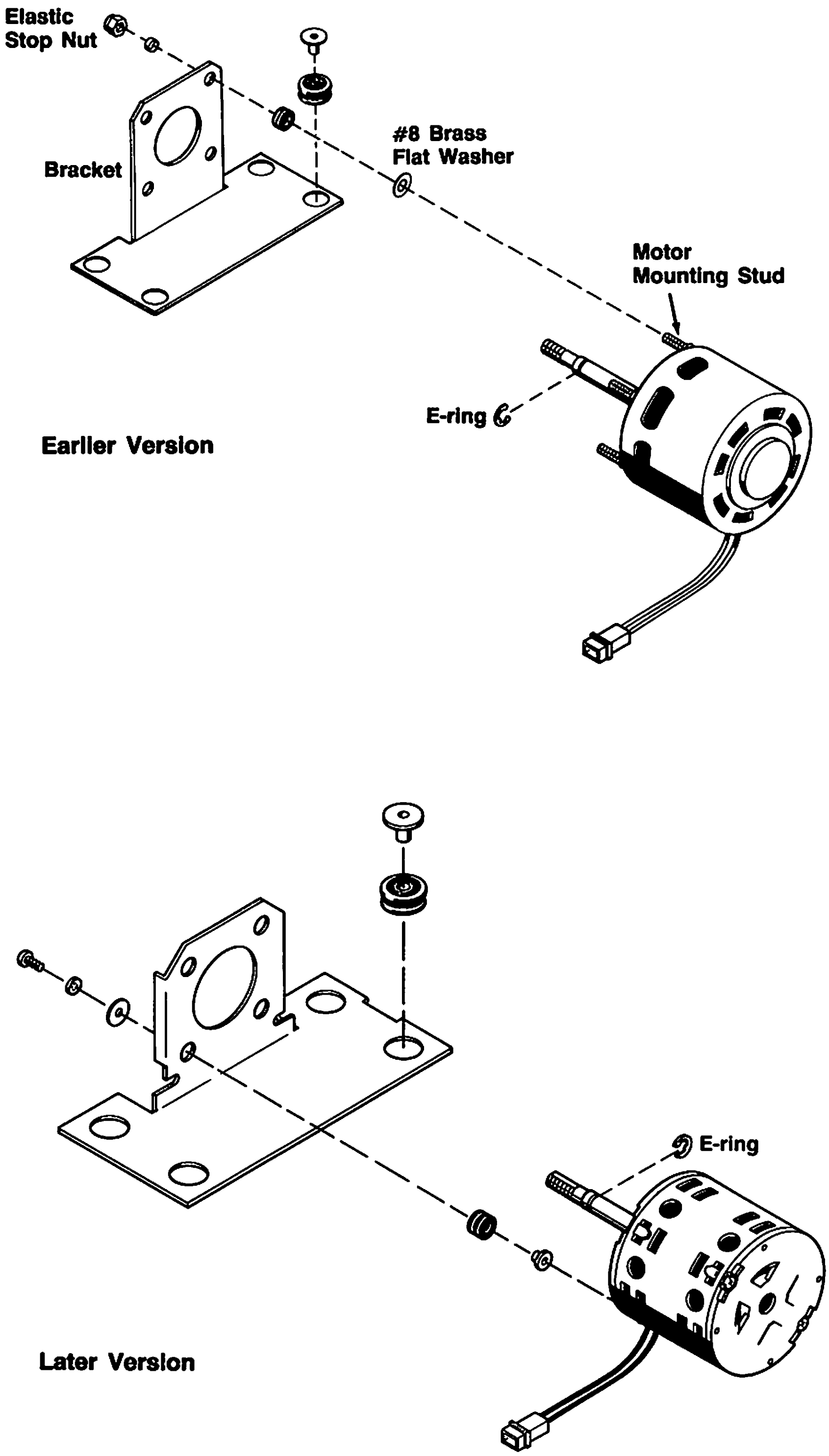


Figure 9-5
Blower Motor Bracket Assembly

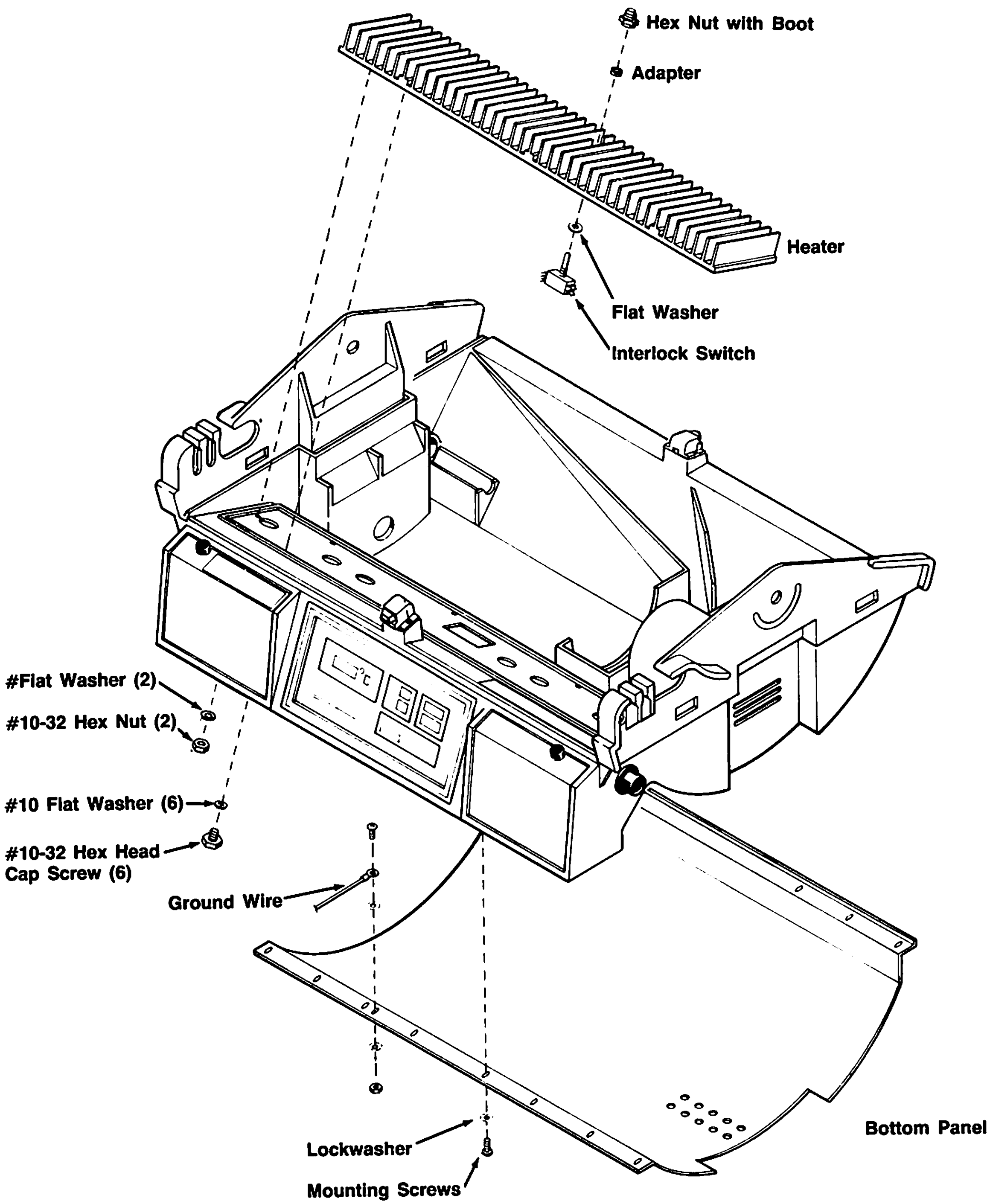


Figure 9-6
Heater Replacement

D. Heater Replacement

(Figures 9-6 and 9-7)

NOTE: An early version of the heater uses hex screws for mounting the heater. New mounting hardware is included in the heater replacement kit.

Removal:

1. Switch the power off and disconnect the power cord.

2. Remove the bed platform, humidifier and blower wheel. See Section 8A.

3. Remove the bottom panel. See Section 8B.

4. Remove the 5/8" nut and adapter from the top of the interlock switch which mounts it to the heater block. The switch and washer are removed from the bottom.

5. Close the incubator hood.

6. Tilt the incubator to the left side.

7. Label the two wires on the right safety theromostat and remove them.

8. Tilt the incubator to the right side.

9. Label the two wires on the left safety thermostat and remove them.

10. Label the remaining two wires on the heater block and remove them.

11. With the incubator tilted to the right use a 5/32" ball-headed hex driver and remove four of the six hex-head mounting screws from the heater block.

NOTE: On later production models air heater removal requires a 1/4 inch drive universal joint, 3/8 inch socket, 3 inch extension and ratchet.

12. Tilt the incubator to the left.

13. Remove the two remaining hex-head mounting screws from the heater block.

14. Discard the old mounting hardware for the defective heater assembly.

Installation:

1. If the #10 studs present on each end of the replacement heater are present on the original heater proceed to step 7. If the #10 studs are not present on the original heater proceed to step 2.

2. Retract the incubator hood under the lower unit.

3. Place the drilling template contained in the heater replacement kit over the heater base in the structural foam enclosure. Place the six #10-32 x 7/8 inch hex head screws through the holes in the template and into the enclosure to hold the template in position.

4. Drill two 7/32 inch holes in the enclosure at each marked position on the template.

5. Remove the mounting screws and remove the drilling template and discard it.

6. Close the incubator hood and reopen the front hood.

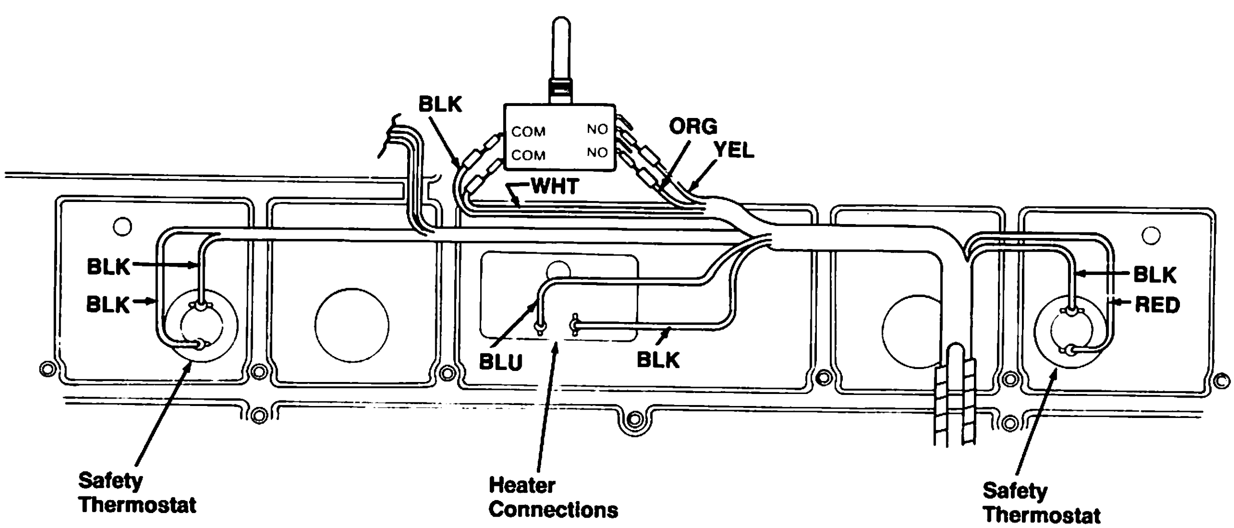


Figure 9-7
Heater Wiring

9/Lower Unit Repairs

7. With the incubator tilted to the left, mount the new heater into the structural foam enclosure. Be sure to position the hole for the interlock switch to the rear of the incubator.

8. Replace the interlock switch on the heater as follows:
 a. Place the washer on the interlock switch.
 b. Place the switch in position on the heater by inserting it from the bottom of the enclosure.
 c. While holding the switch from the bottom with one hand place the threaded adapter and nut (with boot) on the switch from the top. Turn the nut clockwise and tighten securely.

IMPORTANT: After the boot is installed on the switch the boot must be pushed down until the lip on the boot engages the groove on the switch plunger. This will ensure proper operation of the switch.

9. Place a #10 washer on each hex head screw and install the two middle mounting screws for the heater from the bottom of the enclosure.

10. Place one #10 washer and #10-32 hex nut on the end stud of the heater from the bottom of the enclosure.

11. Reconnect the two wires for the right safety thermostat.

12. Tilt the incubator to the right.

13. Replace the four remaining hex head mounting screws for the heater from the bottom of the enclosure. Tighten all six mounting screws securely.

14. Replace the remaining #10 washer and #10-32 hex nut on the end stud of the heater from the bottom of the enclosure

15. Reconnect the two wires for the left safety thermostat.

16. Reconnect the two wires for the heater.

17. Reconnect the remaining wires for the interlock switch.

18. Check that all wires for the heater and interlock switch are connected correctly.

19. Check that all cable harnesses are routed correctly through depressions in the incubator lower unit.

20. Check that all mounting screws are in place and secure.

21. Replace the bottom panel. See Section 8B.

22. Replace the bed platform, humidifier and blower wheel. See Section 8A.

23. Perform the operational check as described in Section 6.

24. Perform the appropriate functional checks in Sections 6M through 6S.

25. Perform the checks in Sections X, Y, and Z.

E. Interlock Switch Replacement

(Figures 9-6 and 9-7)

Removal:

1. Switch the power off and disconnect the power cord.

2. Remove the bed platform, humidifier and blower. See Section 8A.

3. Remove the bottom panel. See Section 8B.

4. Remove the 5/8" nut from the top of the interlock switch which mounts it to the heater block. Be sure to retain the adapter located between the switch and the heater (Figure 9-6).

5. Close the incubator hood.

6. Tilt the incubator to the right side.

7. Pull the interlock switch down from the bottom.

8. Label all of the wires connected to the switch and remove them.

Installation:

1. Reconnect the wires to the replacement interlock switch.

2. Place the switch in position, replace the adapter and washer and replace the 5/8" mounting nut. Be sure the boot is properly seated on the switch.

NOTE: It is important that after the boot is installed onto the switch that the boot is pushed down until the lip on the boot engages the groove on the switch plunger in order to ensure proper operation of the switch.

3. Check that all wires are connected properly.

4. Replace the bottom panel. See Section 8B.

5. Replace the blower wheel, humidifier, air filter, and bed platform. See Section 8A.

6. Check that the bed platform activates the interlock switch when in the latched position.

F. Patient Probe Jack Replacement

(Figure 9-8)

Removal:

1. Switch the power off and disconnect the power cord.

2. Close the incubator hood.

3. Remove the bottom panel. See Section 8B.

4. While holding the phone jack body with one hand from underneath the lower unit turn the bezel counterclockwise.

5. Unsolder the black and clear wires from the phone jack.

Installation:

1. Connect and solder the black wire from the low voltage harness to the terminal marked "TIP" on the replacement miniature phone jack.

2. Connect a jumper (1/2 inch length of a 20 gauge buss wire) between the terminal marked "SHUNT" and the remaining terminal marked "SLV". Solder the terminal marked "SHUNT".

3. Connect the clear wire from the low voltage harness to the terminal marked "SLV". Solder the two wires on the terminal marked "SLV".

4. Mount the miniature phone jack in position on the lower unit.

5. While holding the phone jack body with one hand thread the bezel clockwise onto the sleeve of the phone jack (hand tighten only).

6. Replace the bottom panel. See Section 8B.

7. Perform the control unit check of Section G.

G. Lower Unit and Tilt Mechanism Replacement

(Figures 9-9 and 9-10)

Removal of the Lower Unit and Tilt Mechanism:

NOTE: See Section E of the Appendix for a description of the lower unit support material.

This section describes the removal and replacement of the lower unit and tilt mechanism. In addition, there are subsections within this section for the repair of the tilt mechanism and the replacement of the lower unit.

1. Switch the power off and disconnect the power cord.

2. Remove the incubator hood assembly. See Section 7.

3. Remove the display panel cover. See Section 8C.

4. Remove the display panel. See Section 8D.

5. Remove the display panel and disconnect the ribbon cable.

6. Mark the high and low voltage harness assembly with a pen where the harness passes through the cable clamp.

7. Remove the two cable clamps and ground wires from the ground plate.

8. Remove the bottom panel. See Section 8B.

9. Label all the wires and connectors before removing them.

10. Disconnect the rear wall, front wall and air safety sensors.

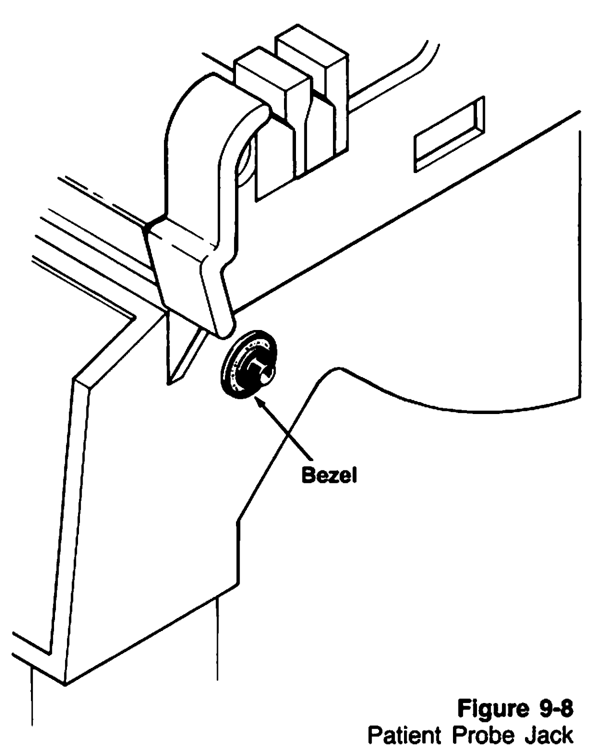


Figure 9-8
Patient Probe Jack

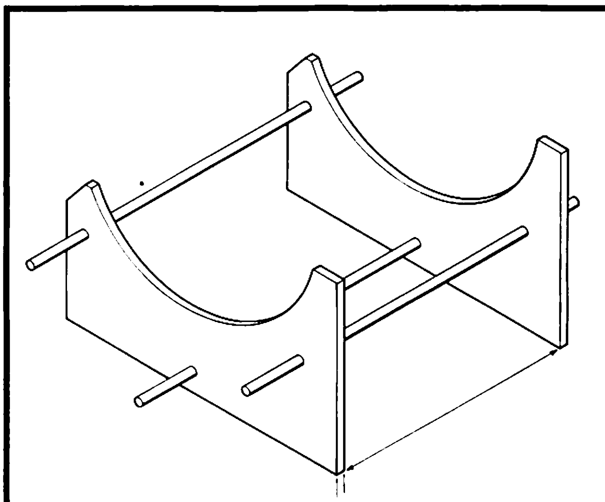


Figure 9-9
Lower Unit Support

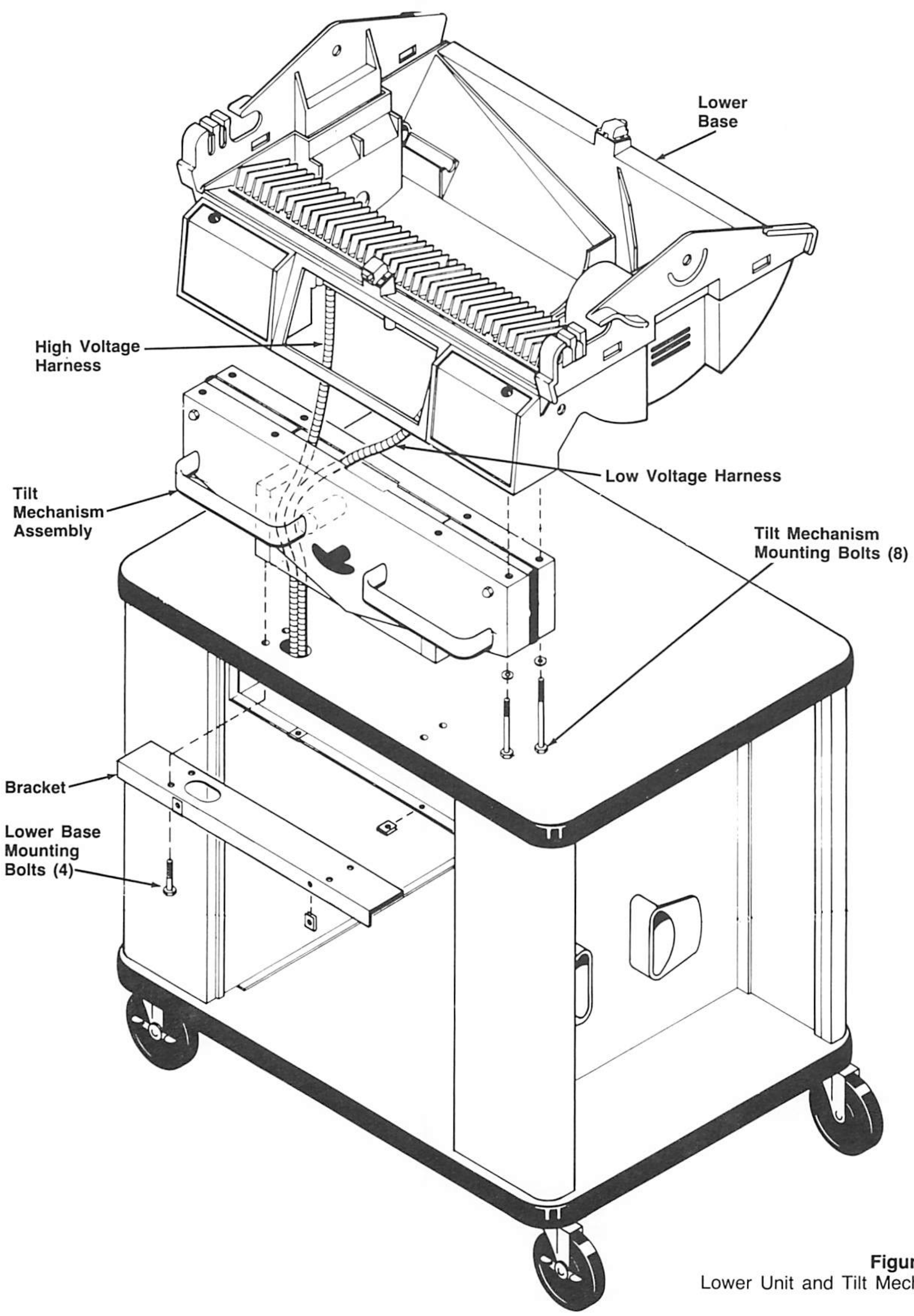


Figure 9-10
Lower Unit and Tilt Mechanism

9/Lower Unit Repairs

11. Disconnect the blower motor.

12. Remove the patient probe jack from the right side of the lower base. Turn the patient probe jack bezel counterclockwise to remove it.

13. Disconnect the heater, interlock switch and thermostats.

14. Replace the bottom panel.

15. Place the support material between the lower base and the cabinet top.

16. Remove the three drawers if present.

17. Remove the raceway cover (Figure 12-13, Item 9).

18. Remove the high and low voltage harness cables by pulling them through the tilt mechanism and cabinet top.

19. Remove the four mounting bolts and bracket which mount the lower base to the cabinet.

20. Lift the tilt mechanism and the lower base assembly from the incubator and place it upside down on a clean flat surface.

21. Remove the eight tilt mechanism mounting bolts.

22. Remove the tilt mechanism assembly.

Tilt Mechanism Repair:
(Figures 9-11 and 9-12)

CAUTION: A new positioning lock handle and detent bar are required when repairing the tilt mechanism. The positioning lock handle is destroyed during disassembly.

An early version of the Indexing Plate is present on some units. Examine the tilt mechanism and determine if the early version or the latest version is present. Follow the instructions for the version present on the incubator.

If the early version parts are present replace those parts with the parts listed in Table 9-1 when repairing the tilt mechanism.

If the indexing plate is worn replace all of the parts listed in Table 9-1 when repairing the tilt mechanism.

Table 9-1

The following parts are required to repair a tilt mechanism:

Description & Qty	Stock No.
*Indexing Plate (1 required)	0217-2919-500
Detent Bar (1 required)	0217-2918-542
Detent (1 required)	0217-2917-535
Compression Spring (1 required)	0203-4033-300
Positioning Lock Handle (1 required)	0212-1942-300
Groove Pin (2 required)	0143-3108-510
Loctite #242, 10cc Tube, Med. Str.	0220-5017-300
Loctite #271, 10cc Tube, Hi. Str.	0220-5021-300
Lubriplate Lubricant (1 Pint Can, No. 130AA or equivalent all purpose grease)	0220-5150-300

*Only the rear Indexing Plate is required when repairing the tilt mechanism. The front indexing plate receives no wear from the detent.

For other repairs replace the Positioning Lock Handle, the detent Bar and any necessary parts.

1. Position the tilt mechanism on the top end so that the mounting posts are at the top.

2. Pull the positioning lock handle out and slide the indexing plate assembly as far as possible to one side.

3. Remove the backup plate.

4. Slide the indexing plate to the other side and remove the other backup plate.

5. Remove the positioning lock handle from the tilt mechanism by turning the handle counterclockwise with a large wrench. The handle should break off.

6. Slide the detent bar out from the rear of the tilt mechanism.

7. Loosen the two assembly screws with acorn nuts located in the lower corner (these screws are slightly longer). **Do not** remove them.

CAUTION: Carefully disassemble the tilt mechanism. The steel ball bearings inside may drop out and get lost.

8. Remove the four assembly screws for the handles.

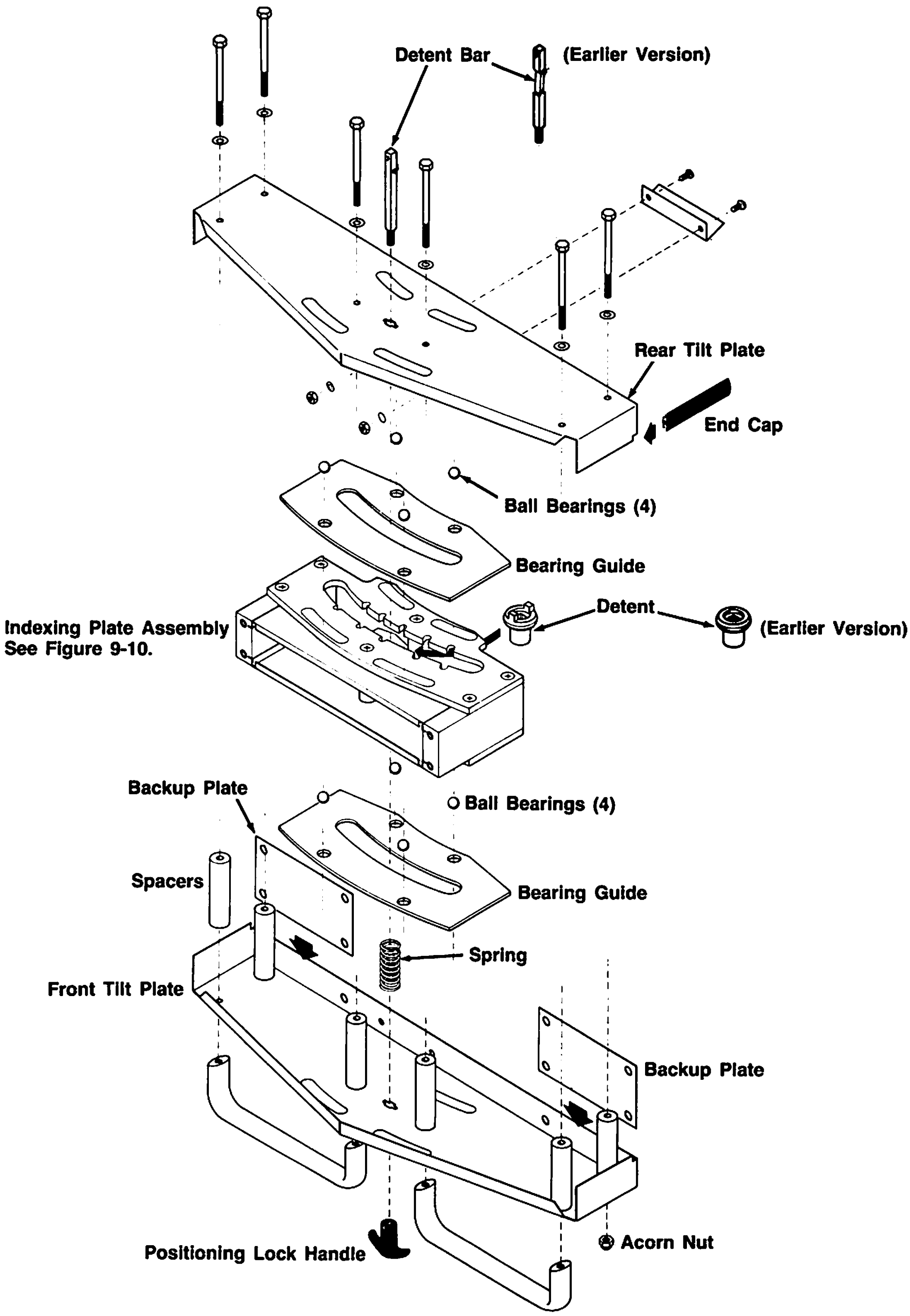


Figure 9-11
Tilt Mechanism Assembly

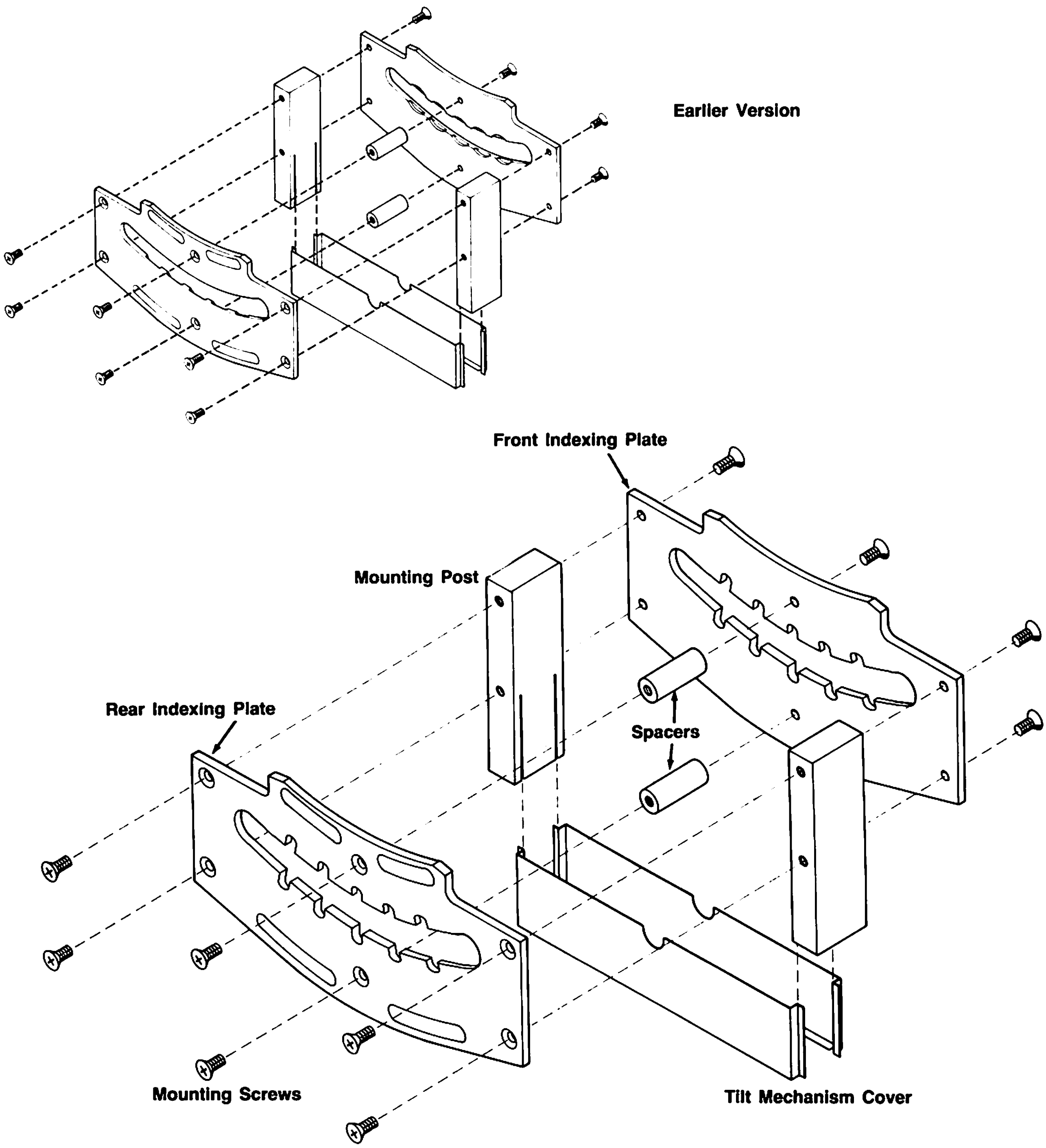


Figure 9-12
Indexing Plate Assembly

9. Lay the tilt mechanism down on its handle side (front tilt plate is on the bottom).

10. Remove the two acorn nuts from the assembly screws.

11. Use a pencil and label the rear tilt plate.

12. Remove the rear tilt plate.

13. Remove the four ball bearings and bearing guide.

14. Remove the spring and detent.

15. Use a pencil and label the rear indexing plate.

16. Remove the indexing plate assembly.

17. Remove the remaining ball bearings, spacers, bearing guide and end caps.

18. Remove the six Phillips head mounting screws from the rear indexing plate.

19. Remove the rear indexing plate.

Tilt Mechanism Assembly (Figures 9-11 and 9-12)

1. Clean the front tilt plate. Wipe the grease from the plate.

2. Place the front tilt plate flat with the inside facing up.

3. Apply a light coating of Lubriplate to the four grooves in the tilt plate.

4. Clean the bearing guide.

5. Place the bearing guide in position on the tilt plate.

6. Clean four of the steel ball bearings.

7. Place the four steel ball bearings in the bearing guide.

8. Clean the indexing plate assembly.

9. Place the new rear indexing plate on the indexing plate assembly.

10. Replace the six Phillips head mounting screws for the new indexing plate. Apply Loctite #242 to the threads of each screw.

11. Lightly coat the grooves on both sides of the indexing plate assembly with Lubriplate.

12. Place the indexing plate assembly on the bearing guide so that the new indexing plate is on top.

13. Clean the other bearing guide.

14. Place the other bearing guide in position on the indexing plate assembly.

15. Clean the remaining four steel ball bearings.

16. Place the remaining four steel ball bearings in the bearing guide.

17. Clean the rear tilt plate.

18. Apply a light coat of Lubriplate to the four grooves in the tilt plate.

19. Place the rear tilt plate on the indexing plate assembly against the ball bearings.

20. Replace the two acorn nuts and hand tighten. Apply Loctite #242 to the threads of each screw.

21. Lift the tilt mechanism up and rest it on the top edge.

22. Place the new detent in position on the new indexing plate (rear indexing plate).

23. Insert the threaded end of the new detent bar into the rear tilt plate and into the detent. Line up the detent bar so the first pin will pass through the tilt plate. This will hold the detent in position while inserting the spring.

24. Place one end of the spring against the detent. Place the other end in the groove in the front indexing plate. Compress the spring and slide it into position so it lines up with the opening in the front indexing plate.

25. Slide the detent bar in through the spring and front tilt plate.

26. Install the new positioning lock handle on the detent bar (Do not use Loctite at this time).

27. Install the remaining four mounting bolts and spacers for the two handles on the tilt mechanism assembly. Apply Loctite #242 to the threads of each screw.

28. Tighten all six mounting screws securely.

29. Check the tilt mechanism for proper operation. The indexing plate assembly must slide easily from one end to the other with the positioning lock handle pulled out. The indexing plate assembly must also lock in each of the five locking positions.

30. Slide the indexing plate assembly all the way to one end and install the backup plate so the notched edge is at the end of the tilt mechanism.

31. Slide the indexing plate assembly to the opposite end and replace the other backup plate so the notched edge is at the end of the tilt mechanism.

32. Install the two end cap extrusions so the notched end is at the notched end of the tilt plates. Bend the latch on the end caps, if necessary, to hold the end caps in position when the tilt mechanism is in a vertical position.

9/Lower Unit Repairs

Lower Unit Replacement:
(Figure 9-3)

The following parts are required to replace a lower unit:

Description & Quantity	Stock No.
Lower Unit	0217-2841-100
Label, Heater Warning	0205-4713-300
Label, Power Warning	0205-4712-300
Label, Patient Probe	0205-4711-300
Rubber Bumper (2 required)	0211-1531-300
Motor Air Seal	0210-6566-300
Air Seal Bushing	0217-2872-500
Styrene Plug	0212-1284-100
Tie-Rap Mounting Blocks (8 required)	0690-1240-323
Tie-Rap (8 required)	0690-1240-302

1. Transfer the rear wall sensor to the new lower unit.
2. Transfer the front wall sensor and air safety sensor.
3. Install the new styrene plug for the front wall sensor.

NOTE: Position the plug so that the small end is at the top of the cavity and the tapered side is facing the rear of the unit. Slide the plug into the housing for a snug fit.

4. Install the three new labels.
5. Install the two new rubber bumpers.
6. Install the eight new tie-rap mounting blocks.
7. Position the tie-raps on the mounting blocks.
8. Transfer the EMI shielding hardware.
9. Transfer the heater.
10. Transfer the blower motor.

Installation of Lower Unit and Tilt Mechanism:
(Refer to Figure 9-10)

1. Place the tilt mechanism upside down on the lower unit. Position the tilt mechanism for insertion of the four mounting bolts.
2. Inset the four mounting bolts and mount the tilt mechanism to the lower unit. Tighten the mounting screws to a torque specification of 60 in. lb.
3. With the assistance of another person, place the lower base and tilt mechanism assembly on the incubator cabinet. Rest the lower base on the support material.
4. Replace the four mounting bolts and bracket which mount the lower base to the cabinet.
5. Insert the high and low voltage cables through the cabinet top and tilt mechanism. Position the high voltage cable on the left and the low voltage cable on the right (Figure 9-13).
6. Replace the two cable clamps and ground wires on the ground plate (Figure 9-13). Use the previously made pen marks for correct positioning.
7. Reconnect the patient probe jack on the right side of the lower base.
8. Reconnect the blower motor.
9. Reconnect the rear wall, front wall and air safety sensors.
10. Reconnect the heater and thermostats.
11. Recheck all wiring connections.

CAUTION: Do not allow the bottom panel to pinch any of the rear sensor wiring. The rear sensor leads must be routed to the left of the center support rib (when viewed from the rear of the incubator). Make sure the sensor cable is routed in the cut outs on the support webbing.

12. Check the tilt mechanism operation. Apply Loctite #242 on the new positioning lock handle.
13. Replace the display panel. See Section 8D.
14. Replace the display panel cover. See Section 8C.
15. Replace the bottom panel. See Section 8B.
16. Replace the incubator hood assembly. See Section 7.
17. Perform the Control Unit Check in Section 6.
18. Perform the Leakage Current Test in Section 6.

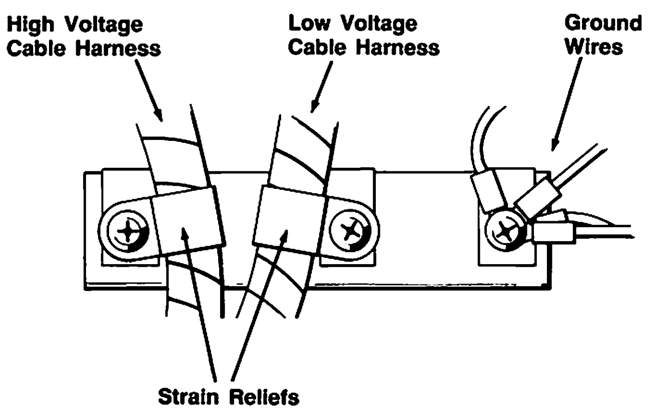


Figure 9-13
Cable and Ground Wire Positioning

H. Display Board or Touch Panel Replacement

(Figure 9-14)

Removal:

1. Set up the static control work station. See Section 4.

2. Remove the Display Panel Access Cover. See Section 8C.

3. Remove the Display Panel. See Section 8D.

4. Disconnect the 26 conductor ribbon cable from the circuit board.

5. Place the Display Panel face down on the static control mat.

6. Remove the 9 conductor ribbon cable from the display board which connects to the touch panel.

7. Remove the 7 Phillips head mounting screws from the display panel.

8. Remove the display circuit board.

9. Remove the touch panel mounting assembly.

Installation:

1. Replace the touch panel mounting assembly.

2. Replace the display circuit board.

3. Replace the 7 Phillips-head mounting screws.

4. Replace the 9-conductor ribbon cable from the touch panel to the display board.

5. Connect the control panel to the incubator with the 26-conductor connector (P7).

NOTE: Some connectors are not pin indexed to prevent improper connection. Be sure to line up the arrows on the connectors for proper connection. In some cases, it may be necessary to remove pin 14 from the J7 connector for proper pin indexing.

6. Replace the display panel mounting brace. Make sure the wire is routed behind the brace.

7. Replace the display panel. Do not crease or pinch the 9 conductor ribbon cable during installation.

8. Replace the two 11/32 display panel mounting nuts. Hand tighten the nuts then use a nut driver and tighten them an additional 1/2 turn. Tilt the incubator if desired for easier access.

CAUTION: Do not over-tighten the two mounting nuts for the display panel. The touch panel switches may become inoperative.

9. Replace the display panel access cover.

10. Perform the calibration, adjustments and checks of Section 6 for the incubator.

I. A/D Converter and Analog Switch Replacement on the Control Board

(Refer to Figure 12-32)

NOTE: Both the A/D Converter and Analog Switch must be replaced.

1. Setup the static control work station.

2. Place the power switch in the OFF position.

3. Disconnect the power cord from the power source.

4. Remove the two screws which mount the control unit to the incubator cabinet.

5. Slide the control unit out. For easy removal, make sure the power cord is not wrapped tightly on the cord holder.

6. Use an IC Puller and remove the A/D converter (Ohio Part No. 0684-1000-000) labeled U1 on the control board. Note the pin 1 location.

7. Install the new A/D converter in the U1 position on the control board. Be sure that pin 1 of the IC is connected to pin 1 of the socket.

8. Use an IC Puller and remove the analog switch (Ohio Part No. 0684-1000-002) labeled U2 on the control board. Note the pin 1 location.

9. Install the new analog switch in the U2 position on the control board. Be sure that pin 1 of the IC is connected to pin 1 of the socket.

10. Refer to Section 6 for calibration of the incubator.

11. Slide the control unit in and replace the two mounting screws.

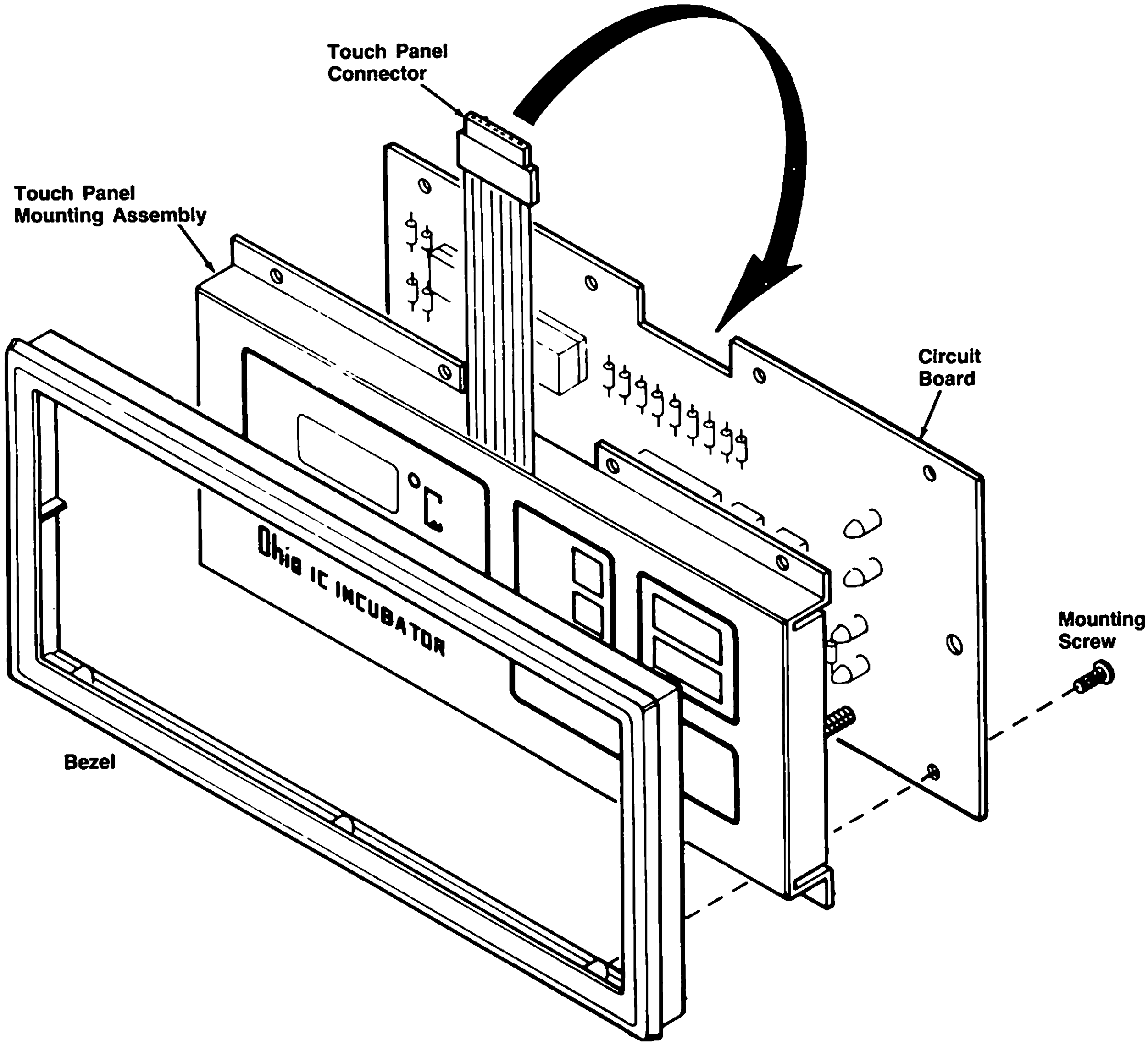


Figure 9-14
Display Board or Touch Panel Replacement

J. Control Board Replacement

(Figure 9-15)

1. Setup the static control work station.
2. Place the power switch in the OFF position.
3. Disconnect the power source.
4. Remove the two screws which mount the control unit to the incubator cabinet.
5. Slide the control unit out. For easy removal, make sure the power cord is not wrapped tightly on the cord holder.
6. Disconnect cable connectors P5, P6 and P4 (use an IC extraction tool to remove the P4 connector).
7. Remove the four control board mounting screws from the outside of the control cabinet.
8. Remove the defective control board and place it on the Velostat mat.
9. Remove the new control board from the conductive packaging and place it on the Velostat mat.
10. Transfer the circuit board standoffs from the defective circuit board to the new circuit board.
11. Install the new control board and replace the four mounting screws from the outside of the control cabinet.
12. Connect the cable connectors P5, P6, and P4 (use an IC extraction tool to install the P4 connector). Be sure that pin 1 of each connector is connected to pin 1 on the printed circuit board. Line up the arrows of P6. The brown wire must be up for P4 and P6.
13. Place the defective circuit board in the conductive packaging.
14. Perform the calibration, adjustments and checks of Section 6 for the incubator.
15. Slide the control unit in place and replace the two mounting screws.
16. Perform the Functional Checkout and Electrical Safety Checks.

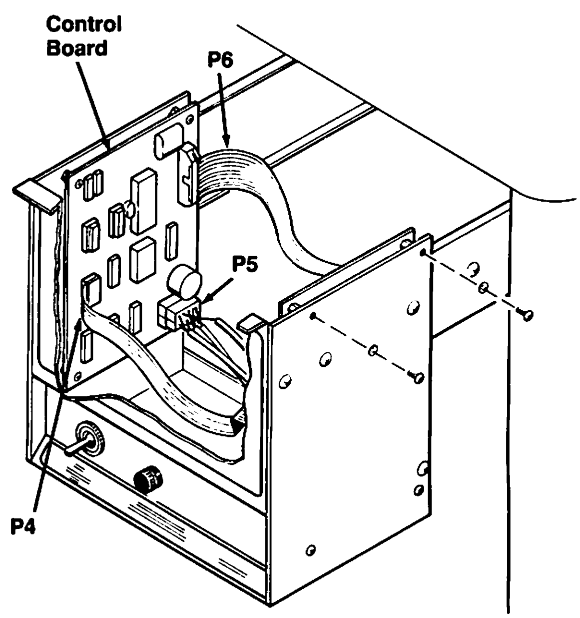


Figure 9-15
Control Board Replacement

K. Power Supply Board Replacement

(Figure 9-16 or 9-17)

Removal:

1. Setup the static control work station.
2. Place the power switch in the OFF Position.
3. Disconnect the power cord from the power source.
4. Remove the two screws which mount the control unit to the incubator cabinet.
5. Slide the control unit out. For easy removal, make sure the power cord is not wrapped tightly on the cord holder.
6. Disconnect P1, (use an IC extraction tool to remove the P1 connector) P2, and P3 connectors from the power supply board.
7. Remove the four Phillips-head mounting screws for the power supply board from the outside of the control unit.
8. Place the old power supply board on the static control mat.

Installation:

1. Remove the new power supply board from the conductive packaging.
2. Transfer the circuit board standoffs from the defective circuit board to the new circuit board.
3. Place the power supply board in the control unit and mount it with the four Phillips-head screws. Verify the presence of a lock washer between the screw head and the chassis. Place the board with the adjustment pots up.
4. Reconnect P1 (use an IC extraction tool to install the P1 connector), P2, and P3 connectors to the power supply board. The brown wire must be up for P1.
5. Place the old power supply board in the conductive packaging.
6. Perform the calibration, adjustments and checks of Section 6 for the incubator.
7. Slide the control unit in and replace the two mounting screws.
8. Perform the Functional Checkout and Electrical Safety checks.

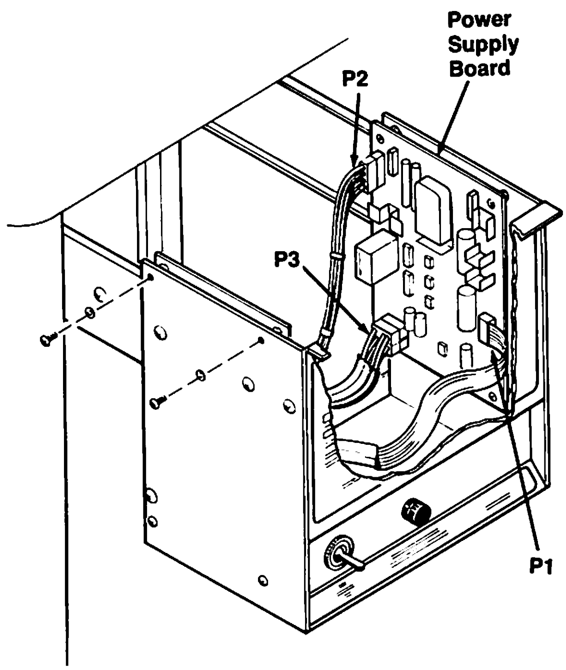


Figure 9-16
Early Version Power Supply Board Replacement

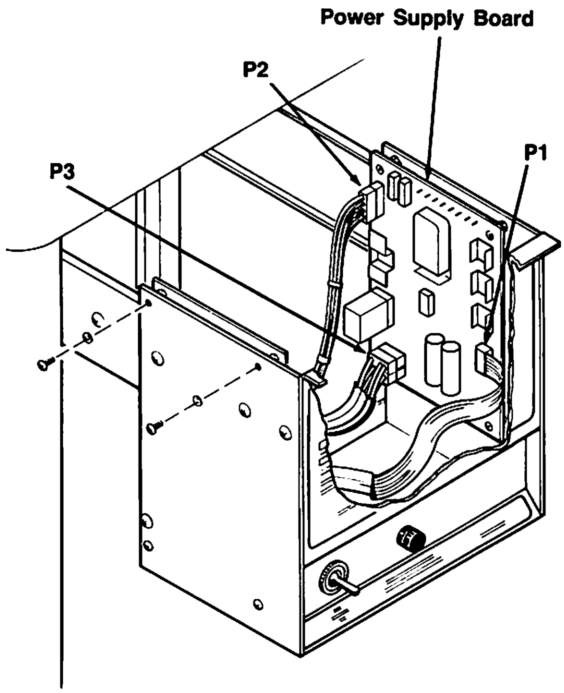


Figure 9-17
Later Version Power Supply Board Replacement

L. Triac Replacement for the Earlier Version Power Supply Board

1. Set up the static control work station.
2. Place the power switch in the OFF position.
3. Disconnect the incubator power cord.
4. Remove the power supply board from the incubator. See Section 9K. Power Supply Board Replacement.
5. Place the component side of the power supply board up.
6. Remove the mounting screw for the triac.
7. Disassemble the triac and heat sink as shown in Figure 9-18.
8. Apply a thermal joint compound (Ohmeda part number 0220-5255-300) between the heat sink and the triac.
9. Assemble the new triac and the heat sink as shown in Figure 9-18.
10. Mount the triac heat sink assembly to the circuit board with the mounting screw.
11. Install the Power Supply Board in the incubator. See Section 9K. Power Supply Board Replacement.
12. Perform the Functional Checkout and Electrical Safety Checks.

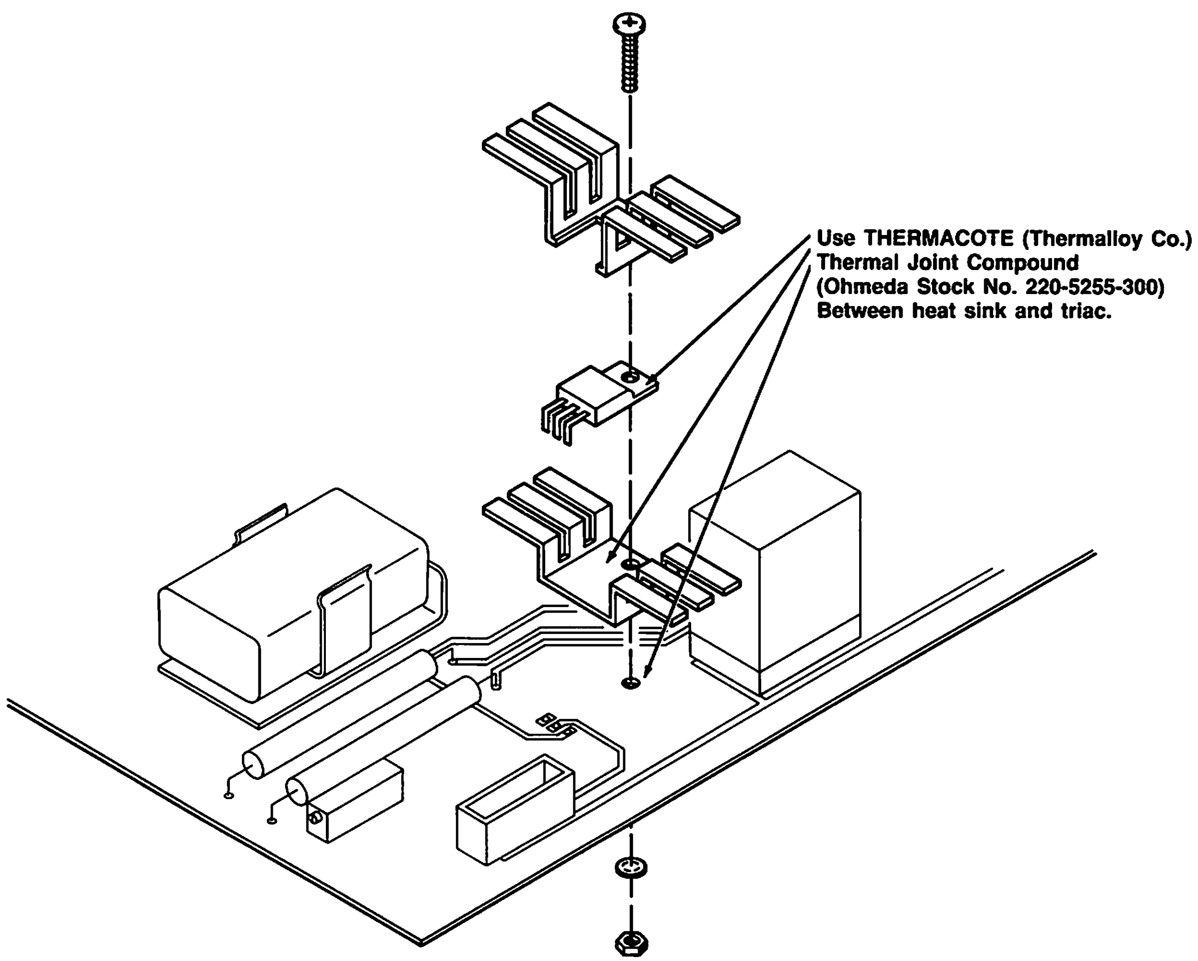


Figure 9-18
Triac Heat Sink Assembly for
Early Version Power Supply Board

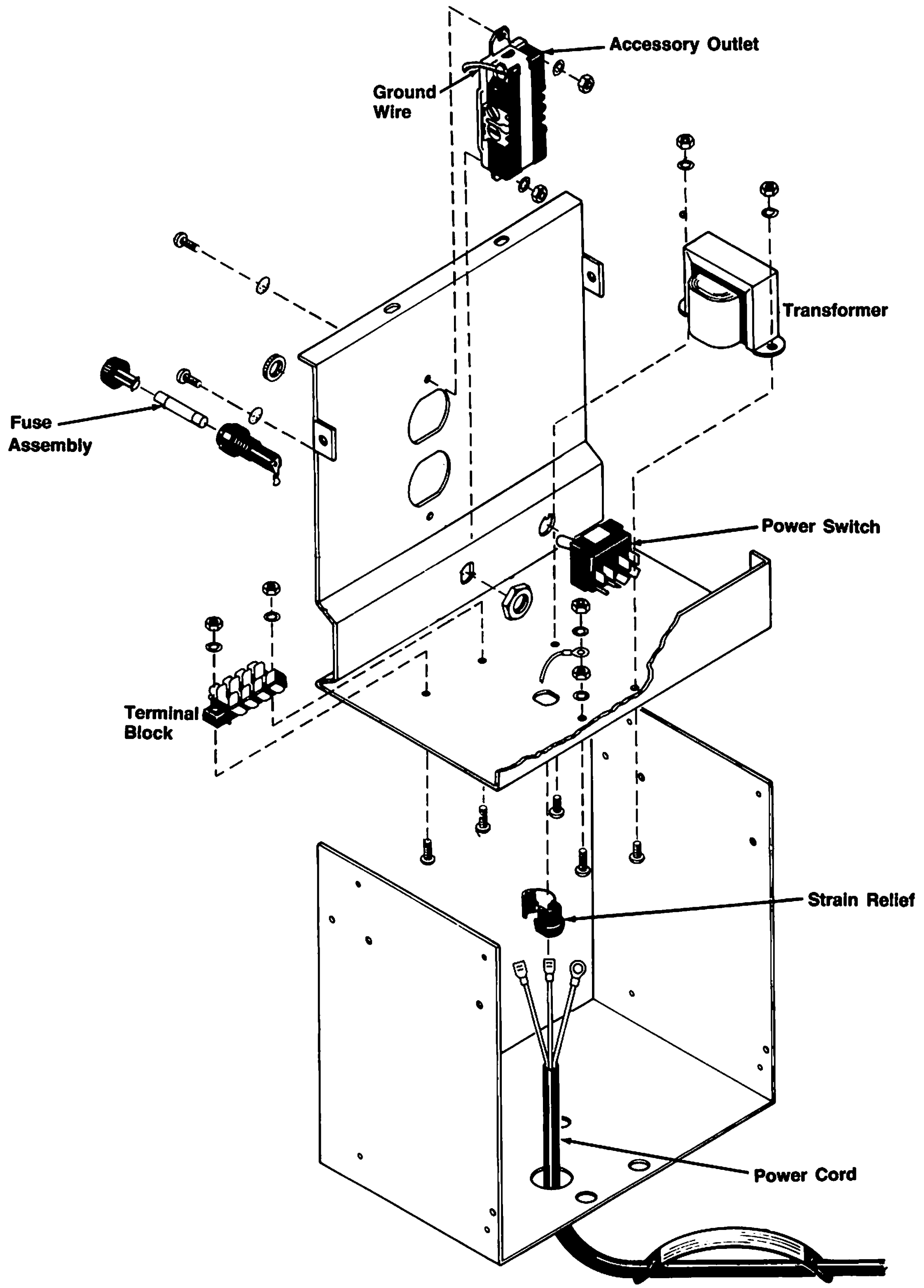


Figure 9-19
120V Controller Assembly

M. Power Switch Replacement
(Figure 9-19)

WARNING: High voltage is present at the power switch. Disconnect the power cord.

CAUTION: Use the Static control Work Station (Part No. 0175-2311-000) to ensure that static charges are safely conducted to ground and not through static sensitive devices.

1. Switch the power off and disconnect the power cord.

2. Remove the two Phillips-head screws which mount the control unit to the incubator cabinet.

3. Slide the control unit out. For easy removal, make sure the power cord is not wrapped tightly on the cord holder.

4. Label all of the wires on the switch for correct replacement.

5. Use a needle nose pliers and remove each wire one at a time from the switch and place them in the correct position on the replacement switch.

6. Remove the switch from the incubator by loosening the hex nut behind the front panel of the control unit.

7. Remove the face nut.

8. Place the replacement switch in position (adjust the face nut so it is flush with the threads) and secure the switch with the hex nut.

9. Check to be sure all wires are installed correctly (Figure 9-20).

10. Perform the calibration, adjustments, and checks of Section 6 for the incubator.

N. Base Slab Replacement
Figure 9-21

1. Remove incubator drawers and rotate hood to open position.

2. Remove shelf/frame assembly (if fitted) from incubator humidifier filler end.

3. Remove mattress and any other loose items.

4. With assistance, carefully lay incubator down on the humidifier filler end.

5. Pull off casters and remove four (4) hex head caster mounting sockets.

6. Remove four (4) hex nuts and washers.

7. Carefully remove the base slab from main assembly.

NOTE: When replacing the base slab on an older incubator, order four (4) each of the following parts:

Spacer, Tie-rod **217-2956-300**
O-ring **210-0410-300**

Refer to Figure 12-33 for a complete list of cabinet assembly parts.

8. Place an 'O' Ring (210-0410-300) on each caster mounting tie-rod, two (2) inches from end (refer to Figure 9-21).

9. Place spacer (217-2956-300) on each caster tie-rod with the slots engaged on rails of extrusion.

10. Place new slab on unit and refit hex nuts with washers and hex head caster mounting sockets.

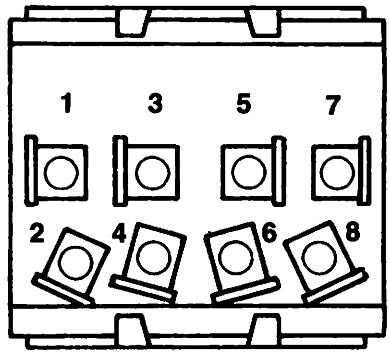
Note: Tie-rods may need alignment through access holes.

11. Torque nuts and sockets to 150 inch lbs.

12. Refit casters in sockets with two locking casters at front.

13. Ensure assembly is secure and with assistance carefully stand unit upright.

14. Ensure correct operation of casters and return unit to service.



1. **Yellow wire**-to fuse holder
2. **Yellow wire**-to terminal block
3. **Orange wire**-to interlock switch
4. **Orange wire**-to terminal block
7. **Red wire**-to pin 8 of P3
8. **Two Brown wires**-to pin 7 of P3
   to pin 3 of P5

Figure 9-20
Power Switch Wiring for 120V Model

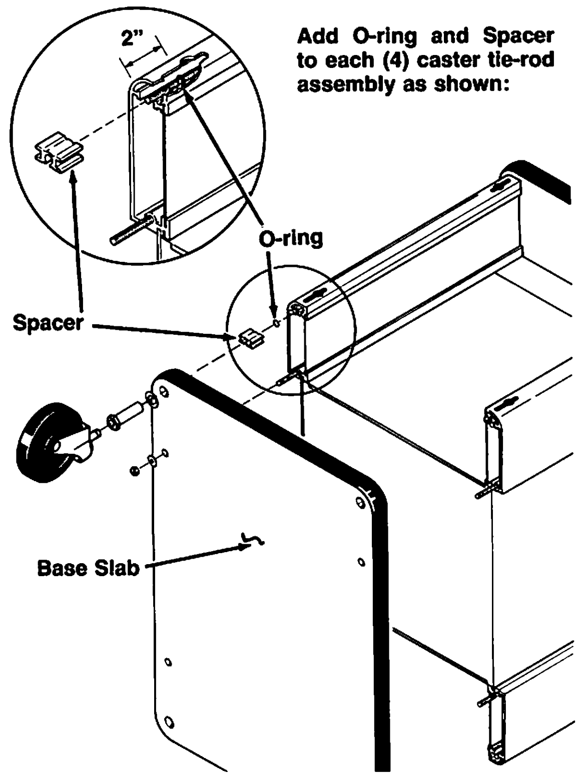


Figure 9-21
Cabinet Assembly

10/Phototherapy Lamp Repairs

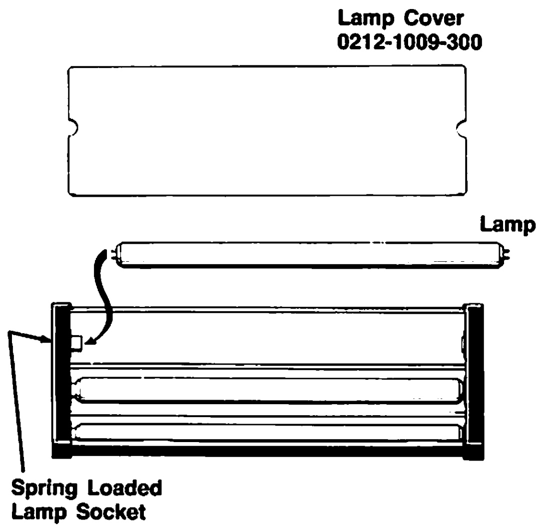


Figure 10-1
Lamp Replacement

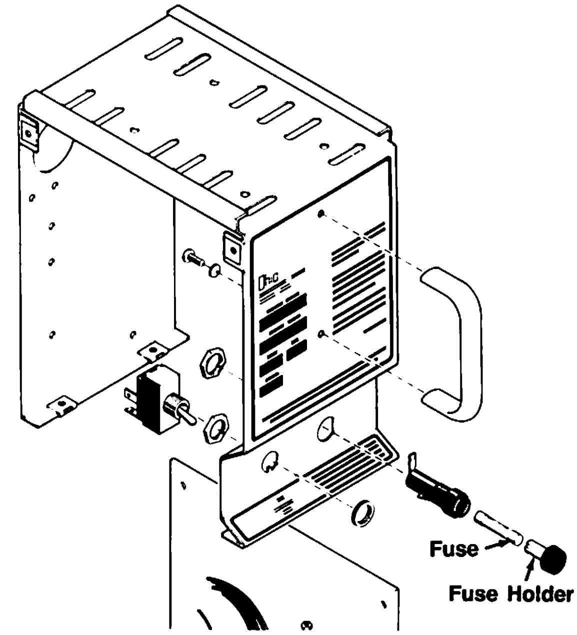


Figure 10-2
Fuse Replacement

The Phototherapy Lamp contains three 24 inch 20 watt daylight fluorescent lamps (GE F-20T12-D or equivalent). Replace the lamps at the lamp manufacturer's recommended time interval for phototherapy treatment applications or sooner if they fail. Most lamps require replacement after 1000 hours of operation.

A. Lamp Replacement

(Figure 8-1)

WARNING: Disconnect the power cord before replacing the Phototherapy Lamps.

WARNING: Do not replace the fluorescent lamps while the Phototherapy Lamp is mounted on an occupied incubator.

1. Disconnect power to the Phototherapy Lamp.
2. Remove the Phototherapy Lamp and place it on a clean flat surface.
3. Rest the unit on the handle side.
4. Insert your fingers under the cut out portions of the press-fit lamp cover and lift the cover to the bowed out position. With one hand pry the cover away at one edge a few inches. Insert a pencil under that portion of the lamp cover and slide it down the length of the cover to remove it.
5. Push each fluorescent lamp toward the spring-loaded lamp socket and raise the lamp for removal.
6. Replace all 3 lamps.
7. Replace the press-fit cover by pressing it into position.

B. Fuse Replacement

(Figure 10-2)

WARNING: Disconnect power to the incubator before attempting to replace a fuse.

WARNING: For continued protection against a fire hazard, replace the fuse with the same type and rating.

The fuse is located on the Phototherapy Control Unit next to the power switch.

Replacement Fuses
Model-Description

120V Slow-Blow 1A, 250V 0.25D x 1.25 in . . . 0690-1700-302
220V * Slow-Blow 1A,
250V Miniature 5 x 20 mm 0690-1700-320
240V* Slow-Blow 1A,
250V Miniature 5 x 20 mm 0690-1700-320
100V* Slow-Blow 1.6A,
250V Miniature 5 x 20 mm 0690-1700-319
*Both hot and neutral lines are fused.

To remove the fuse push the fuse holder in and turn it counterclockwise. Export units require a screwdriver.

To install the fuse push the fuse holder in and turn it clockwise.

If the fuse continues to open, the phototherapy Lamp requires service.

10/Phototherapy Lamp Repairs

C. Crane Arm Replacement

(Figure 10-3)

1. Remove the crane arm 1/4" hex head mounting screw.

2. Remove the crane arm.

3. Remove the end cap and transfer it to the new crane arm.

4. Place the new crane arm in position and mount it with the 1/4" hex head screw. Apply Loctite 242 and torque to 150 in. lbs.

D. Phototherapy Lamp Disassembly for Repair of Ball and Socket

(Figure 10-3)

1. Open the unit from the power cord end for access to the ball and socket mounting bracket. Open the unit from the other end for access to the wiring at the opposite end and the push fit sockets.

2. Remove the four cover mounting screws.

3. Remove the cover and insulator.

4. Remove the four handle mounting screws. Note the position of the green-yellow ground wire.

5. Slide the top cover plate out far enough to access the power cord grommet.

6. Remove the grommet from the cover by pinching it with a pliers.

7. Open the grommet and remove it from the power cord.

8. Remove the ground wire from the top cover.

9. Slide out the top cover far enough to access the ball and socket mounting bracket.

10. Remove the four ball and socket mounting screws from the inside of the top cover. Apply Loctite #242 during reassembly.

11. Remove the spring, friction spacer, metal ball, and ball socket.

12. Reassemble in the opposite order.

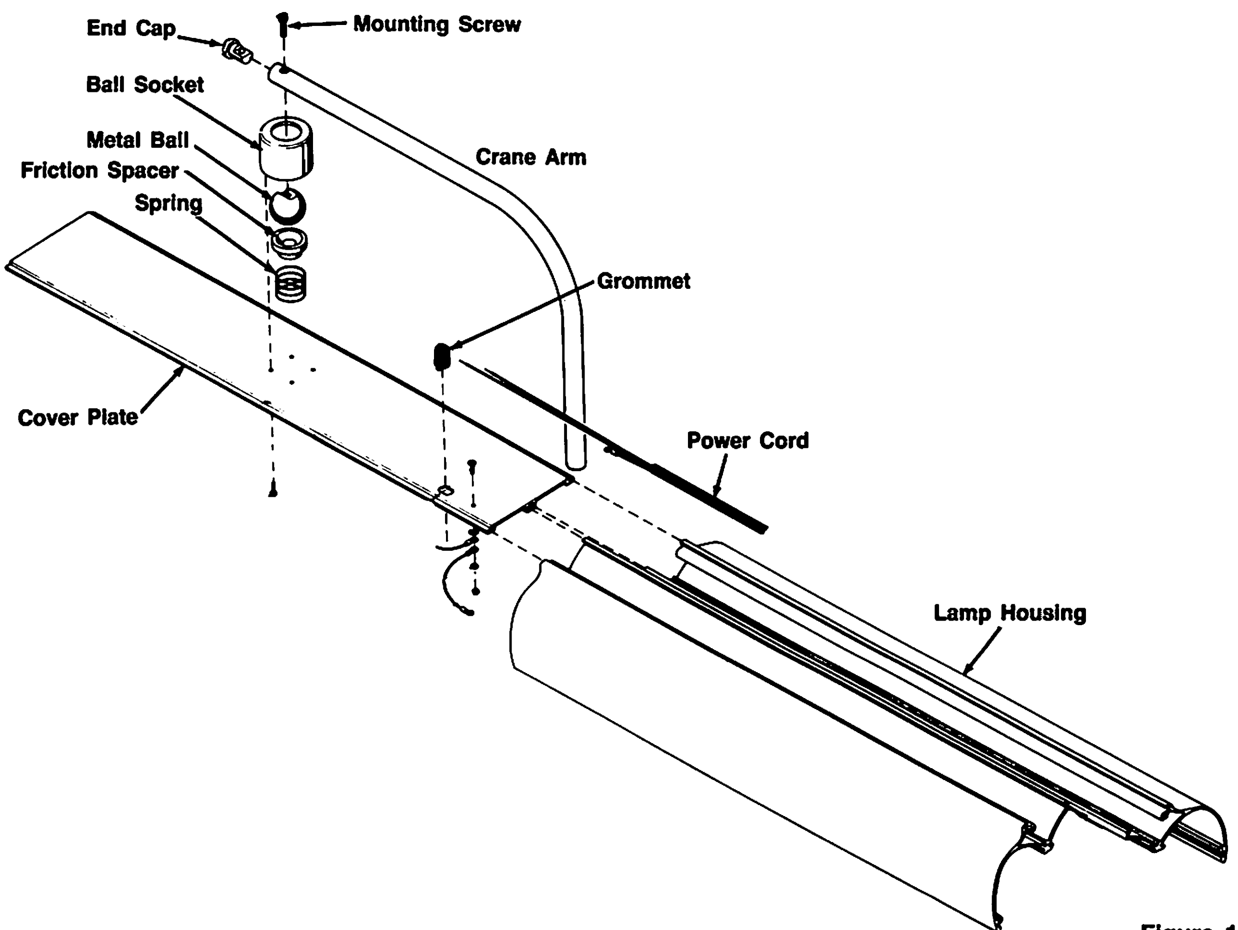


Figure 10-3
Crane Arm Assembly

E. Phototherapy Light Lamphouse End Cap Disassembly

(Figure 10-4)

Removal of Stationary Lampholder End Cap

1. Switch the power OFF on the control unit.
2. Disconnect the power cord from the control unit.
3. Remove the lamp cover.
4. Remove the three daylight lamps.
5. Remove the four Phillips-head screws from the cover plate.
6. Remove the cover plate and insulator.
7. Remove the six Phillips-head screws which mount to the end cap.
8. If it is necessary to remove the wires, label each wire and make a wiring diagram.
9. To remove a wire, place a small flat-blade screwdriver in the slot next to the wire to be removed and push gently. (Do not push too hard or the connector will be damaged.) Then pull the wire from the connector.
10. To replace the wire simply push the wire into the connector. Pull on the wire to make sure a proper connection is made.
11. The stationary lampholder may be replaced by pushing out the lampholder. When replacing the lampholder, be sure to line up the notch on the end cap with the index on the lampholder.

Assembly of the Stationary Lampholder End Cap

1. Place the end cap in position and mount it with the six Phillips-head screws. Be sure the ground wire is attached between the two middle screws.
2. Replace the insulator and cover plate.
3. Replace the four Phillips-head mounting screws.

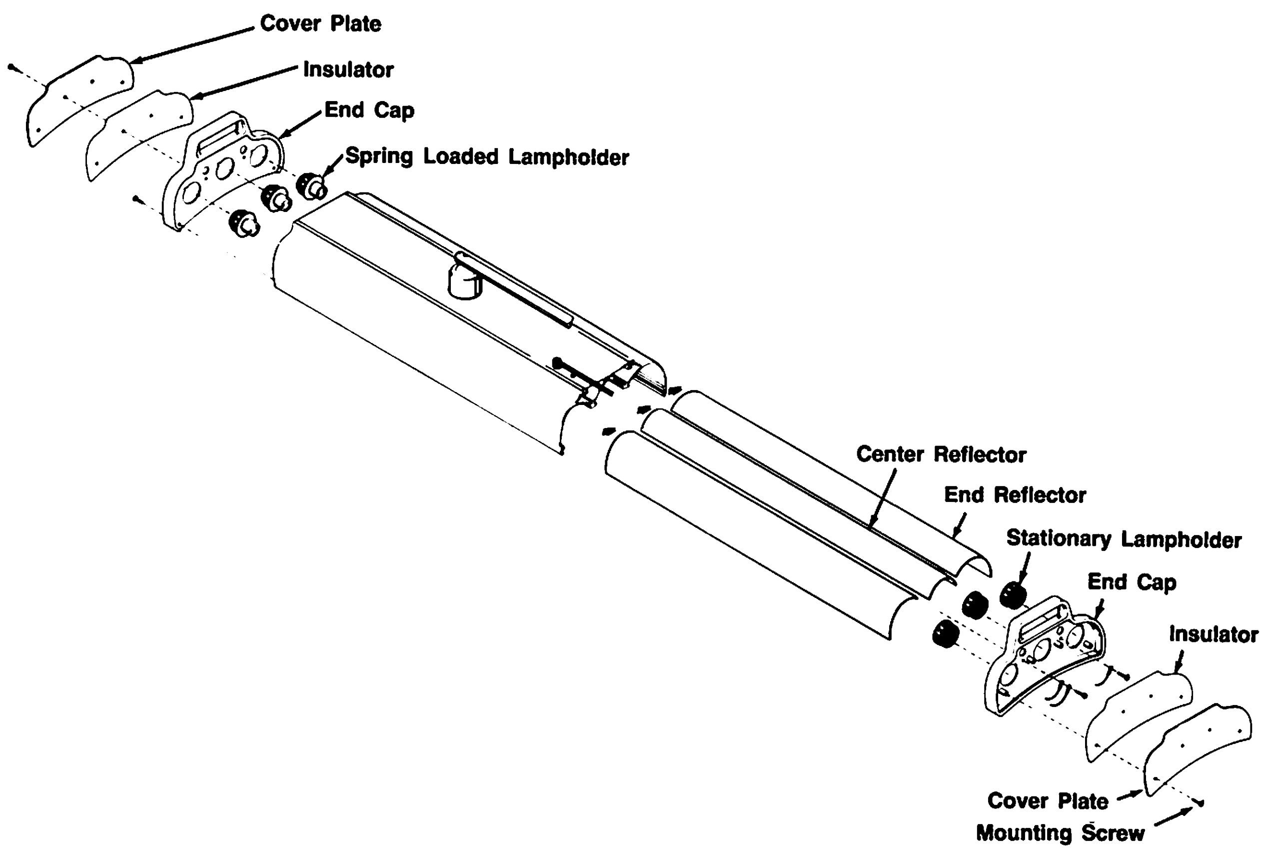


Figure 10-4
End Cap Assembly

10/Phototherapy Lamp Repairs

Removal of the Spring Loaded Lampholder End Cap

1. Remove the four Phillips-head screws.
2. Remove the cover plate and insulator.
3. Remove the six Phillips-head screws which mount the end cap.
4. If it is necessary to remove the wires, label each wire and make a wiring diagram.
5. To remove a wire, place a small flat-blade screwdriver in the slot next to the wire to be removed and push gently. (Do not push too hard or the connector will be damaged.) Then pull the wire from the connector.
6. To replace a wire simply push the wire into the connector. Pull on the wire to make sure a proper connection is made.
7. The spring-loaded lampholders are removed by pushing out the lampholders. When replacing the lampholder be sure to line up the notch on the end cap with the index on the lampholder.

Assembly of the Spring Loaded Lampholder End Cap

1. Place the end cap in position and mount it with the six Phillips-head screws.
2. Replace the insulator and cover plate.
3. Replace the four Phillips-head mounting screws.

F. Phototherapy Lamp Cable Connector Repair (Earlier Version Only)

(Figure 10-5)

Removal:

1. Disconnect the phototherapy lamp power cord from the control unit.
2. Remove the two strain relief screws from the cable clamp.
3. Hold the front portion of the connector and turn the rear strain relief portion counterclockwise. Be careful not to twist the power cord while turning the strain relief off.
4. Slide the strain relief back on the power cord.
5. Note the pin locations (Figure 10-5). Do not remove the jumper wire between pins 1 and 4 (2 gold pins) unless they need to be repaired. If one of the three pins of the power cord is broken, all three pins will have to be replaced.

CAUTION: To avoid damaging the pins, use extreme care when removing them.

6. With the extraction tool's plunger (AMP part #305183) in the out position, slide the sleeve as far as possible over the pin to be removed.
7. While holding the sleeve against the connector, push the plunger in to force the pin out the back of the connector.
8. To remove the pins from the connector repeat steps 6 and 7.

Repair:

1. Remove the pins to be replaced.
2. Strip 1/4 inch of insulation from each wire.
3. Insert the wire and crimp the pin to the insulated portion of the wire.
4. Solder the wire to the pin.
5. Repeat steps 2, 3, and 4 for each pin replaced.

Installation:

1. Place the jumper wire between pins 1 and 4.
2. Position the three pins of the power cord in the connector correctly. Green wire in pin 3 position, white wire in pin 11 position and black wire in pin 13 position.
3. Slide all three power cord wires in at the same time until they lock in position. Gently tug on each wire to be sure each wire is latched into position.
4. Check each of the five pins from the front of the connector to make sure they are positioned correctly (Figure 10-5).
5. Slide the cable clamp up to the connector and replace the two strain relief screws.
6. Perform the Phototherapy Lamp Check of Section 6.

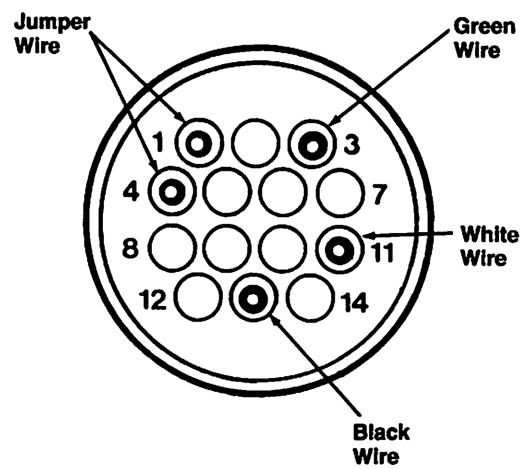


Figure 10-5
Front View of Cable Connector Wiring

G. Phototherapy Lamp Control Unit Connector Repair (Earlier Version Only)

(Figure 10-6)

Removal:

1. Switch the power off for the control unit.
2. Disconnect the phototherapy lamp power cord from the control unit.
3. Remove the Phototherapy Lamp Control Unit from the incubator.
4. Remove the 6 Phillips head cover screws from the control unit.
5. Note the pin locations (Figure 10-6). Cut the cable tie if necessary for easier access to the wiring.

CAUTION: To avoid damaging the pins, use extreme care when removing them.

6. With the extraction tool's plunger (AMP part #305183) in the out position, slide the sleeve as far as possible over the pin to be removed.
7. While holding the sleeve against the connector, push the plunger in to force the pin out the back of the connector.
8. To remove the other pins from the connector repeat steps 6 and 7.

Repair:

1. Remove the pins to be replaced.
2. Strip 1/4 inch of insulation from each wire.
3. Insert the wire and crimp the pin to the insulated portion of the wire.
4. Solder the wire to the pin.
5. Repeat steps 2, 3, and 4 for each pin replaced.

Installation:

1. Position the pin of each wire in the connector correctly (Figure 10-6).
2. Slide each wire in until it locks in position. Gently tug on each wire to be sure it is latched into position.
3. Check each of the five pins from the front of the connector to make sure they are positioned correctly (Figure 10-6).
4. Replace the cover and six mounting screws.
5. Perform the Phototherapy Lamp Check of Section 6.

H. Phototherapy Lamp Hardwire Kit

(0217-2783-810)

The plug and socket connection for the phototherapy lamp can be eliminated by hardwiring the controller assembly to the lamphouse assembly.

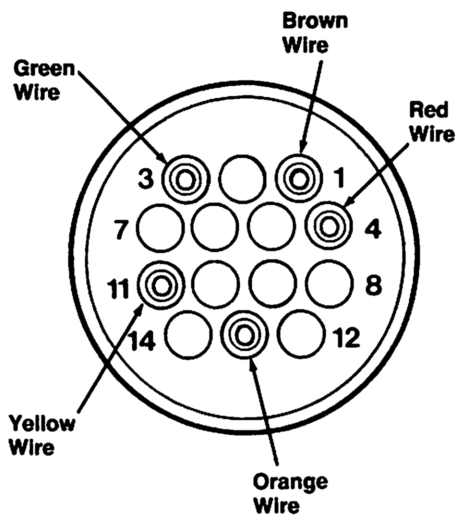


Figure 10-6
Front View of Controller Connector Wiring

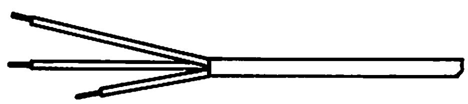


Figure 10-7
Stripped Wires

Required Tools:
Standard screw driver
Phillips screw driver
Wire cutter and stripper
Needle nose pliers
Strain relief tool or channel lock pliers

Note: Terminals must be properly crimped with appropriate tools.

AMP #59824-1 or standard crimping Tool AMP #90124-2.

1. Disconnect the power cord for the incubator.
2. Disconnect the phototherapy controller unit from the incubator.
3. Disconnect the lamphouse cable connector from the controller and cut the lamphouse cable adjacent to the plug.
4. Carefully strip the lamphouse cable jacket back 4 inches from the end. See Figure 10-7.
5. Cut the white wire to a 2 inch length.
6. Strip the black, green, and white wires 3/16th inches from their ends.

7. Crimp an AMP pin terminal (part #0208-2213-300) on each of the lamphouse cable wires.

8. Remove the control unit cover and save the hardware. Detach the green/yellow ground wire from the housing end. The cover can now be separated from the controller with the ground wire attached.

9. Remove the original socket connector from the cover and install the adapter plate (#0214-2262-500), on the underside of the cover, with the hardware used for the connector. See Figure 10-8.

10. Insert the lamphouse cable through the adapter plate. See Figure 10-8.

11. Connect the lamphouse cable wires to the supplied AMP Female Connector (#0208-2004-300) in the following order:

White to socket #1
Green to socket #2
Black to socket #3

12. Set the cover aside for later installation.

WARNING: Shock hazard exists from charged capacitor. Discharge capacitor before making wiring changes.

13. Use an insulated 1000 ohm resistor or wire and carefully discharge the filter capacitor to ground.

14. Remove the tie wraps on the control unit wire harness.

15. Adjacent to the original socket, cut the red, orange, yellow, green/yellow, and brown wires. See Figure 10-9.

16. Remove the brown wire from the rectifier and discard it.

17. Remove the positive terminal screw on the filter capacitor.

18. Discard the loose yellow wire.

19. Select the loose red wire and cut it 5 inches from the ring terminal.

20. Strip the red wire 1/4 inch and crimp on a female spade terminal (#0208-2217-300) supplied with the kit.

21. Attach the red wire spade terminal to the rectifier's positive terminal. See Figure 10-10.

22. Attach the ring terminal connectors of the red wire from the inverter, the red wire from the rectifier, and the new black wire supplied in the kit, to the positive terminal of the capacitor with the terminal mounting screw.

23. Select the orange wire from the inverter. Measure 2 inches from the inverter and cut the wire. Strip the wire 3/16ths of an inch and crimp on an AMP socket terminal (#0208-2214-300).

24. Select the green/yellow wire with the loose end. Measure 8 inches from the ring tongue terminal and cut the wire. Strip 3/16ths of an inch from the wire and crimp on an AMP socket terminal (#0208-2214-300).

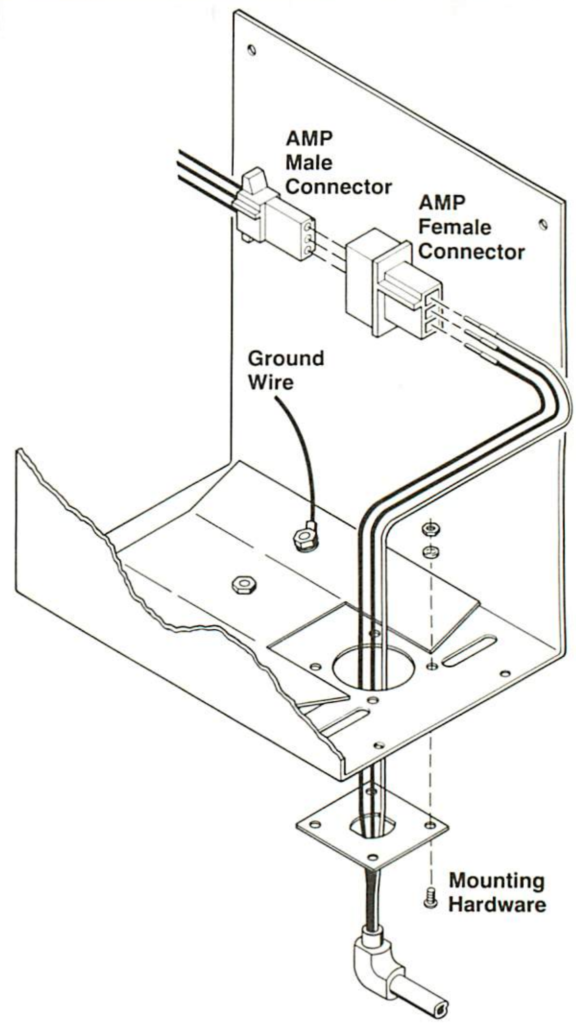


Figure 10-8
Adapter Plate and Cable Installation

25. Connect the remaining wire ends with pin socket terminals to the new male connector (#0208-2005-300) in the following order:

Orange to connector socket #1
Green/Yellow to connector socket #2
Black to connector socket #3

26. Attach the stripped end of the new ground wire supplied in the kit (#0208-0659-700) to the Hubbel 120 volt plug.

27. Detach all chassis ground wires on the back side of the controller.

28. Remove the old screw and replace it with an 8-32 x 5/8 screw (#0140-6627-110). Reattach the ground wires with the lock washer and nut.

10/Phototherapy Lamp Repairs

29. Slide the lock washer onto the screw and place the remaining green/yellow, ground wires as follows:

Ground wire from .... Hubbel 120v plug.
Ground wire from .... rectifier
Ground wire from .... negative side of capacitor
Ground wire from .... controller cover
Ground wire from .... male AMP connector

30. Secure wires in place with the lockwasher and nut.

31. Connect the new connectors together, slide the cover over the controller housing with the power cord closest to the front power switch.

32. Secure the cover with the previously removed cover hardware.

33. Place the Heyco strain relief (#0208-0323-300) on the power cord and insert it into the cover so the cord is pointing towards the front power switch. See Figure 10-8.

34. Connect the unit to the power source and check the power switch and lights for proper operation.

35. Perform the electrical safety tests as outlined in Section 6 of this service manual.

I. Phototherapy Lamp Control Unit Repairs

(Refer to Figures 12-41A through 12-44B)

1. Disconnect the power cord from the phototherapy lamp controller.

2. Remove the phototherapy lamp controller from the incubator.

3. Remove the six Phillips-head cover screws.

NOTE: With the cover removed replacement of the inverter, transformer, power switch, fuse holder, capacitor, bridge rectifier and connectors is possible. When replacing any of these items be sure to label all wires before disconnecting them. Refer to the schematic for correct wiring of the phototherapy lamp control unit.

4. Replace the cover and six Phillips-head screws. Be sure the cover is mounted so that the connector is closest to the handle side.

5. Perform the Phototherapy Lamp Check of Section 6.

10/Phototherapy Lamp Repairs

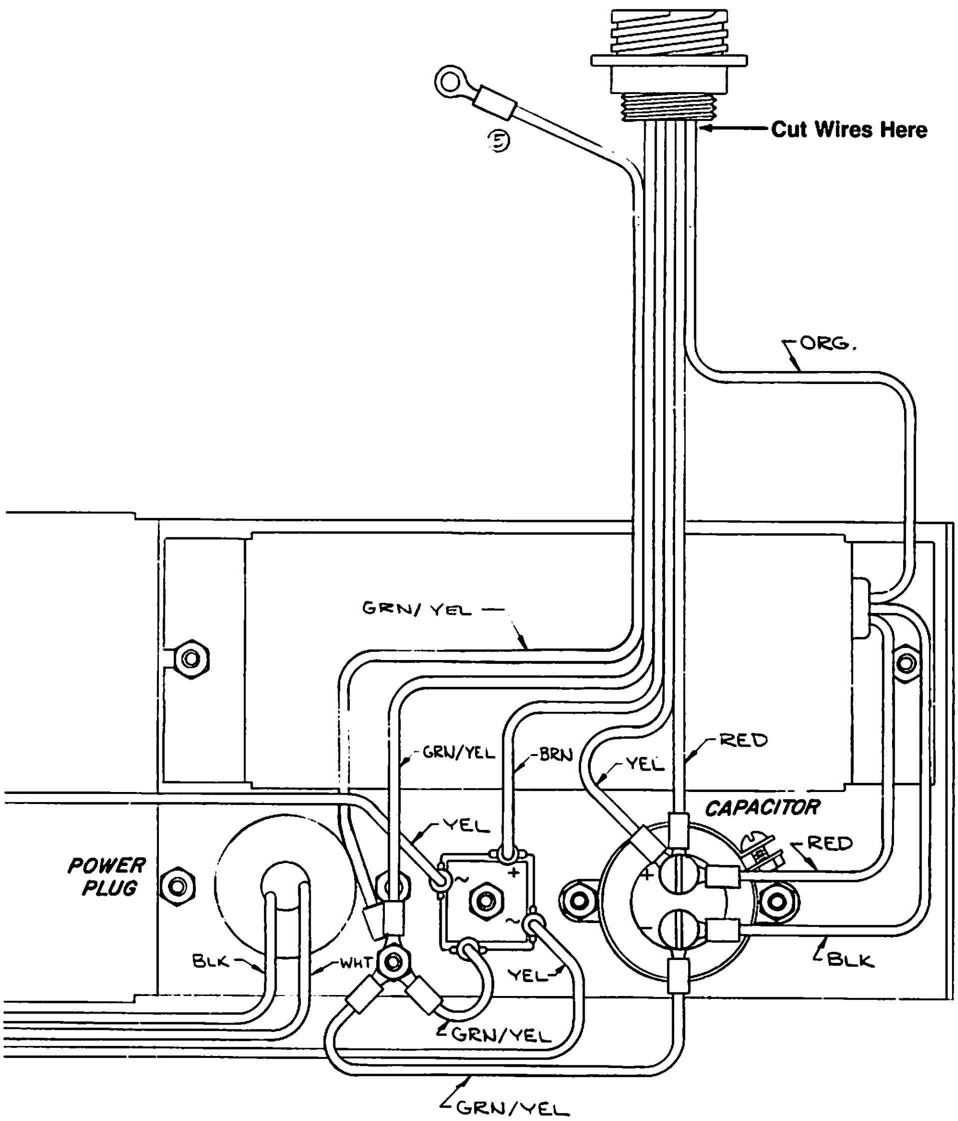


Figure 10-9
Earlier Version
Controller Wiring Diagram

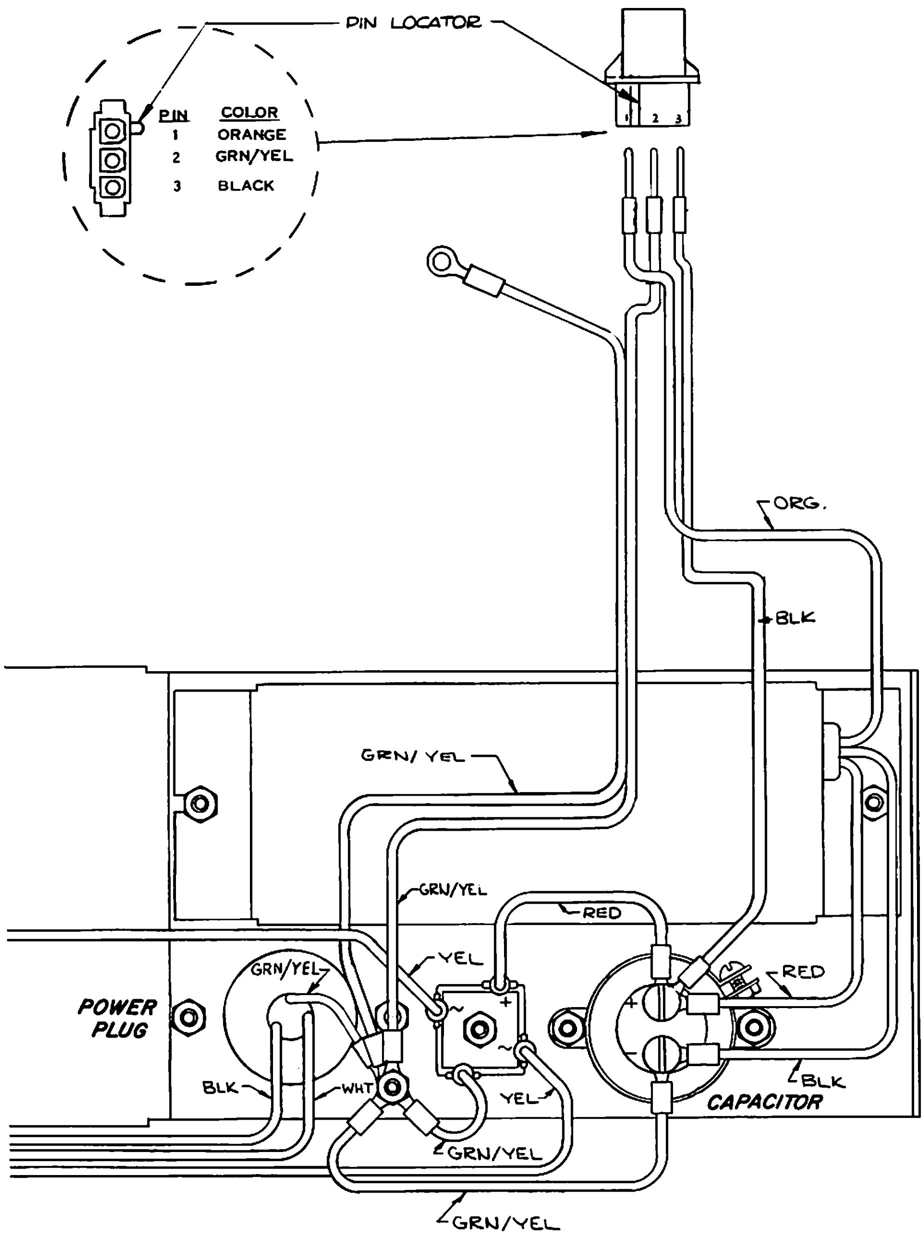


Figure 10-10
Later Version
Controller Wiring Diagram

11/Troubleshooting

11.1 Troubleshooting Table

I. Incubator

A. Hood and Sensor Alignment

Symptom	Problem	Possible Solutions
1. Front sensor not touching front retainer.	Front hood and counterbalance out of alignment.	Follow hood alignment procedure in Section 7.
2. Front sensor not centered on front hood retainer.	Front lower unit bumpers (2) are missing or deteriorated.	Replace rubber bumpers see Figure 12-10, item 28.
3. Rear sensor not touching rear hood retainer.	Rear hood and counterbalance out of alignment.	Follow hood alignment procedure in Section 7.
4. Rear sensor not centered on rear hood retainer.	Open hood fully (both hoods rotated under incubator). Close the incubator hood. If rear hood retainer is not centered on rear sensor as shown in Figure 7-12 then the hood is not in alignment.	Hood alignment is necessary see Section 7.

B. Alarms

Symptom	Problem	Possible Solutions
1. No LED's lit, audible alarm present, power switch on.	Power failure alarm has activated.	Check for: **a.** Disconnected power cord. **b.** Unlatched bed platform (open interlock switch). **c.** Open fuse **d.** Open in power cord
2. System Fail-Overtemp LED lit, and audible alarm present. Audible alarm does not silence when the alarm silence touch switch is pressed.	Processor lost	Turn power switch off then on. If unit does not reset: **a.** Replace EPROM U6. **b.** Check control inputs & outputs to U9, U4, U5, U6, U7 on control board. Replace IC's or control board as necessary.
3. System Fail-Overtemp LED lit, and audible alarm present. Audible alarm silences when alarm silence touch switch is pressed. See front panel switch troubleshooting for SYSTEM FAIL-OVERTEMP ALARM to identify alarm activated. See Section 11.4.	**1.** Env. Temp > 39C alarm activated	**a.** Set humidity control to minimum if humidity charger is not being used. **b.** Check heater control voltage. for possible Triac (Q1) failure. **c.** Power supply IC's, U5, U4, U2, U1, Q1 and K1. **d.** Control board IC's U5, U6, and U7.
	2. Inlet wall >45C alarm activated	**a.** Check heater control voltage for possible Triac (Q1) failure. **b.** Power supply board IC's, U5, U4, U2, U1, Q1 and K1. **c.** Control board IC's U5, U6, and U7.
	3. Inlet wall sensor open or shorted.	**a.** Replace inlet (rear) wall sensor. **b.** Control board IC's, U2, & U3. Replace IC's or control board as necessary.
	4. Outlet wall sensor open or shorted.	**a.** Replace outlet (front) wall sensor. **b.** Control board IC's, U2, U3, replace IC's or control board.
	5. Patient Probe alarm active in servo mode.	**a.** Patient probe not connected to phone jack. **b.** Patient probe open or shorted replace probe. **c.** Patient probe jack defective check and replace if necessary. **d.** Check continuity of low voltage harness. **e.** Control board IC's U2, U3 or control board.

11/Troubleshooting

Symptom	Problem	Possible Solutions
	6. Incubator not in calibration.	**a.** Check calibration of ADC. See Section 6. **b.** Inlet wall sensor (rear) shorted to ground through bottom panel. Check sensor cable under bottom panel. **c.** control board components, R7, U-2, U-3 or control board.
	7. Air safety circuit alarm activated.	**a.** Check air safety calibration. See Section 6. **b.** Check that blower wheel is in place. **c.** Check blower motor operation. See Section 9 for check out. **d.** Check air filter and humidity chamber for obstruction. **e.** Incubator relocation (unplugging unit allows heater air to rise past air safety sensor) Plug unit in and allow blower to run in order to circulate air past sensor. Alarm will reset when temperature sensed is between 37 and 38.5C. **f.** Check insulation under front wall sensor. Replace if missing or damaged. **g.** Check air safety thermistor for short. Replace thermistor if necessary. **h.** Check that wall sensors are touching hood retainers. If not see Section 7. **I.** Check power supply IC's, U1, Q2, K1. Replace component or power supply board.
	8. Electronic malfunction where all displays other than control temp displays are displaying HHH.	**a.** Check control board function component U1, U2, and U3. Replace if necessary. If either U1 or U2 need replacement then replace both U1 and U2. See Section 9 for replacement procedure or replace the control board see Section 9. **b.** Check continuity between connectors of 26-Pin ribbon cable.
4. Patient-Temp sensor LED lit and audible alarm sounds in servo.	Indicates patient temp is greater than ±1.0C of the control temp setting in servo.	Normal - press alarm silence touch switch to silence audible alarm. Audible alarm will sound again if temp differencies are not less than ±1C within 15 minutes.

11/Troubleshooting

Symptom	Problem	Possible Solutions
C. Displays		
1. Env. Temp displays HHH.	**a.** Wall sensor open or shorted.	**a.** Identify wall sensor using front panel switch troubleshooting guide of Section 11.4 steps 4A and 4B. Replace wall sensors as necessary. See Section 9.
	b. Electronic malfunction	**b.** Check components U2 and U3. Replace if necessary or replace control board.
2. Patient Temp displays HHH.	**a.** Disconnected, open or shorted patient probe.	**a.** Check that probe is connected. Check resistance of probe see resistance chart Appendix D. Replace probe if necessary.
	b. Defective phone jack	**b.** Check condition of phone jack. Replace if necessary. See section 9.
	c. Open connection in low voltage cable.	**c.** Check continuity between phone jack and Mate-N-Lok connector J-5 at control board.
	d. Electronic malfunction	**a.** Check control board components U2 and U3. Replace if necessary. If U2 is replaced also replace U3 or replace the control board.
3. Cal resistor check displays other than 37.3±0.5C.	**a.** Power supply and/or ADC not in calibration.	**a.** Calibrate 9.6V supply on power supply board. See Section 6. Calibrate ADC see Section 6.
	b. Bottom panel shorted to inlet (rear) wall sensor.	**b.** Remove four screws holding bottom cover in place. Wall sensor wires must be routed to left of structural foam rib.
	c. Electronic malfunction	**c.** Check control board components R7, U1, U2, U3 replace components if necessary. If U1 or U2 is replaced, replace both U1 and U2 or replace control board.
4. Control temp displays HHH.	**a.** Microprocessor lost	**a.** Turn power switch off then on.
	b. Electronic malfunction	**b.** Replace control board.
5. Erratic display, no control of front panel with touch switches.	**a.** Power supply malfunction	**a.** Check supply voltage replace defective components or power supply board. See Section 6.
	b. 26 Pin ribbon cable in low voltage harness defective.	**b.** Check continuity of ribbon cable. Replace low voltage ribbon cable if necessary.
	c. Defective membrane switch panel.	**c.** Check continuity of switch panel. See Section 11 replace switch panel if necessary see Section 9.
	d. Electronic malfunction	**d.** Check assembly panel components U5, U6, U7. Replace components if necessary or replace display board. Check control board components U5, U6, U7. Replace components if necessary or replace control board.
6. Switches between manual mode and servo on its own.	**a.** Electronic malfunction.	**a.** Check display board D6, D7, U7 replace as necessary or replace display board.
7. Cannot switch between manual and servo.	**a.** Defective switch panel	**a.** Check display panel See Section 11.
	b. Electronic malfunction.	**b.** Replace display board.

11/Troubleshooting

Symptom	Problem	Possible Solutions
D. Manual Mode		
1. Incubator will not heat in manual mode.	**a.** Control temp in manual does not exceed Env. Temp.	**a.** Increase control temp setting in manual mode to appropriate temperature.
	b. No control voltage to heater.	**b.** Perform manual mode heater control voltage check see Section 11.2. Replace components on P.S. Board as necessary. Check P.S. components Q1, U1, and U5.
	c. Safety thermostat on heater remains open.	**c.** Check continuity of heater circuit when heater is cold. Remove J2 connection from P.S. and check continuity between pins 1 and 4 on the J-2 connector. If open replace the heater subassembly. See Section 9.
	d. Heater defective	**d.** Typical heater resistance values measured across the heater terminals when the heater is cold are as follows: 100V heater 22 ohms 120V heater 32 ohms 220V heater 117 ohms 240V heater 139 ohms If resistance indicates an open or shorted condition replace heater subassembly See Section 9.
	e. Electronic malfunction.	**e.** Replace power supply board Replace control board.
E. Servo Mode (IC Incubator Only)		
1. SYSTEM-FAIL OVERTEMP alarm active and patient temp displays HHH.	**a.** Patient probe disconnected, open, or shorted.	**a.** Check connection or replace patient probe as necessary.
2. Incubator not heating.	**a.** Patient probe sensing a temp less than 34C (assume probe problem).	**a.** Probe detached from infant. Check probe.
	b. Incubator not preheated in manual mode.	**b.** See O&M Manual for proper setup.
	c. Electronic malfunction.	**c.** Perform servo mode heater control voltage checks. See Section 11.3. If D.E.T. does not change or heater checks fail, replace control board component U6 or control board.
F. Patient Monitor		
1. Patient Monitor interference present when brought near incubator.	**a.** EMI conductive bumper defective.	**a.** Check EMI shield. See Section 6. Check conductive bumper and or ground connections. Replace or repair as necessary.
	b. R20 on power supply board open or not connected to chassis.	**b.** Check chassis ground connection to R20 and/or check resistance of R20 on the power supply board. Repair ground connection or replace R20 as necessary.

11/Troubleshooting

Symptom	Problem	Possible Solutions
G. Motor Vibration		
1. Excessive Motor vibration.	**a.** Blower wheel broken.	**a.** Inspect blower wheel for cracks, also check that metal insert is pressed on the blower wheel. Replace blower wheel if necessary.
	b. Motor mounting system rubber goods deteriorating.	**b.** Check condition of rubber grommets. Replace with blower motor shock mount replacement kit if necessary. See Section 9 for replacement.
	c. Spacers not set properly.	**c.** Perform motor check out procedure. See Section 9. Install or remove spacers as necessary.
H. Tilt Mechanism		
1. Does not tilt all the way in one direction.	**a.** Wiring harnesses not routed properly.	**a.** Check routing of wiring harnesses. See Section 9.
2. Does not lock into position.	**a.** Worn detent or indexing plate.	**a.** Replace parts as specified in Section 9 or or replace tilt mechanism assembly see Section 9.
I. Phototherapy Lamp		
1. Phototherapy Lamp will not turn ON.	**a.** Lamp housing power cable not connected	**a.** Assume power cable is connected to controller see Section 10.
	b. Power switch on controller not turned on.	**b.** Turn P.T. controller power switch on.
	c. Lamps not in sockets.	**c.** Check lamp to be sure they are positioned in sockets correctly.
	d. Fuse open.	**d.** Check fuse.
	e. Jumper not positioned correctly in power cable connector.	**e.** Check that jumper is positioned between pins 1-4 of connector. See Figure 10-5.
	f. Electronic malfunction.	**f.** Check input voltage of inverter. For 20VDC nominal. NOTE: Pin 1 and 4 of jack must be jumpered. If not present check output voltage of transformer & output voltage of bridge rectifier. Replace transformer bridge or filter cap if necessary. Connect three fluorescent lamps in series to output of controller. Voltage should measure 140V RMS @20KHz with load applied. **WARNING: Do not measure open circuit voltage of 1000V @20KHz unless that equipment is rated for this voltage.** If voltage is present; lamps, cabling, or sockets are defective. Replace as necessary. If output voltage is absent replace the inverter.

11.2 Manual Mode Heat Control Check

NOTE: If an alarm is present the alarm must be cancelled before the check procedure can be completed. First refer to the calibration procedure in Section E3 to cancel the air safety alarm. If the alarm cannot be canceled refer to the A/D Zero and Gain adjustment in Section F2, 3 to cancel the calibration alarm if necessary. If the alarm is still present refer to the troubleshooting information in this section. When the alarm is canceled return to the air safety check and continue with the procedure.

1. Connect the temperature simulator to the incubator.

2. Select switch position I1 and the DVM/CAL position on the simulator.

3. Switch the incubator ON.

4. Set the incubator CONTROL TEMP to 33.0C in the manual mode.

5. Press the PATIENT TEMP touch switch and verify a digital display of 31.0C±0.1C.

6. Press the ENVIRONMENTAL TEMP touch switch and verify a digital display of 31.0C±0.1C.

7. Press the CONTROL TEMP touch switch.

8. Adjust the control temperature for each of the three settings listed in Table 11-1. For each control temperature setting verify the heater lamp condition (heater voltage) on the simulator. Allow approximately 30 seconds at each control temperature setting before verifying the neon lamp condition.

11.3 Servo Mode Heat Control Check (IC Incubator Only)

NOTE: A SYSTEM-FAIL OVERTEMP alarm cannot be present while performing this procedure.

1. Connect the temperature simulator to the incubator.

2. Select switch position I11 and the DVM/CAL position on the simulator.

3. Switch the incubator ON.

4. Set the incubator CONTROL TEMP to 33.0C in the manual mode.

5. Press the SERVO MODE touch switch.

6. Set the incubator CONTROL TEMP to 37.0C in the servo mode.

7. Verify that the heater lamp on the simulator is ON FULL (allow approximately 30 seconds).

8. Set the incubator CONTROL TEMP to 35.5C in the servo mode.

9. Verify that the heater lamp on the simulator is OFF FULL (allow approximately 30 seconds).

10. Perform the Servo Mode Operational Check in Section 6U. This section checks the DET increase and decrease operation. If the DET does not increase or decrease as described in Section 6U replace the EPROM on the control board or replace the control board.

Table 11-1
Manual Mode Heat Control Checkout

Incubator	Simulator	Troubleshooting Guide	
CONTROL TEMP	**Heater Lamp**	**Incorrect Heater Lamp Condition**	**Problem/Solution**
a. 30.0C	OFF	ON	Shorted Triac Q1 on Power Supply Bd.
b. 32.0C	Proportioning	ON Full, OFF	Triac Q1 shorted Triac Q1 is open or no gate pulses to Q1.
c. 34.0C	ON Full	OFF	No Gate Pulses to Q1. Triac Q1 is open.

11.4 SYSTEM FAIL-OVERTEMP ALARM Troubleshooting:

Use the troubleshooting guide (at right) to evaluate SYSTEM FAIL-OVERTEMP alarms. All checks are done at the display panel.

Press	Press & Hold	Display	MODE	Alarm Evaluation
1. Alarm Silence	---	Alarm does not silence.		Processor lost.
2. Env. Temp	---	39C	M	Env. Temp>39C
3. Env. Temp	↑	45C	M	Inlet Wall Temp>45C.
4. Env. Temp Patient Temp Control Temp	--- ---	HHH Normal Normal	M	Wall Sensors Open or Shorted.
4A. Env. Temp	↑	HHH	M	Inlet Wall Sensor Open or Shorted.
4B. Env. Temp	↓	HHH	M	Outlet wall sensor open or shorted.
5. Env. Temp Control Temp Patient Temp	--- --- ---	Normal Normal HHH	S	Patient Probe Plug not connected, open, or shorted.
6. Patient Temp	↓	Other than 37.5±0.5C	M	Calibration system in error.
7. Env. Temp Env. Temp	↑	39C 45C If alarm reset to approximately 32 or 33C.	M M	Air safety circuit.
8. Patient Temp		HHH or inaccurate display	M	Electronic malfunction
Env. Temp		HHH or inaccurate display		
Env. Temp	↑	HHH or inaccurate display		
Env. Temp	↓	HHH or inaccurate display		
Patient Temp	↓	May not be 37.3±0.5°		
Cont. Temp		Normal Normal	M S	

11.5 Display Panel Troubleshooting

1. Remove the display panel cover. See Section 8C.
2. Remove the display panel. See Section 8D.
3. Disconnect the 26 pin ribbon cable and place the display panel on the static control work station.
4. Disconnect the 9 pin connector from the display board and verify that the cable is not creased.
5. Position the display panel and 9 pin connector on the static control work station as shown in Figure 11-1.
6. Use a standard size staple (must not be larger than connector pins) and place it in pin 1 of the connector (Figure 11-1).
7. Place another staple in pin 9 of the connector.
8. Use an ohmmeter and measure the resistance between the pins listed in Table 11-2 for the switch panel's 9-pin connector P-8. You must press and hold the designated front panel switch in order to complete the switching circuit.

Table 11-2
Touch Panel Resistance Check

D.M.M. Connection	Press and Hold
1. Pin 1 - Pin 9	SERVO
2. Pin 2 - Pin 9	MANUAL
3. Pin 3 - Pin 9	↑
4. Pin 4 - Pin 9	↓
5. Pin 5 - Pin 9	ALARM SILENCE
6. Pin 6 - Pin 9	CONTROL TEMP
7. Pin 7 - Pin 9	PATIENT TEMP
8. Pin 8 - Pin 9	ENVIRONMENTAL TEMP

9. Verify that all of the resistances measured are less than 100 ohms.
10. Replace the touch panel if necessary.
11. Install the display panel. See Section 8D.
12. Install the display panel cover. See Section 8C.
13. Perform the Control Unit Check in Section 6.

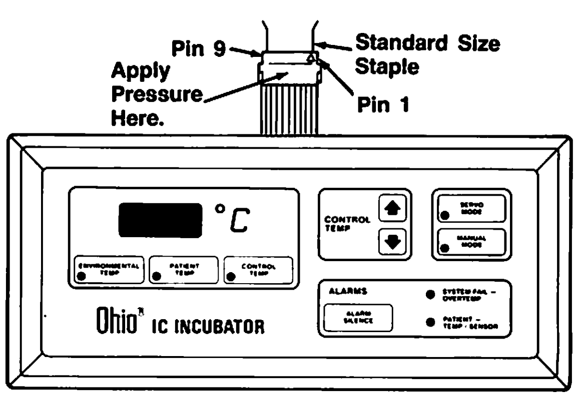


Figure 11-1
Control Panel and 9 Pin Connector

11.6 Mounting the Circuit Boards for Troubleshooting

(Figures 11-2, 11-3 and 11-4)

Mounting Procedure:

CAUTION: Electronic devices in the microprocessor controller are susceptible to damage from static electric discharge. Use static control precautions to protect these devices from static electric discharge when connecting cables or making adjustments.

NOTE: Use this procedure for mounting either the power supply board or the control board for troubleshooting.

1. Switch the incubator power off.
2. Disconnect the incubator power cord.
3. Remove the two screws which mount the control unit to the incubator cabinet and slide the control unit out.
4. Remove the four circuit board mounting screws from the outside of the control cabinet.
5. Carefully lift the circuit board up and mount the bottom of the circuit board where the top of the circuit board normally mounts.
6. Repeat steps 4 and 5 for the other circuit board if necessary.

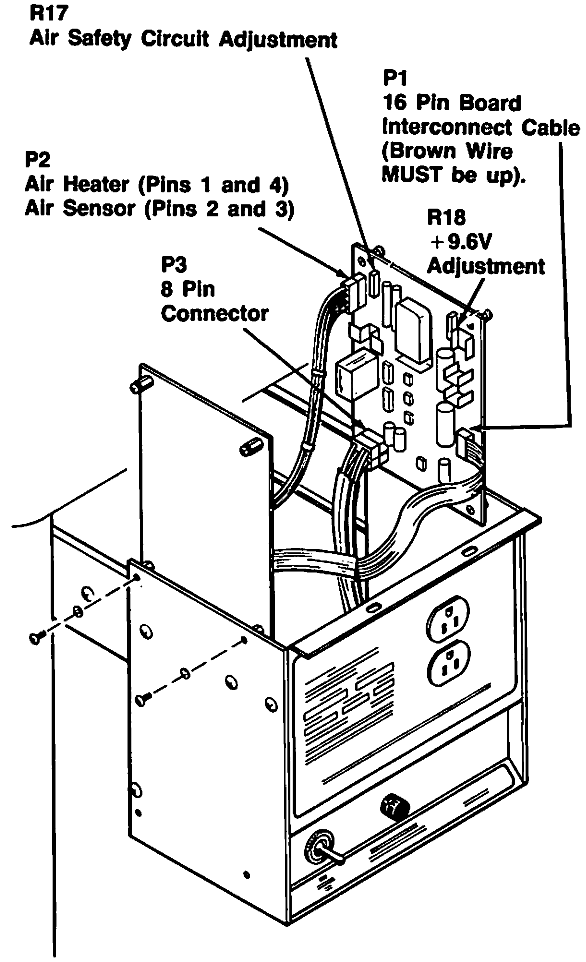


Figure 11-2
Early Version Power Supply Board
Mounted for Troubleshooting

11/Troubleshooting

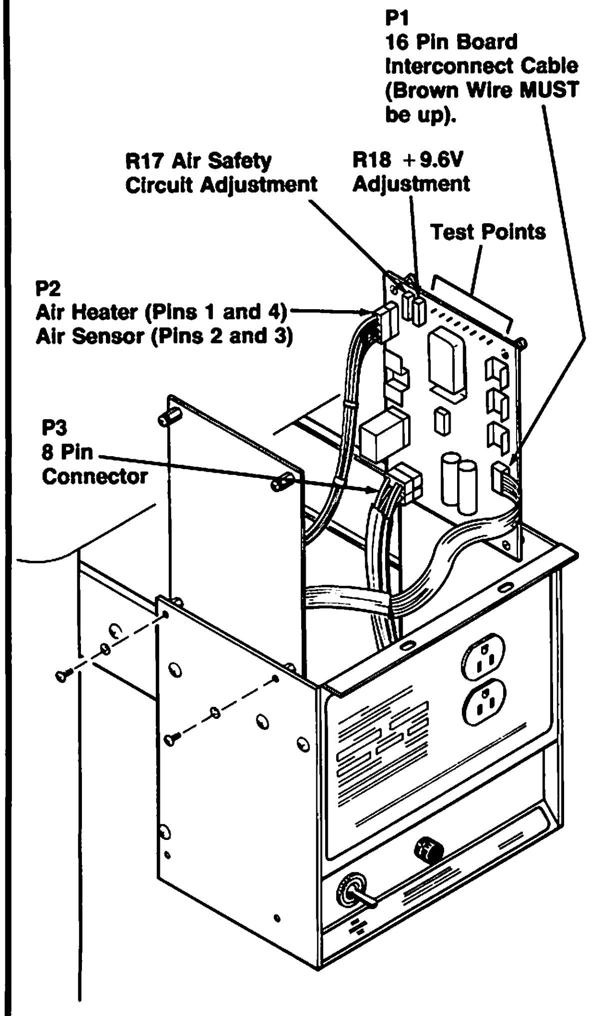


Figure 11-3
Later Version Power Supply Board
Mounted for Troubleshooting

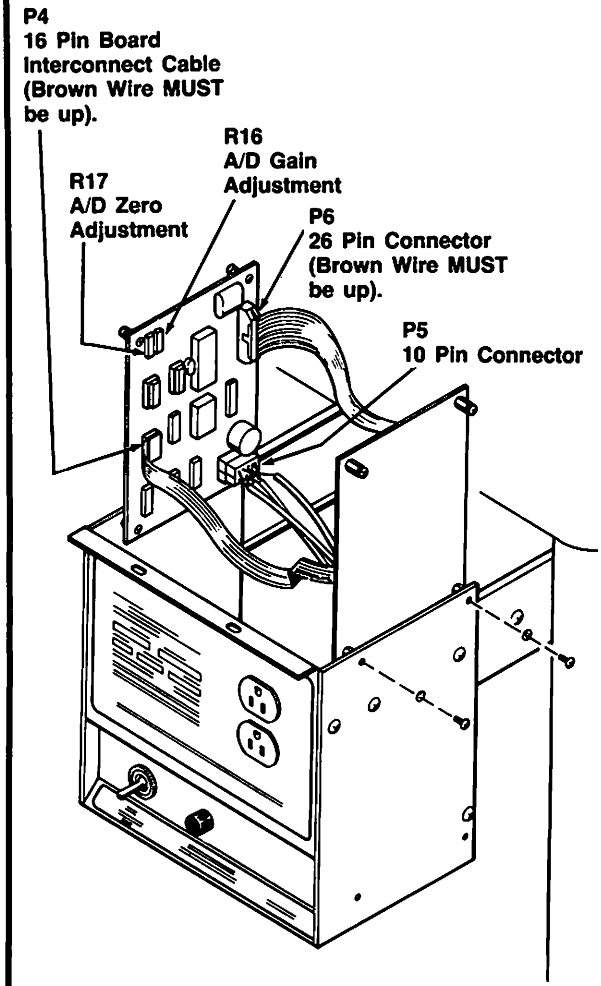


Figure 11-4
Control Board Mounted
for Troubleshooting

12/Illustrated Parts

Product Stock Number List

Description	Stock Number
I.C. Incubator 120V 60 Hz	0304-3256-910
I.C. Incubator 220V 50 Hz	0304-3256-911
I.C. Incubator 240V 50 Hz	0304-3256-912
I.C. Incubator 100V 50/60 Hz	0304-3256-913
Phototherapy Unit 120V 60 Hz	0304-3300-900
Phototherapy Unit 220V 50 Hz	0304-3300-901
Phototherapy Unit 240V 50 Hz	0304-3300-902
Phototherapy Unit 100V 50/60 Hz	0304-3300-903
Radiant Warmer 120V 60 Hz	0304-3310-800
Radiant Warmer 240V 50 Hz	0304-3310-801
Radiant Warmer 220V 50 Hz	0304-3310-802
Radiant Warmer 100V 50/60 Hz	0304-3310-803

IC & GC Incubator Accessory List

Upright & 12" Shelf	0217-2990-800
Upright Only	0217-2990-801
18" Shelf Accessory w/support and mounting hardware	0217-2782-800
Deluxe Drawer Kit for Ser. # BECL00230 & before	0217-2993-870
for Ser. # after above, order	0217-2993-871
Outlet Accessory	0217-2991-800
Tube Support Accessory	0217-2992-800
Air Filter, Box of 5	0217-2871-600
Molded Mattress	0305-5058-600
Water Mattress	0212-1290-300
Patient Probe	0208-0697-700
Heat Reflecting Probe Patch (Pack of 50)	0203-1980-300
Temperature Conversion Card	0205-7243-300
IV Pole	0217-5090-700
IV Pole w/Rail System Bracket	0221-5684-800

Intensive Care Incubator Printed Circuit Boards

Description	Stock Number
Display Board	0208-6325-700
100V/120V Power Supply Board	0208-6326-700
220V Power Supply Board	0208-6327-700
240V Power Supply Board	0208-6328-700
Control Board	0208-6329-700

General Care Incubator Printed Circuit Boards

Description	Stock Number
Display Board	*See Note Below
100V/120V Power Supply Board	0208-6326-700
220V Power Supply Board	0208-6327-700
240V Power Supply Board	0208-6328-700
Control Board	0208-6329-700

* Many General Care Incubator Parts are no longer available. Contact your local Ohmeda service representative for further information.

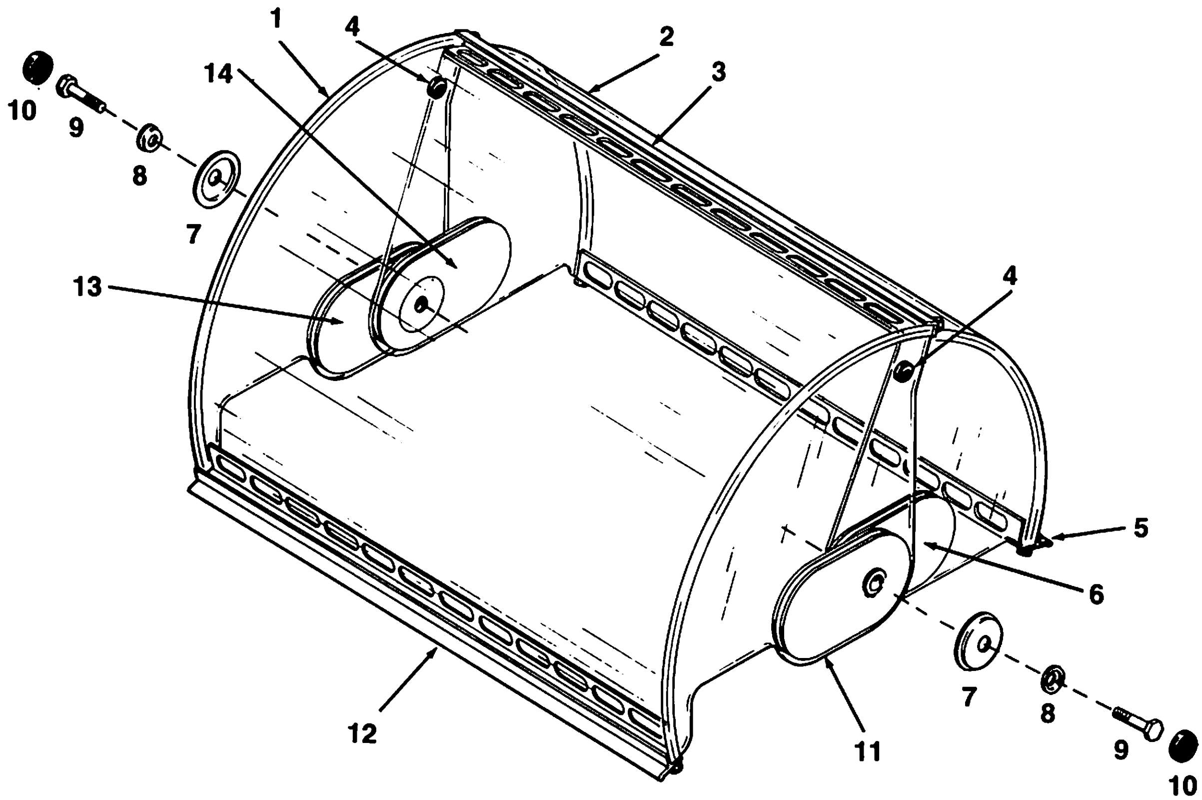
Incubator Connectors and Cables

Description	Stock Number
Interconnect Cable S/A (Power Supply Bd. to Control Bd.)	0208-0673-700
26 Conductor Ribbon Cable (Control Bd. to Display Bd.)	0690-1230-316
26 Pin Connector w/o Strain Relief	0690-1561-390
Polarizing Plug for 26 Pin Connector	0690-1562-331
Patient Probe Phone Jack	0690-1950-330
10 Conductor Mate-N-Lok Male Housing	0208-2011-300
Mate-N-Lok Socket (Gold)	0690-2600-337
8 Conductor Mate-N-Lok Male Housing	0208-2009-300
Mate-N-Lok Socket	0208-2212-300
4 Conductor Mate-N-Lok Male Housing	0208-2013-300
Mate-N-Lok Socket	0208-2212-300
2 Conductor Mate-N-Lok Male Housing	0208-2003-300
Mate-N-Lok Socket (Gold)	0690-2600-337
Mate-N-Lok Socket	0208-2212-300
2 Conductor Mate-N-Lok Female Housing	0208-2002-300
Mate-N-Lok Pin (Gold)	0690-2600-336
Mate-N-Lok Pin	0208-2211-300

Touch-Up Paint

Beige touch-up paint for exterior use on some IC and GC Incubators is available at local Sherwin-Williams outlet stores. Specify Federal Specification #595A-27778, air-dry enamel.

12/Illustrated Parts



Description	Stock Number
1. Hood Replacement Kit (includes front and rear hood sections w/counterbalances, end caps, bumpers and/instructions less inner walls and retainers	0217-2986-800
2. Rear Upper Retainer - 28-1/2"	0217-2818-549
*3. Front Upper Retainer - 30-1/8"	0217-2816-549
4. Hood Stop Bumper (2 required)	0211-1534-600
*5. Rear Lower Retainer - 28-1/8"	0217-2817-549
6. Rear Right counterbalance Assembly	0217-2978-800
7. End counterbalance cover (2 required)	0214-2208-531
8. Washer (2 required)	0203-0187-300
9. Screw 3/8 - 24 X 2 - 1/2 (2 required)	0144-2246-240
10. End cap (2 required)	0203-0186-300
11. Front Right Counterbalance Assembly	0217-2976-800
12. Front Lower Retainer 30-1/8"	0217-2815-549
13. Front Left Counterbalance Assembly	0217-2977-800
14. Rear Left Counterbalance Assembly	0217-2979-800

Items Not Numbered:

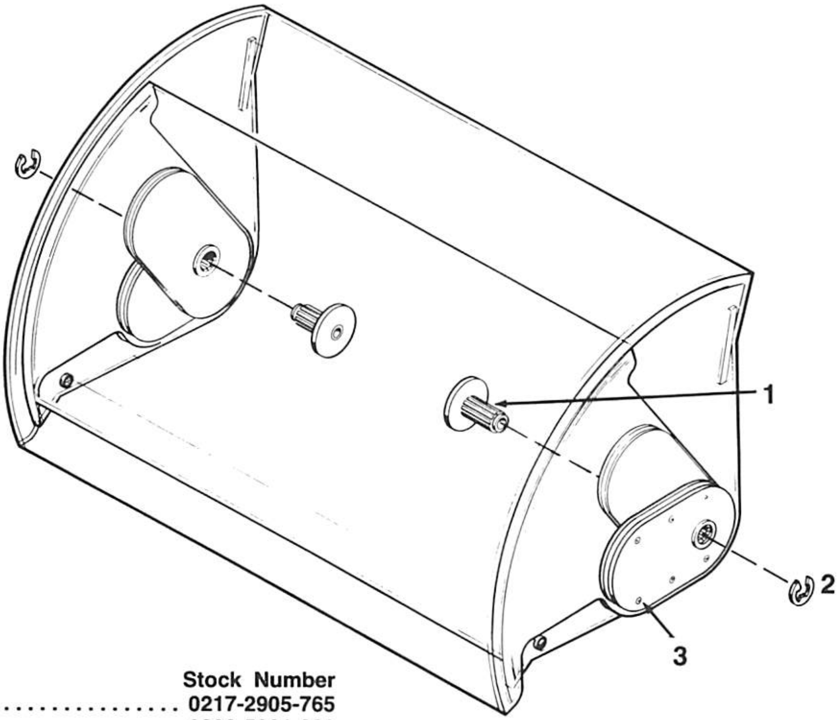
+* Front Hood Shell Replacement Kit (w/2 End Caps)	0217-2987-880
+* Rear Hood Shell Replacement Kit (w/2 End Caps)	0217-2987-881
Front Inner Wall	0212-1343-300
Rear Inner Wall	0212-1344-300

* Does not include wipers, latches, or bumpers

+ Does not include inner wall, retainers, or counterbalances. Special alignment tool required for installation (not included).

Figure 12-1
Complete Incubator Hood Assembly

12/Illustrated Parts



Description	Stock Number
1. Spline (2 required)	0217-2905-765
2. E-Ring (2 required)	0203-5261-300
3. Screw #6 X 9/16 (12 required/counterbalance)	0142-2833-609

Figure 12-2
Incubator Hood Separation

Description	Stock Number
Captive Knob Update Kit	0217-2784-880
1. Left Latch	0217-2776-700 — 37.00
2. Right Latch	0217-2775-700 — 36.00
3. Retainer Ring	0203-5313-300 — 1.00
4. Black Plastic Knob (captive)	0212-1949-100 — 1.00
5. Conductive Neoprene Wiper (30-½")	0211-1387-100

2 required for:
Front Lower Retainer
Front Upper Retainer
Rear Lower Retainer

Not Shown:
Felt Pile Wiper (28")
(1 required for Rear Upper Retainer) ... 0217-2921-700

NOTE: See Section 7I for latch and captive knob replacement.

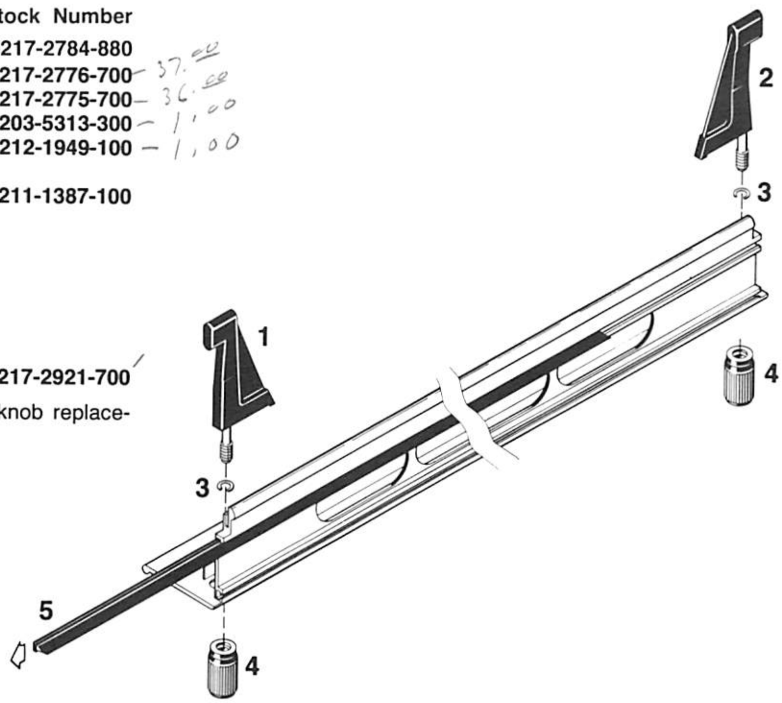
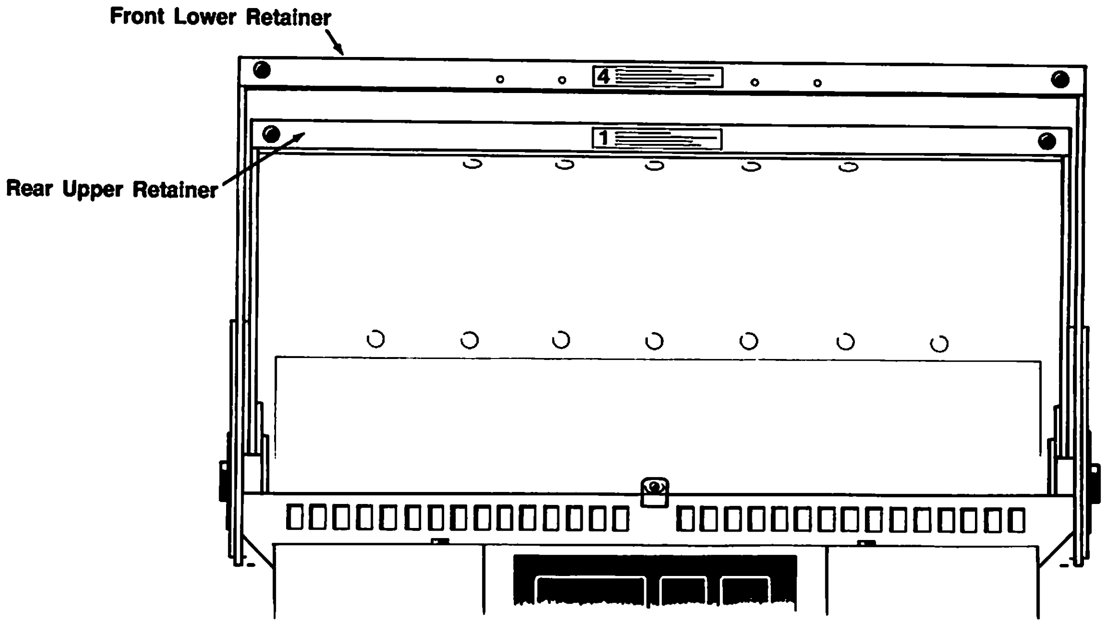


Figure 12-3
Hood Retainer Assembly

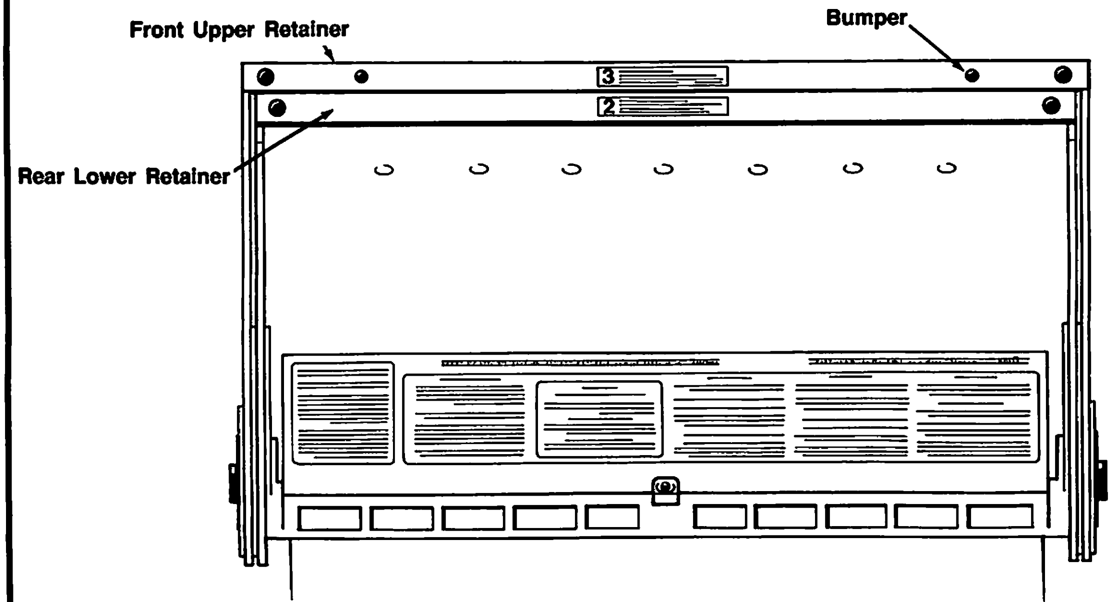
12/Illustrated Parts



NOTE: The rear hood is in the normally closed position. The front hood is in the fully open position.

Description	Stock No.
1. Label No. 1 for Rear Upper Retainer	0205-4755-300
2. Label No. 4 for Front Lower Retainer	0205-4758-300

Figure 12-4
Front View of Incubator

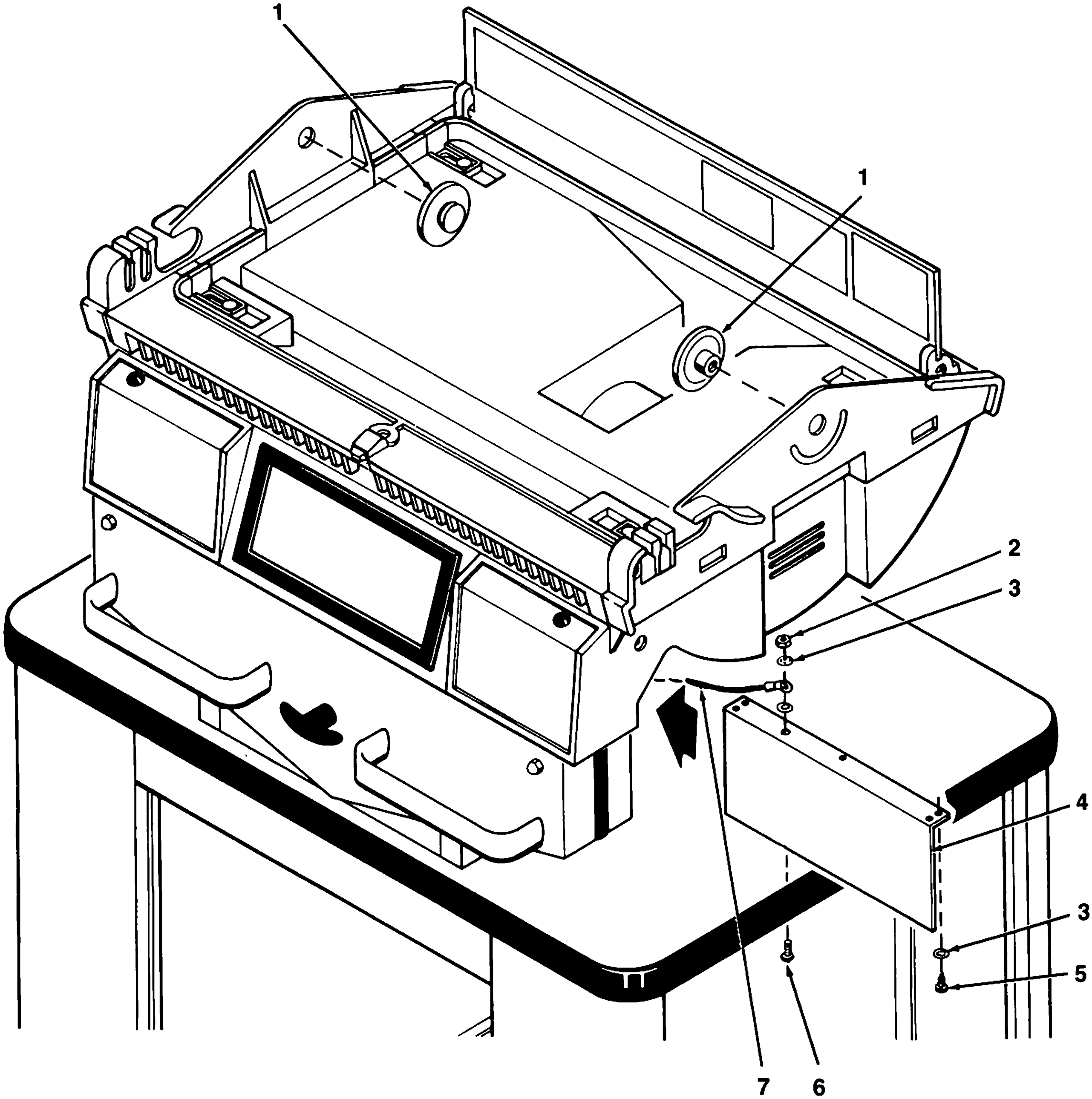


NOTE: The front hood is in the normally closed position. The rear hood is in the fully open position.

Description	Stock No.
1. Conductive Bumper (2 required for front upper retainer)	0211-1517-300
2. Label No. 2 for Rear Lower Retainer	0205-4756-300
3. Label No. 3 for Front Upper Retainer	0205-4757-300

Figure 12-5
Rear View of Incubator

12/Illustrated Parts

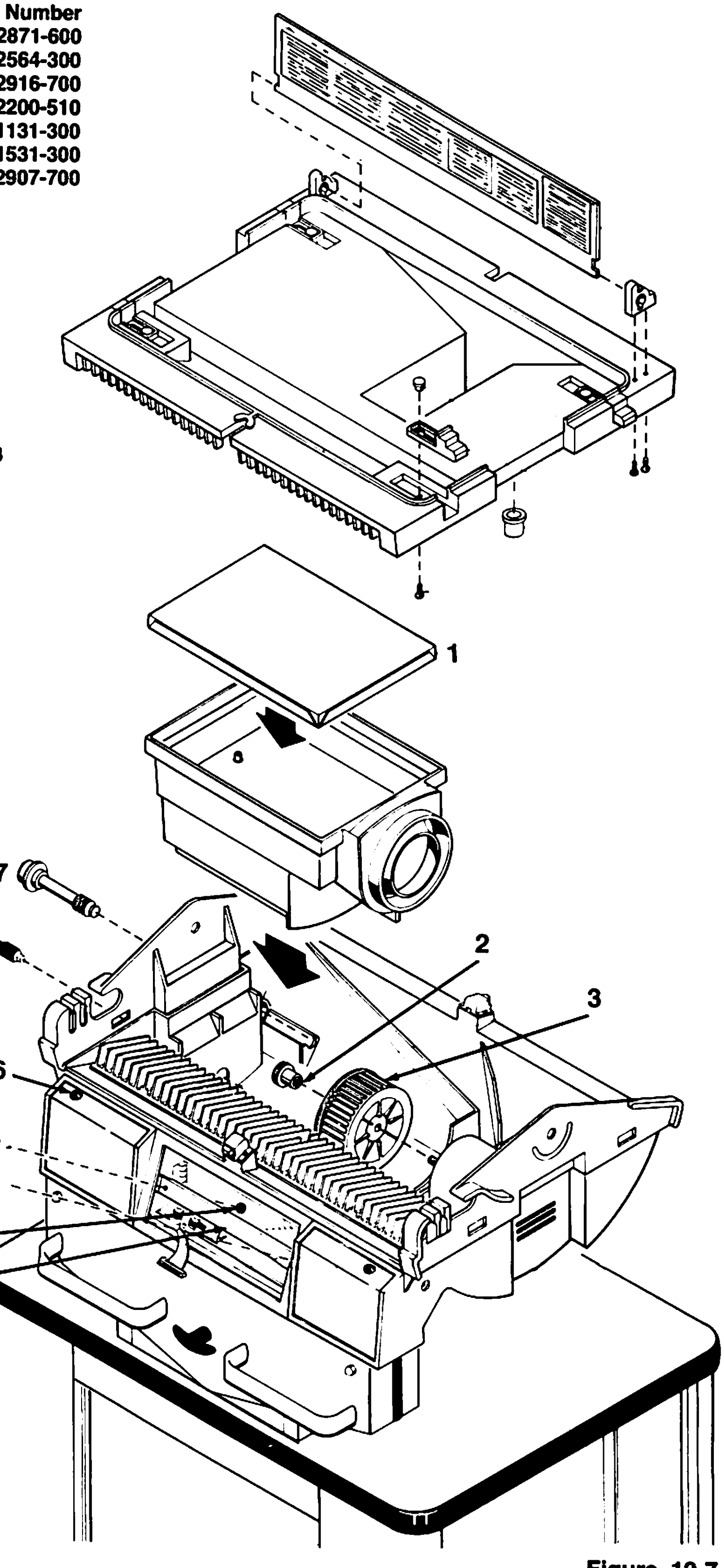


Description	Stock Number
1. Disc Insert (2 required)	0217-2785-207
2. Hex Nut 6-32	0144-3324-113
3. Lock Washer Ext. 6 (7 required)	0202-3200-300
4. Display Panel Cover	0214-2229-500
5. Screw 6-32 X 1/4 (14 required)	0140-6624-104
6. Screw 6-32 X 1/4	0140-6624-104
7. Ground Wire	0208-0698-700

Figure 12-6
Disc Insert and Display Panel Cover

12/Illustrated Parts

Description	Stock Number
1. Air Filter (Box of 5)	0217-2871-600
2. Blower Wheel Nut	0208-2564-300
3. Blower Wheel w/Insert	0217-2916-700
4. Display Mount Bracket	0214-2200-510
5. Lock Nut 8-32	0202-1131-300
6. Front Bumper (2 required)	0211-1531-300
7. Humidity Control	0217-2907-700

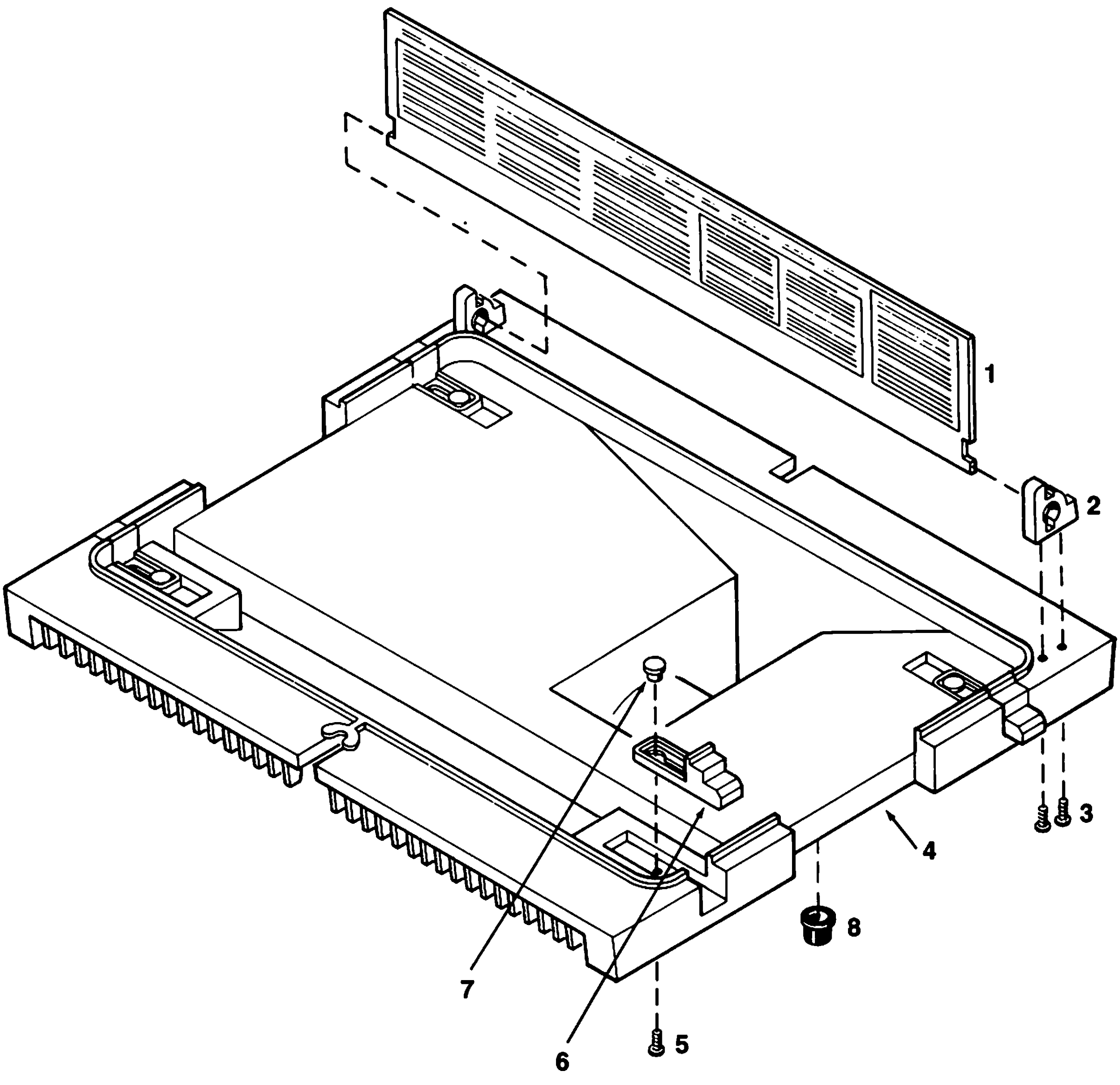


See Figure 12-8

See Figure 12-9

Figure 12-7
Lower Unit

12/Illustrated Parts

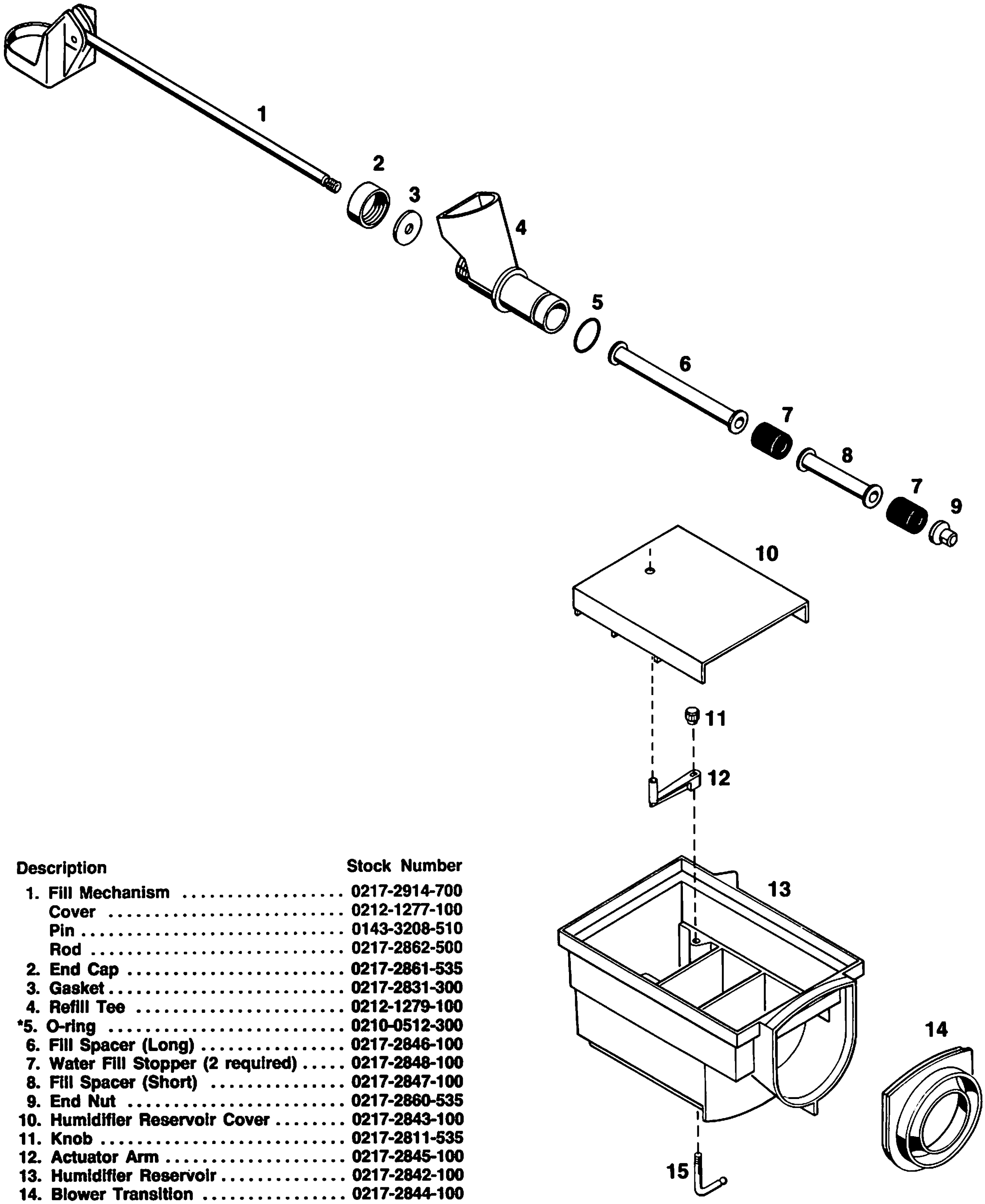


Description	Stock Number
1. IC Incubator Rear Wall Shield	0217-2891-600
2. Rear Partition Bracket (2 required)	0217-2849-100
3. Screw #8 X 5/8 (4 required)	0142-3114-110
4. Structural Foam Bed	0217-2840-100
*5. Screw 10-24 X 1/2 (4 required)	0140-6630-108
6. Bed Latch (4 required)	0203-2490-100
7. Bed Latch Retainer (4 required)	0402-1710-500
8. Conductive Rubber Foot (EMI)	0211-1267-300

* Apply Loctite #242 (0220-5016-300) to threads prior to assembly

Figure 12-8
Bed Platform

12/Illustrated Parts

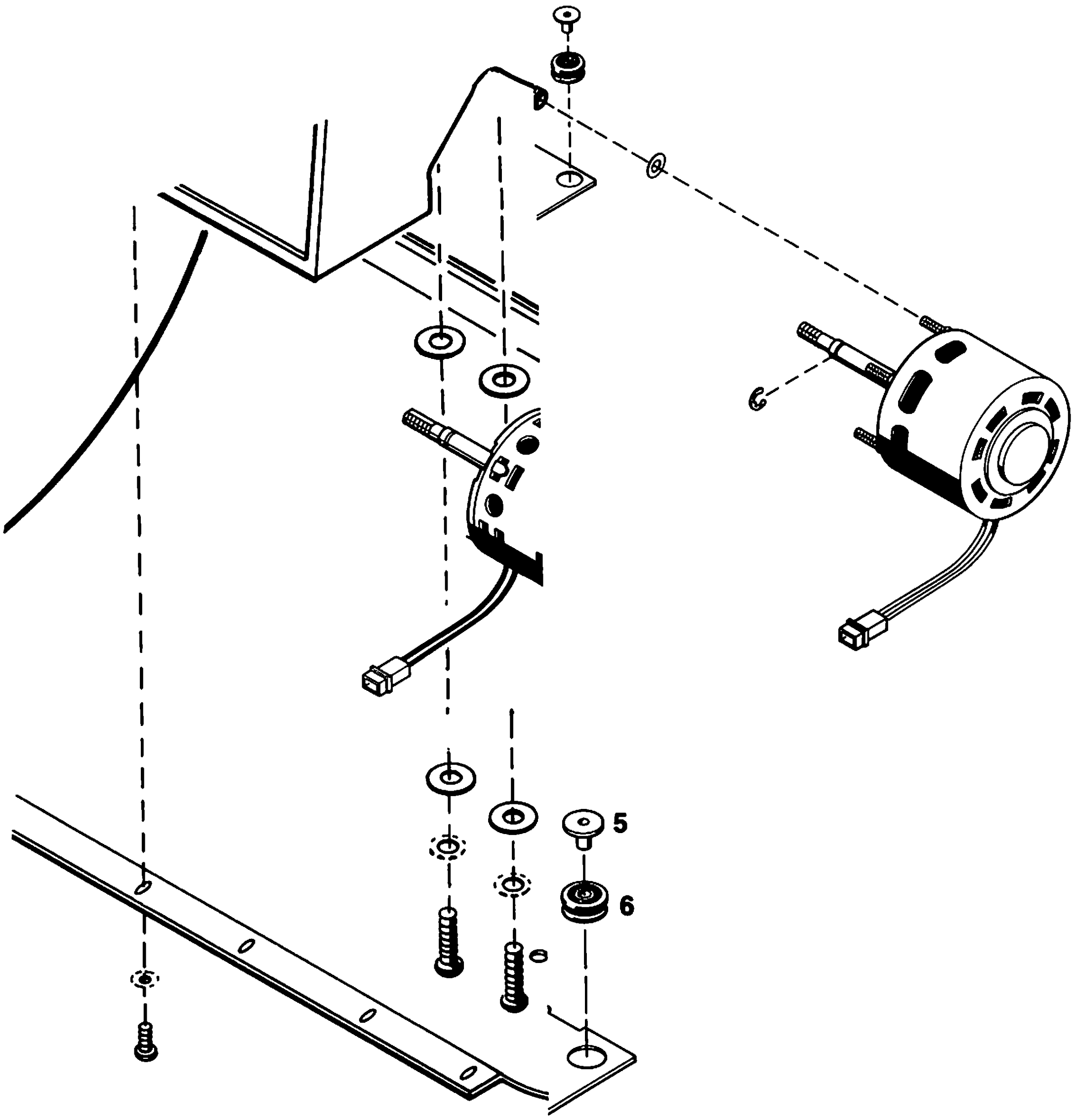


Description	Stock Number
1. Fill Mechanism	0217-2914-700
Cover	0212-1277-100
Pin	0143-3208-510
Rod	0217-2862-500
2. End Cap	0217-2861-535
3. Gasket	0217-2831-300
4. Refill Tee	0212-1279-100
*5. O-ring	0210-0512-300
6. Fill Spacer (Long)	0217-2846-100
7. Water Fill Stopper (2 required)	0217-2848-100
8. Fill Spacer (Short)	0217-2847-100
9. End Nut	0217-2860-535
10. Humidifier Reservoir Cover	0217-2843-100
11. Knob	0217-2811-535
12. Actuator Arm	0217-2845-100
13. Humidifier Reservoir	0217-2842-100
14. Blower Transition	0217-2844-100
15. Actuator Rod	0217-2858-500

* Lubricate with Vac-Kote (0220-0091-300)

Figure 12-9
Fill Port and Humidifier

12/Illustrated Parts



Description | **Stock Number**

Blower Motor Shock Mount
Replacement Kit 0217-2994-800
Kit Includes:
- **Motor Bracket Assembly (See Figure 12-11)**
- **#8 Flat Washer (Brass) (Qty. 8) 0402-1028-300**
- **Air Seal (See Figure 12-12, Item 20) 0210-6566-300**
- **Installation Instructions 0176-1466-000**

Blower Motor Replacement Kit 0217-2995-800
Kit Includes:
1. **Motor and Bracket Assembly (See Figure 12-11)**
2. **Flat Washers St. St. (Qty. 8) 0402-1133-300**
3. **#8 Ext. Lockwashers (Qty. 4) 0202-3205-300**
4. **#8 X 7/8" Screw (Qty. 4) 0140-6527-114**
   - **Air Seal (Figure 12-12, Item 20) 0210-6566-300**
   - **Plastic Air Seal Bushing (Fig. 12-10, Item 30) 0217-2872-500**
   - **#8 Flat Washer (Brass) (Qty. 8, Fig. 12-11, Item 7) 0402-1028-300**
   - **Installation Instructions 0176-1466-000**

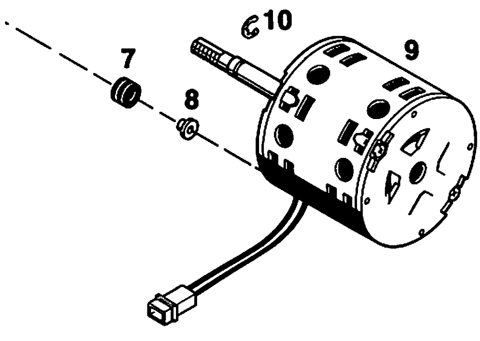


Figure 12-11
Blower Motor Bracket Assembly

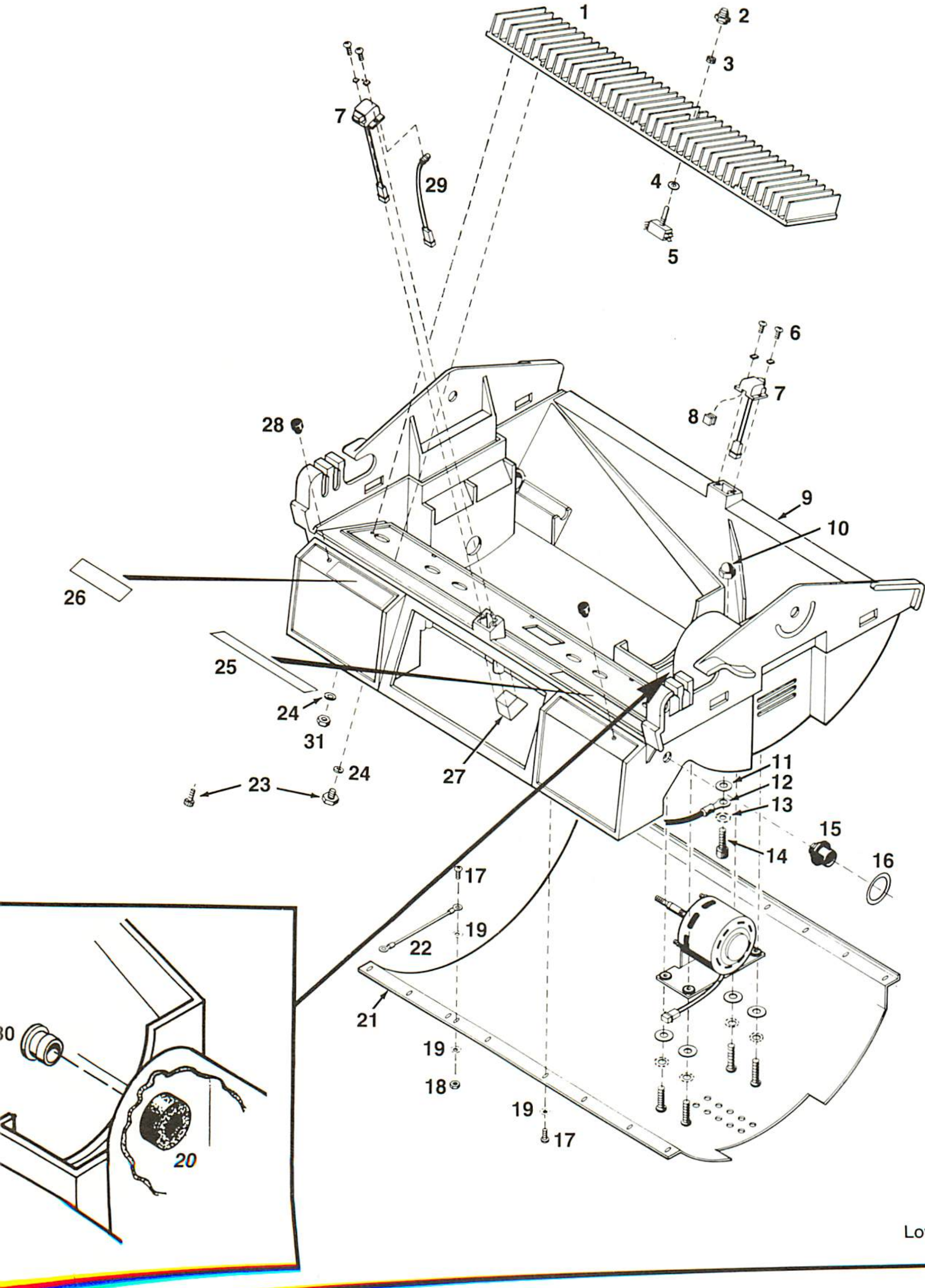
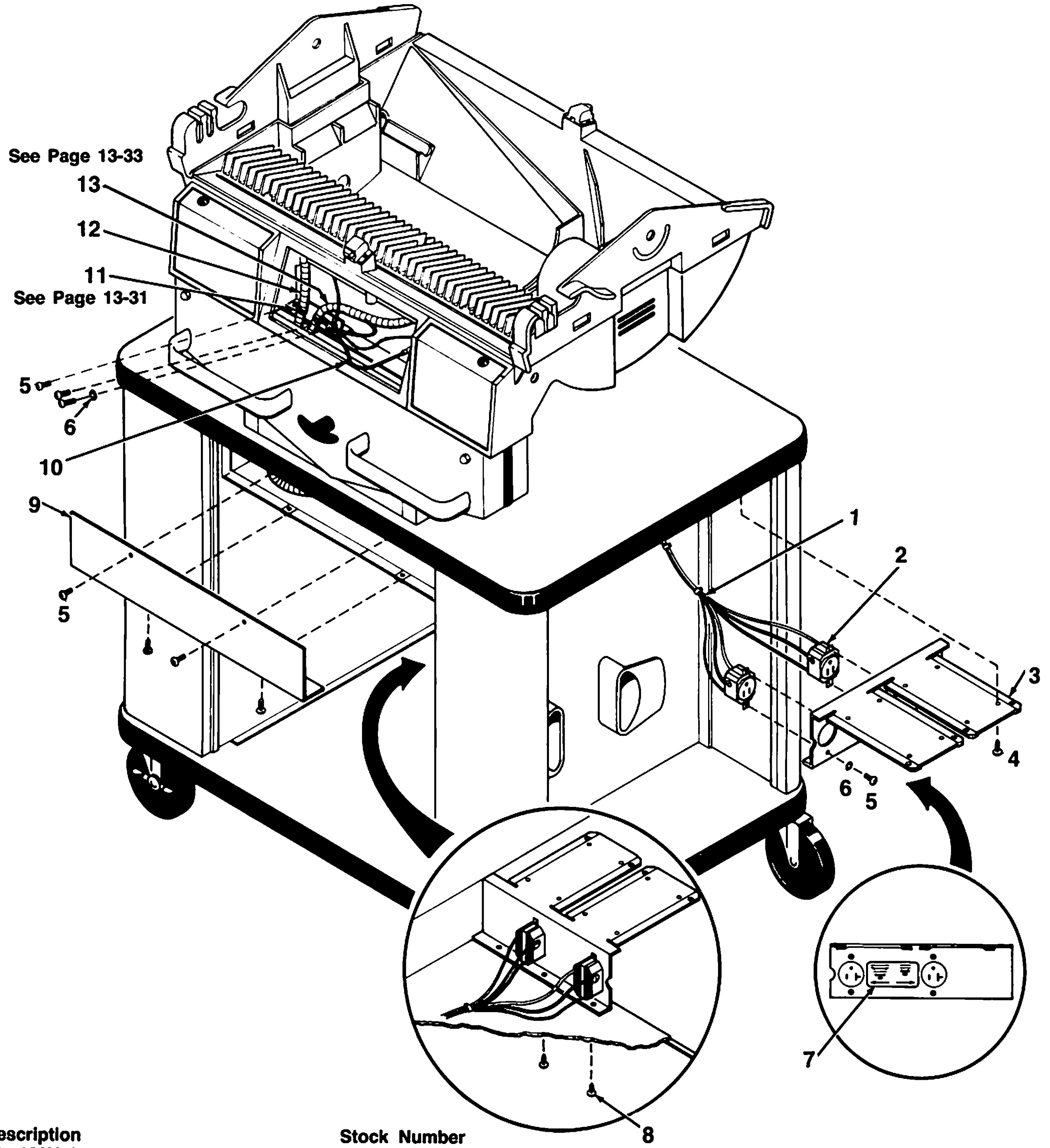


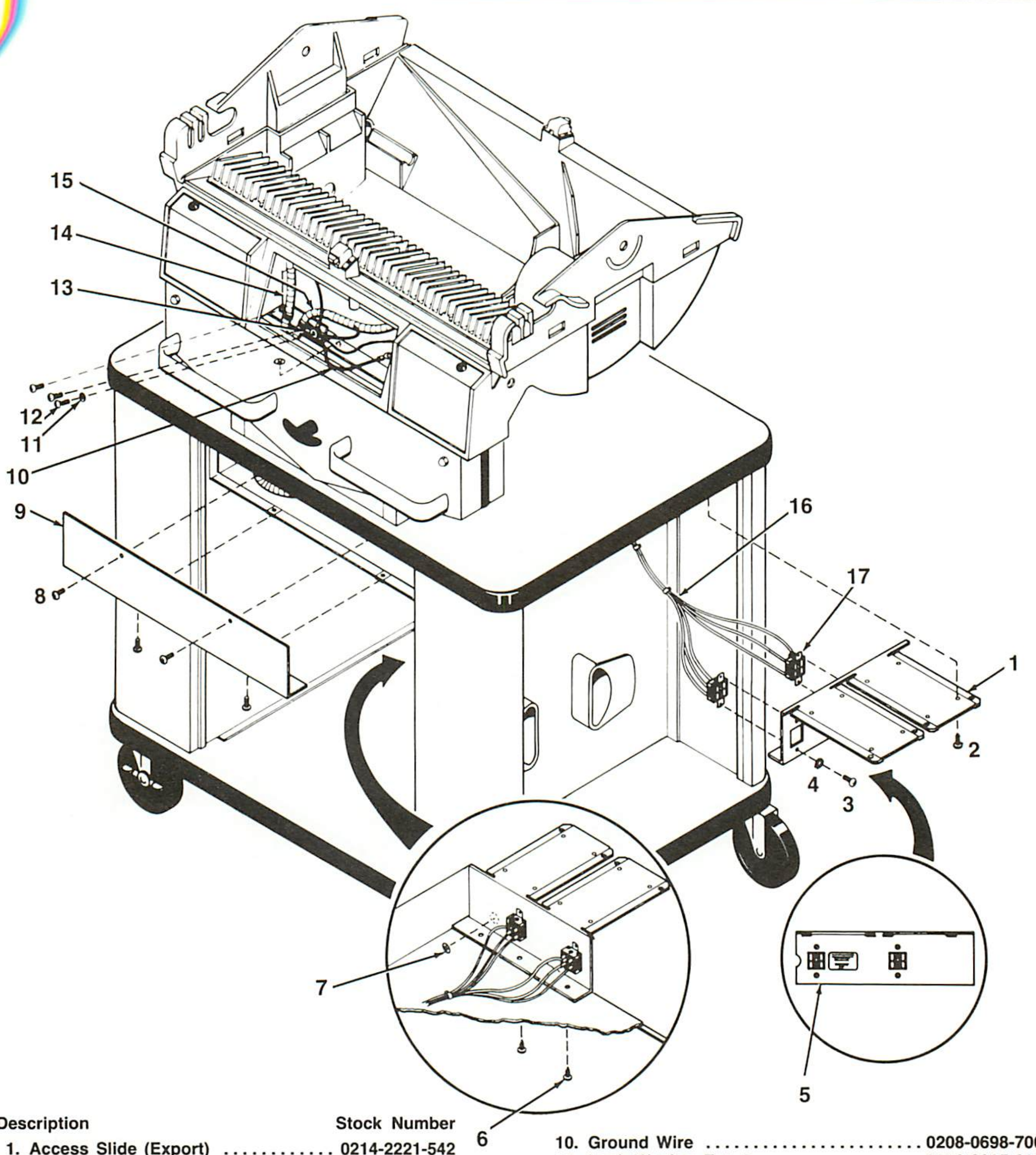
Figure 12-12
Lower Unit Assembly



Description	Stock Number
1. 120V Accessory Outlets Harness S/A	0208-6161-700
2. Single Receptacle 120V (2 required)	0208-0544-300
3. Access Slide 120V	0214-2220-542
4. Screw #6 X 1/2 (10 required)	0142-4113-108
5. Screw 8-32 X 3/8 (11 required)	0140-6627-106
6. Lock Washer Ext. 8	0202-3205-300
7. Access Outlet Nameplate	0205-4714-302
8. Screw #8 X 3/8 (3 required)	0142-2164-206
9. Raceway Access Cover	0214-2213-549
10. Ground Wire	0208-0698-700
11. Nylon Cable Clamp (4 required)	0690-1240-331
12. High Voltage Harness S/A	0208-6155-700
13. Low Voltage Harness S/A	0208-6166-700
Not Shown:	
Accessory Outlet Ground Wire	0208-0658-700

Figure 12-13
120V Lower Unit

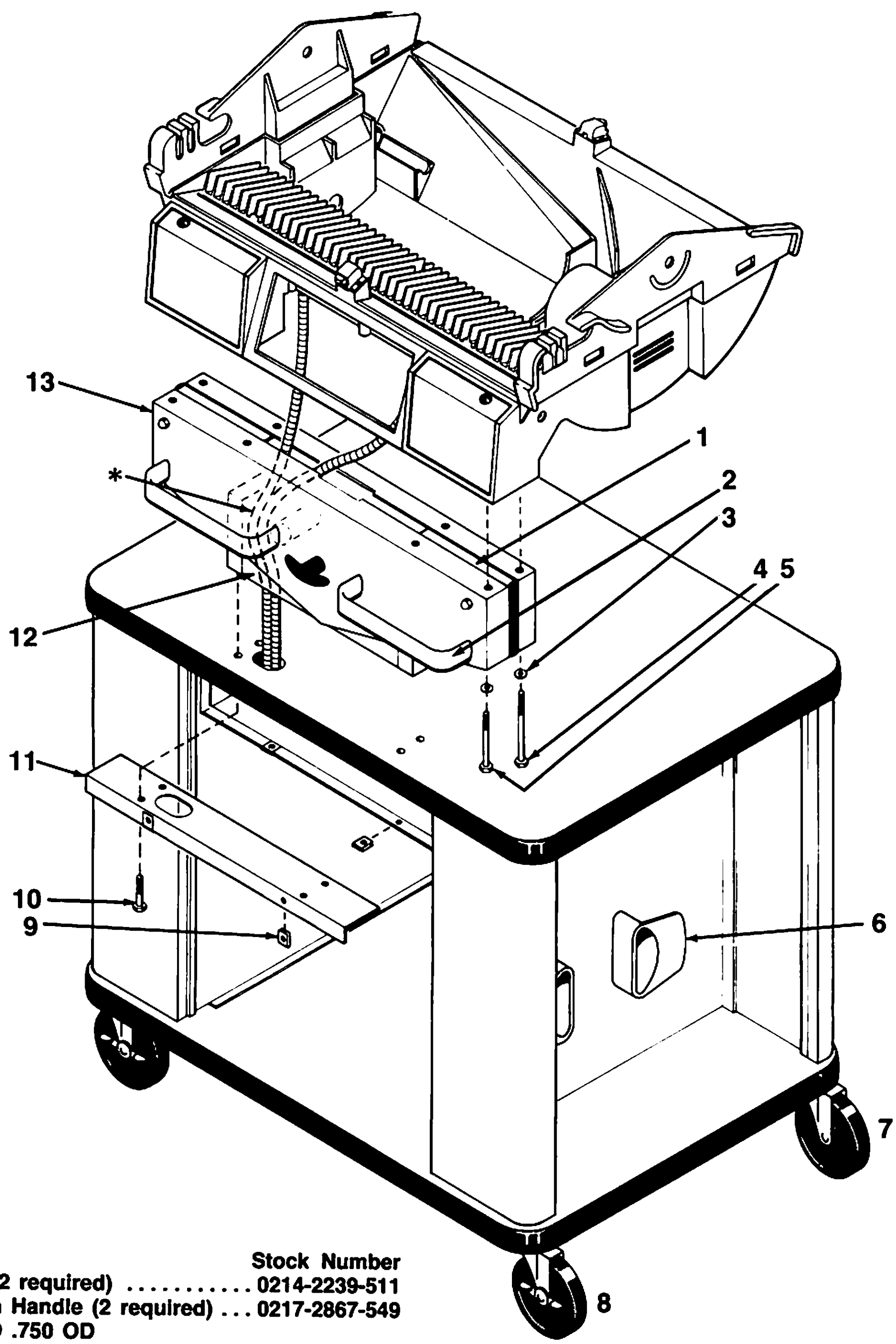
12/Illustrated Parts



Description	Stock Number
1. Access Slide (Export)	0214-2221-542
2. Screw #6 X 1/2 (8 required)	0142-4113-108
3. Screw 6-32 X 1/4	0140-6624-104
4. Lock Washer Ext. 6	0202-3200-300
5. 100V Access Outlet Nameplate	0205-4717-300
220V Access Outlet Nameplate	0205-4715-300
240V Access Outlet Nameplate	0205-4716-300
6. Screw 8 X 3/8 (3 required)	0142-2164-206
7. Mains Ground Label (2 required)	0205-4737-300
8. Screw 8-32 X 3/8 (4 required)	0140-6627-106
9. Raceway Access Cover	0214-2213-549
10. Ground Wire	0208-0698-700
11. Lock Washer Ext. 8	0202-3205-300
12. Screw 8-32 X 3/8 (3 required)	0140-6627-106
13. Nylon Cable Clamp	0690-1240-331
14. High Voltage Harness S/A	0208-6155-700
15. Low Voltage Harness S/A	0208-6166-700
16. Accessory Outlets Harness S/A	0208-6162-700
17. Single Receptacle (2 required)	0208-0538-300

Figure 12-14
Export Lower Unit

12/Illustrated Parts



Description	Stock Number
1. Backup Plate (2 required)	0214-2239-511
2. Tilt Mechanism Handle (2 required)	0217-2867-549
3. Washer .312 ID .750 OD (8 required)	0402-1102-300
+4. Screw 5/16-18 X 5-1/4 (4 required)	0144-2240-284
+5. Screw 5/16-18 X 4-1/4 (4 required)	0144-2240-268
6. Cord Bracket (2 required)	0212-3501-100
7. Conductive Caster without lock (2 required)	0215-8077-300
8. Conductive Caster with lock (2 required)	0215-8079-300
9. Tinnerman Nut (4 required)	0402-2005-300
10. Screw 5/16-18 X 1-7/8 (4 required)	0144-2240-230
11. Bracket	0214-2212-500
12. Tilt Mechanism Cover (2 required)	0214-2260-510
13. Tilt Mechanism Assembly	0217-2951-800

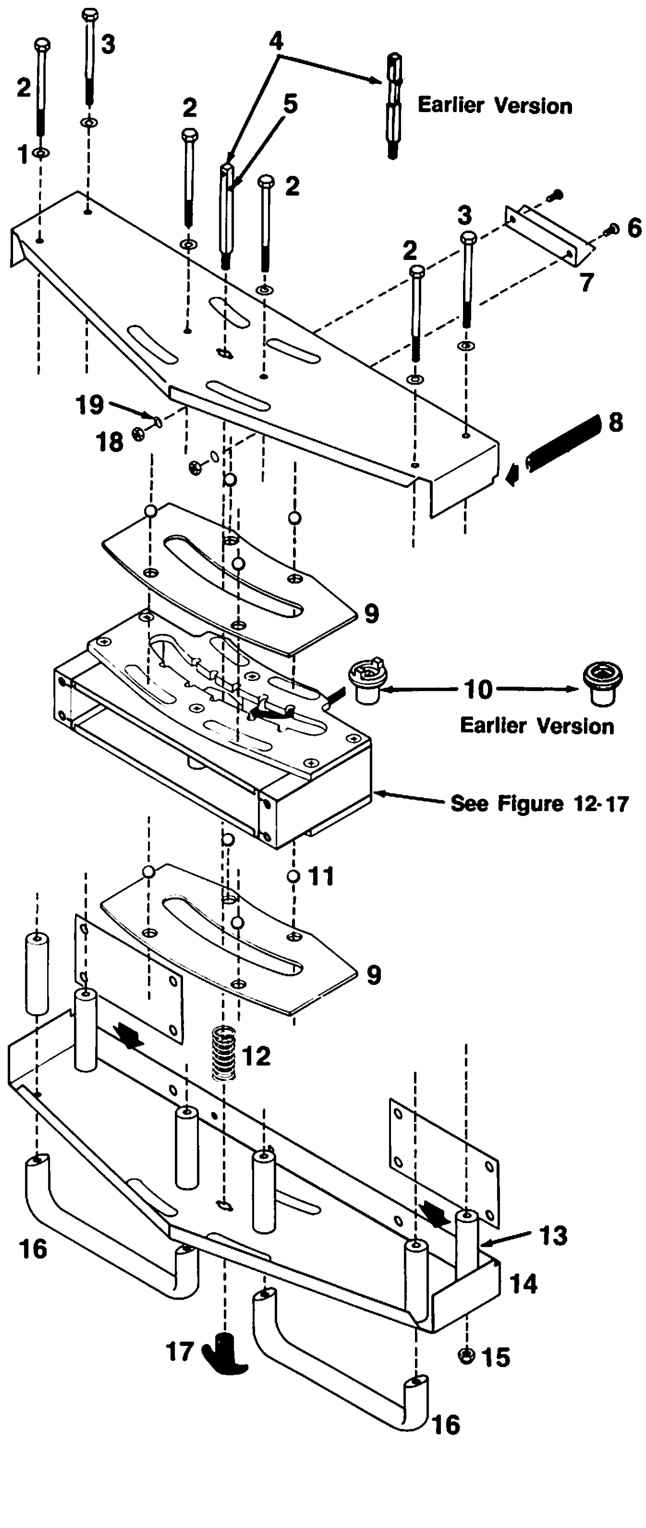
Not Shown:
Wire Insulating Bushing for Bracket ... 0217-2964-100

* Cables must be routed between handle spacer and post as shown. Cables must be located on left side of handle spacer.

+ Torque to 60 in. lb.

Figure 12-15
Tilt Mechanism Replacement

12/Illustrated Parts



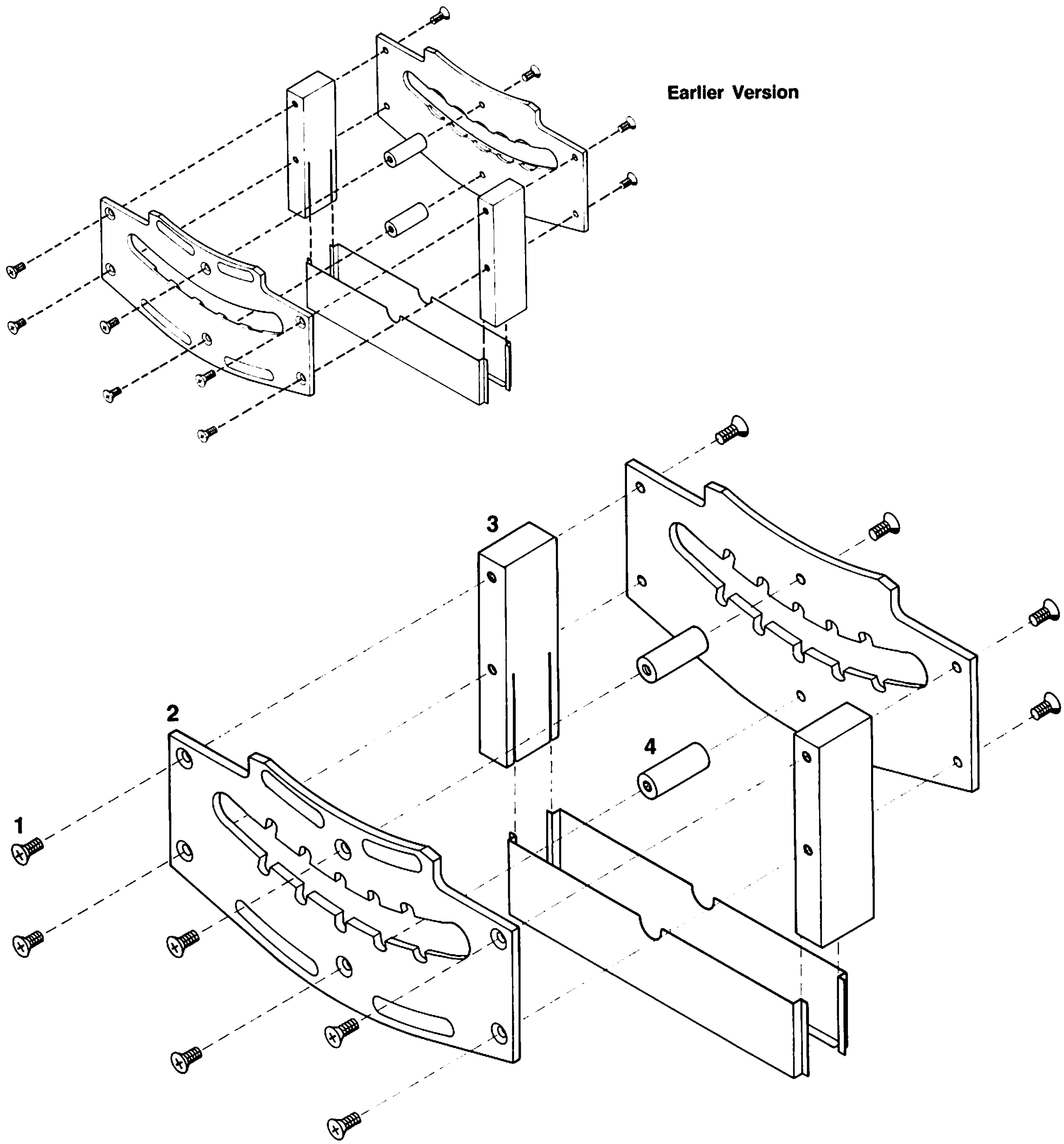
Description

	Tilt Mechanism Assembly	0217-2951-801
1.	Lock Washer Int-1/4 (6 required)	0202-3415-340
2.	Screw 1/4-20 X 3-1/2 (4 required)	0144-2236-256
3.	Screw 1/4-20 X 3-3/8 (2 required)	0144-2236-254
+4.	Detent Bar	0217-2918-542
5.	Groove Pin 1/8 X 5/8 (2 required)	0143-3108-510
6.	Screw 10-24 X 3/8 (2 required)	0140-6630-106
7.	Harness Mounting Bracket	0217-2963-700
8.	End Cap Extrusion (2 required)	0217-2839-100
9.	Bearing Guide (2 required)	0212-1285-300
+10.	Detent	0217-2917-535
11.	Steel Ball 1/2" Dia Cr Pl (8 required)	0409-1722-300
12.	Compression Spring	0203-4033-300
13.	Spacer (6 required)	0202-0002-500
14.	Tilt Plate (2 required)	0214-2236-510
15.	Acorn Nut 1/4-20 (2 required)	0144-3136-221
16.	Tilt Mechanism Handle (2 required)	0217-2867-549
*17.	Positioning Lock Handle	0212-1942-300
18.	Nut 10-24 (2 required)	0144-3130-113
19.	Lock Washer Ext-10 Wh. Ni (2 required)	0202-3210-340

* Apply Loctite #271 (0220-5021-300) to threads

+ Earlier version of Detent Bar, Detent, and Indexing Plate are present on some models. See Section 9G. Tilt Mechanism Repair.

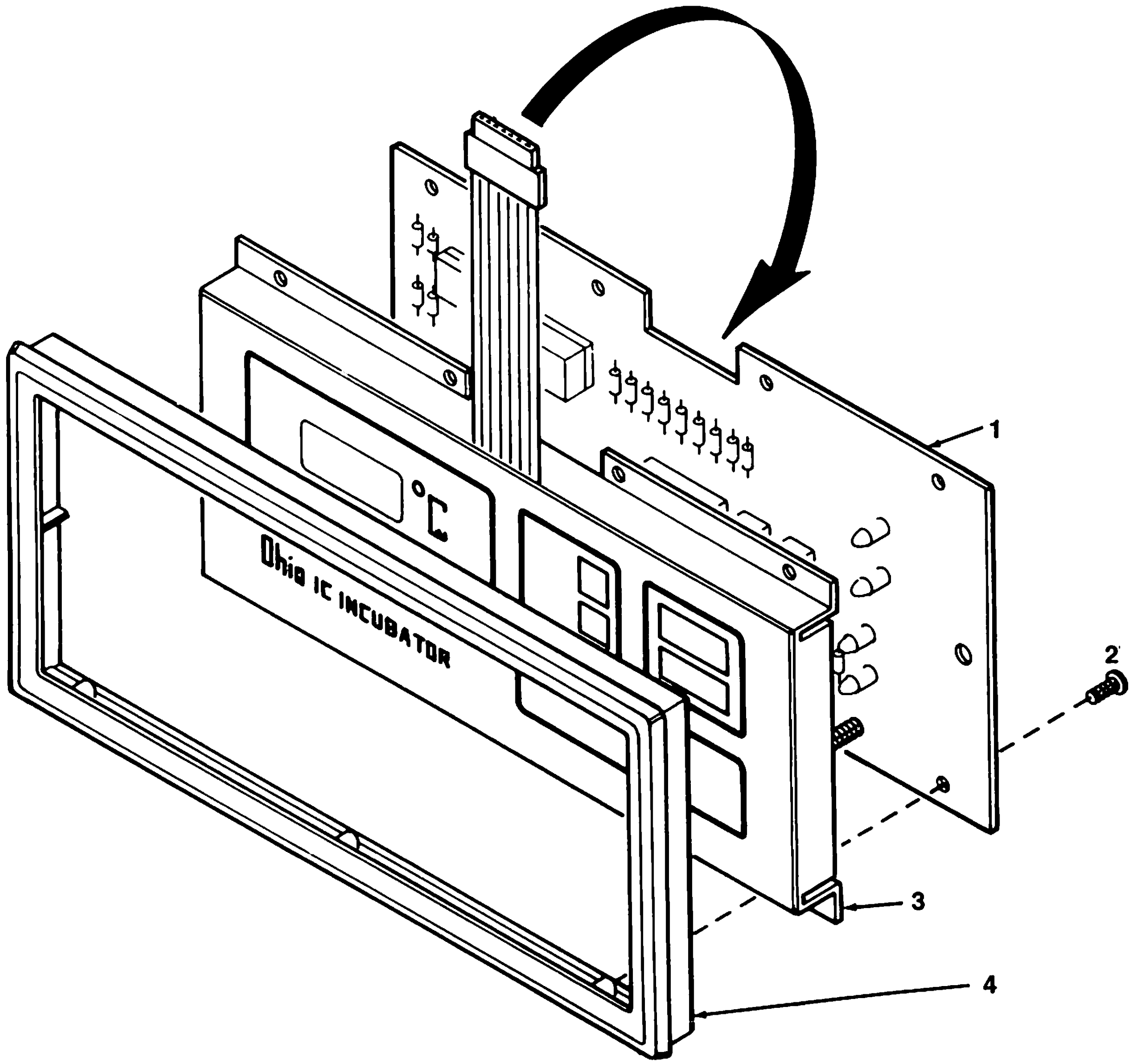
Figure 12-16
Tilt Mechanism Assembly



Description	Stock Number
1. Screw 1/4-20 X 5/8 (12 required)	0140-6236-110
*2. Indexing Plate (2 required)	0217-2919-500
3. Mounting Post (2 required)	0217-2966-549
4. Spacer (2 required)	0202-0001-500

* Earlier version of Detent Bar, Detent, and Indexing Plate are present on some models See Section 9F.

Figure 12-17
Indexing Plate Assembly

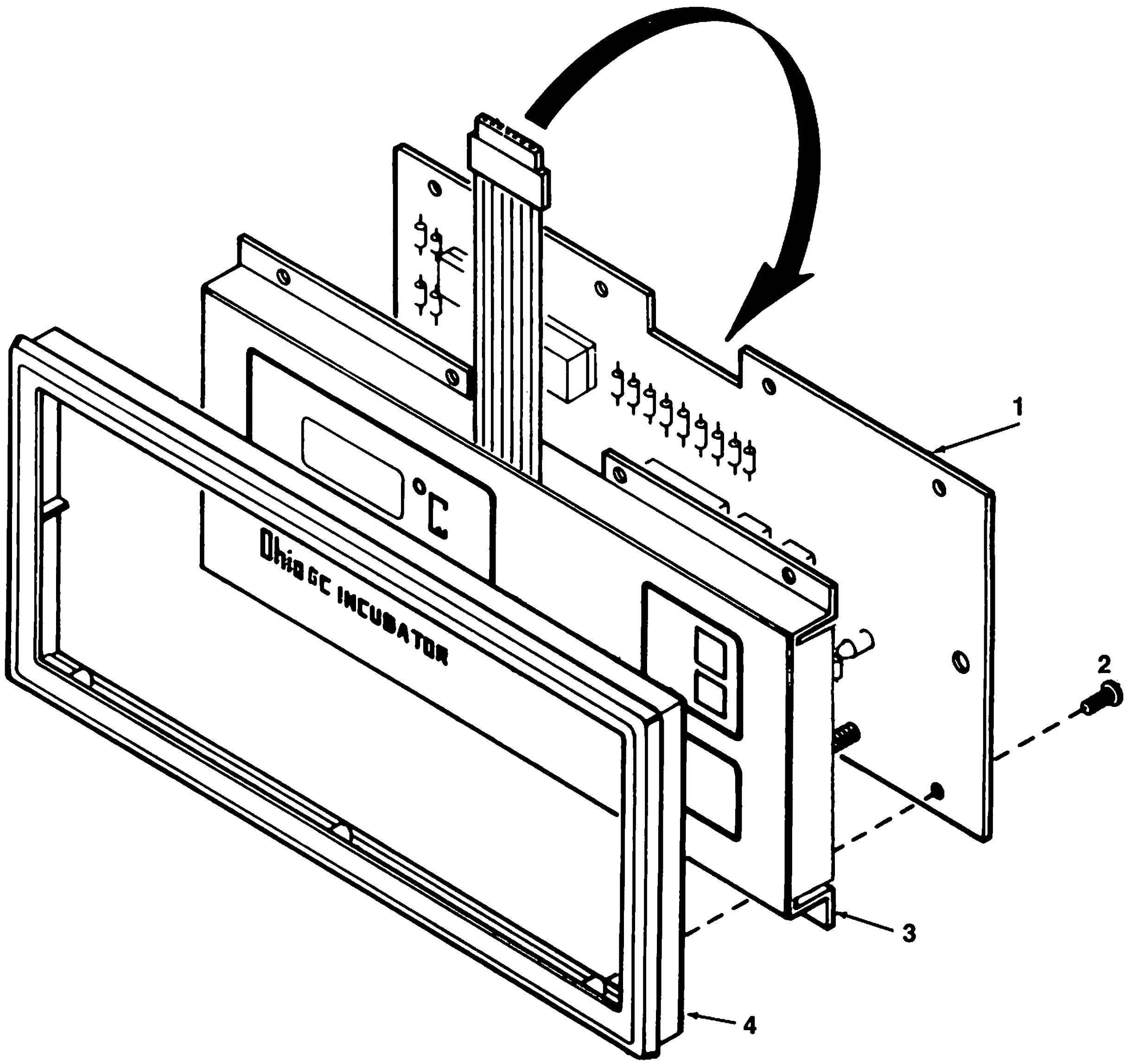


Description	Stock No.
IC Incubator Display Panel Assembly Complete	0217-2960-800
*1. Display P.C. Board	0208-6325-700
2. Screw 6 X 1/2	0142-4823-108
3. Display Panel Mounting Assembly	0217-2900-700
4. Display Panel Bezel	0212-0906-100

* This part subject to damage from static electricity. Use static control precautions when handling the printed circuit boards.

Figure 12-18
IC Incubator Display Panel

12/Illustrated Parts



Note: These General Care Incubator parts are no longer available. Contact your Ohmeda service representative for further information.

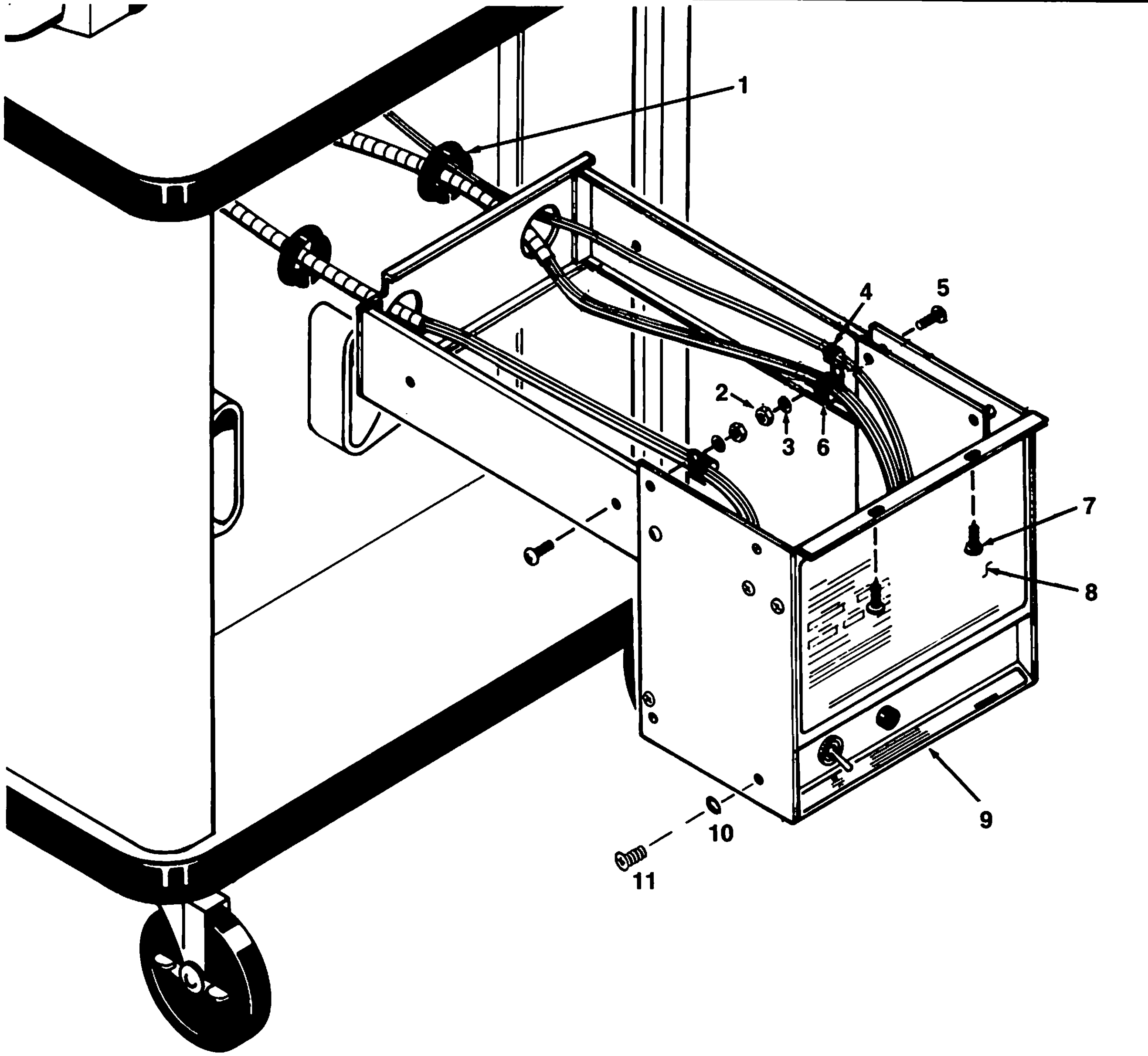
Description

GC Incubator Display Panel Assembly Complete
*1. Display P.C. Board
2. Screw 6 X 1/2
3. Display Panel Mounting Assembly
4. Display Panel Bezel

* This part subject to damage from static electricity. Use static control precautions when handling the printed circuit boards.

Figure 12-19
GC Incubator Display Panel

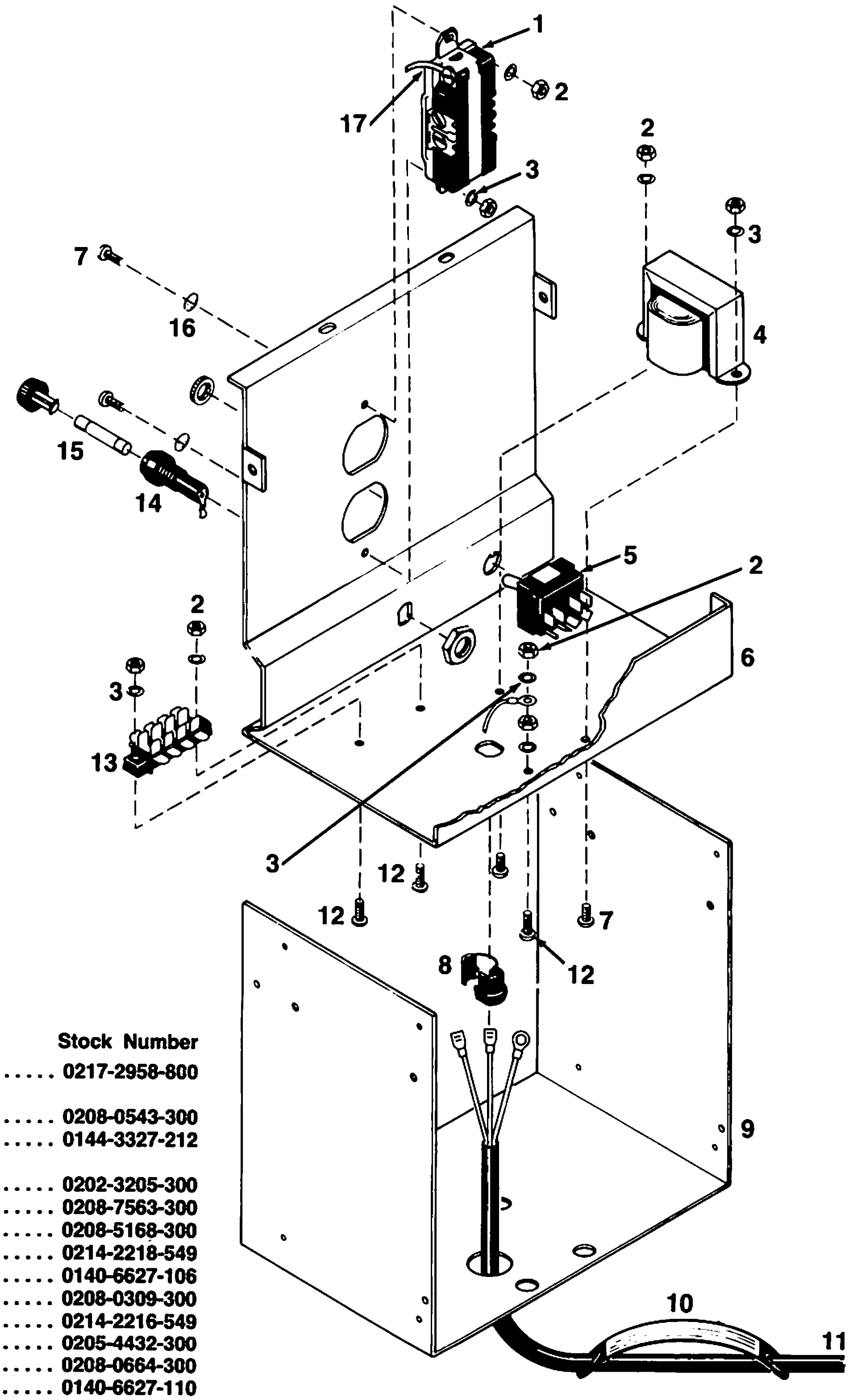
12/Illustrated Parts



Description	Stock No.
1. Snap-split Bushing (2 required)	0690-1090-324
2. Hex Nut 8-32 (2 required)	0144-3327-212
3. Lock Washer Ext. 8 (2 required)	0202-3205-300
4. Cable Clamp	0208-0335-300
5. Screw 8-32 X 1/2 (2 required)	0140-6627-108
6. Nylon Cable Clamp (2 required)	0690-1240-331
7. Screw #6 X 3/4 (10 required)	0142-4363-112
8. IC 120V Main Control Nameplate	0205-4725-300
IC 220V Main Control Nameplate	0205-4727-300
IC 240V Main Control Nameplate	0205-4729-300
IC 100V Main Control Nameplate	0205-4731-300
9. Fuse Warning Nameplate 120V	0205-4722-300
Fuse Warning Nameplate 220V	0205-4723-300
10. Lock Washer Ext. 6 (8 required)	0202-3200-300
11. Screw 6-32 X 1/4 (14 required)	0140-6624-104

Figure 12-20
IC and GC Incubator Control Unit

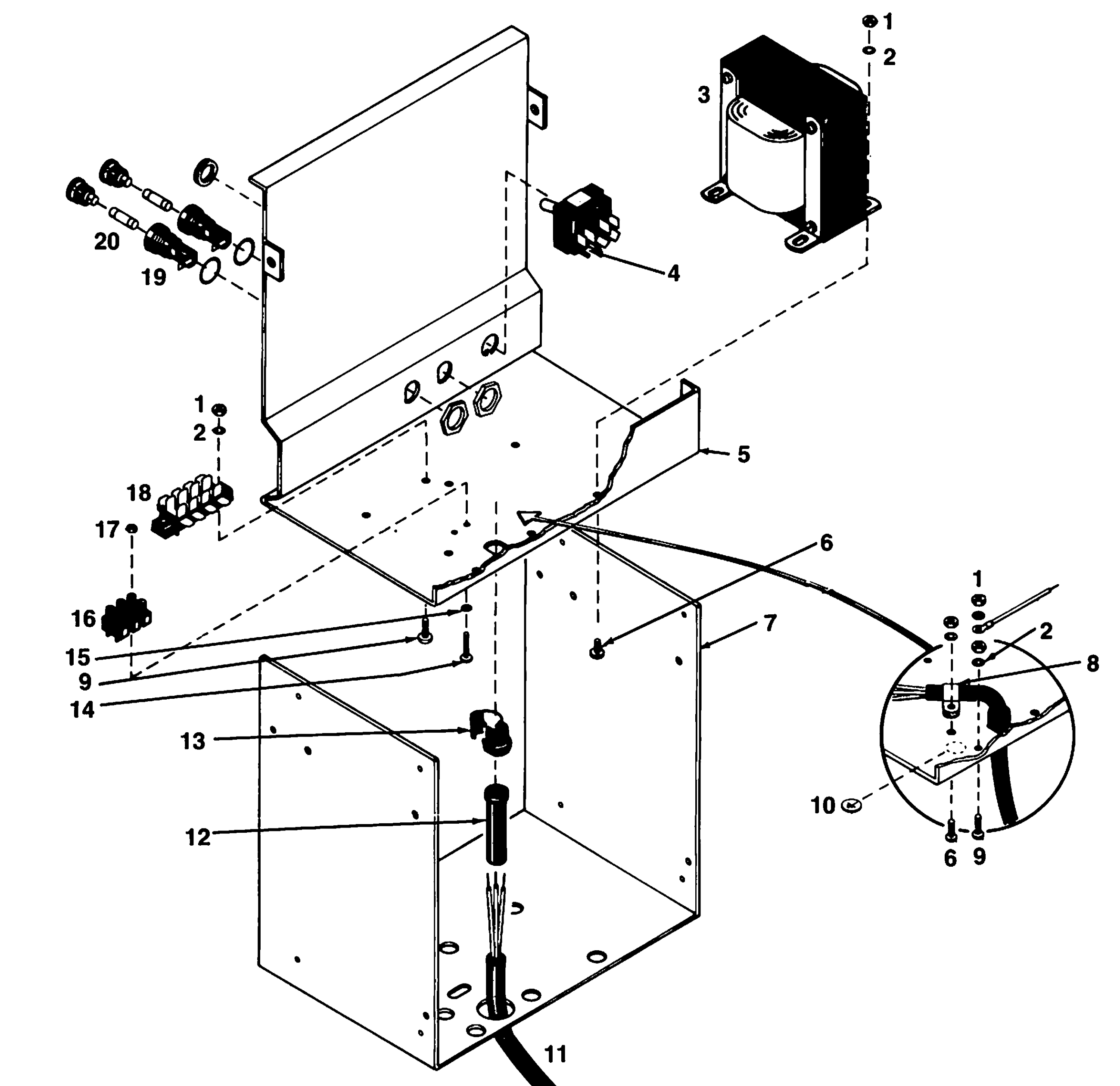
12/Illustrated Parts



Description	Stock Number
120V Controller Assembly	0217-2958-800
1. Dplx. Recp. 15A 125 VAC (Hospital Grade)	0208-0543-300
2. Hex Nut 8-32 (8 required)	0144-3327-212
3. Lock Washer Ext. -8 .328 OD (8 required)	0202-3205-300
4. Transformer 115V Primary	0208-7563-300
5. Toggle Switch 4PST	0208-5168-300
6. Main Control Chassis	0214-2218-549
7. Screw 8-32 X 3/8 (4 required)	0140-6627-106
8. Strain Relief Bushing	0208-0309-300
9. Main Control Cover	0214-2216-549
10. Ground Reliability Label	0205-4432-300
11. Power Cord 10'2" w/plug	0208-0664-300
12. Screw 8-32 X 5/8 (3 required)	0140-6627-110
13. Terminal Block	0690-2700-320
14. Fuseholder, 3AG	0208-1041-300
15. Fuse, 6.25A, Slow Blow	0208-1028-300
16. Lock Washer Int.-8 .328 OD (2 required)	0202-3436-300
17. Ground Wire	0203-0003-700

Figure 12-21
120V Controller Assembly

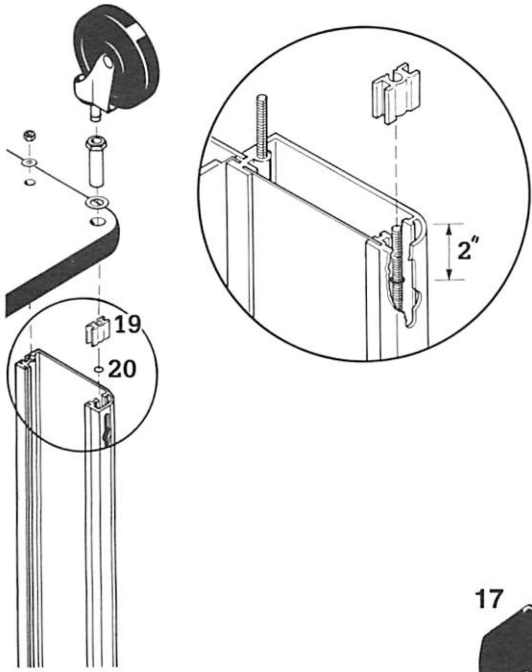
12/Illustrated Parts

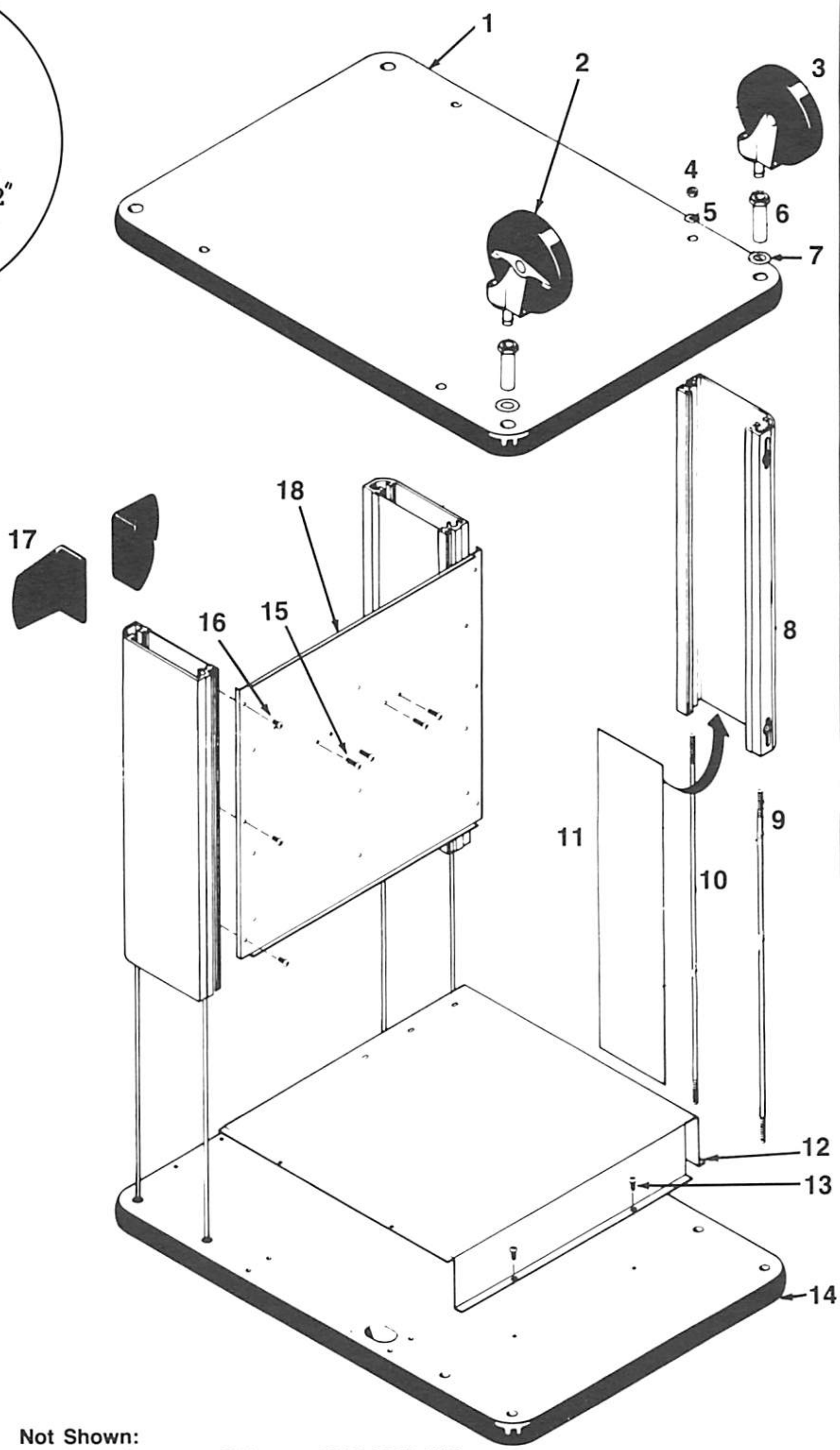


Description	Stock Number
220V Controller Assembly	0217-2958-801
240V Controller Assembly	0217-2958-802
100V Controller Assembly	0217-2958-803
1. Hex Nut 8-32 (8 required)	0144-3327-212
2. Lock Washer Ext. 8 (9 required)	0202-3205-300
3. 100-220-240V Transformer	0208-7564-300
4. Toggle Switch 4PST	0208-5168-300
5. Chassis	0214-2219-549
6. Screw 8-32 X 3/8 (5 required)	0140-6627-106
7. Main Control Cover	0214-2217-549
8. Cable Clamp	0208-0335-300
9. Screw 8-32 X 5/8 (3 required)	0140-6627-110
10. Main Ground Label	0205-4737-300
11. Power Cord 18-3 SJO/SJT	0208-0650-500
12. Strain Relief Bushing	0208-0617-100
13. Strain Relief	0208-0601-300
14. Screw 4-40 X 3/4 (2 required)	0140-6517-112
15. Lock Washer Int - 4 (2 required)	0202-3406-300
16. Terminal Block	0690-2700-319
17. Hex Nut 4-40 (2 required)	0144-3117-113
18. Terminal Block	0690-2700-320
19. Fuseholder (2 required)	0690-1750-309
20. 220V and 240V Fuse 3.15A Slow Blow (2 required)	0690-1700-317
100V Fuse, 6.3A, Slow Blow (2 required)	0690-1700-318

Figure 12-22
Export Controller Assembly

12/Illustrated Parts





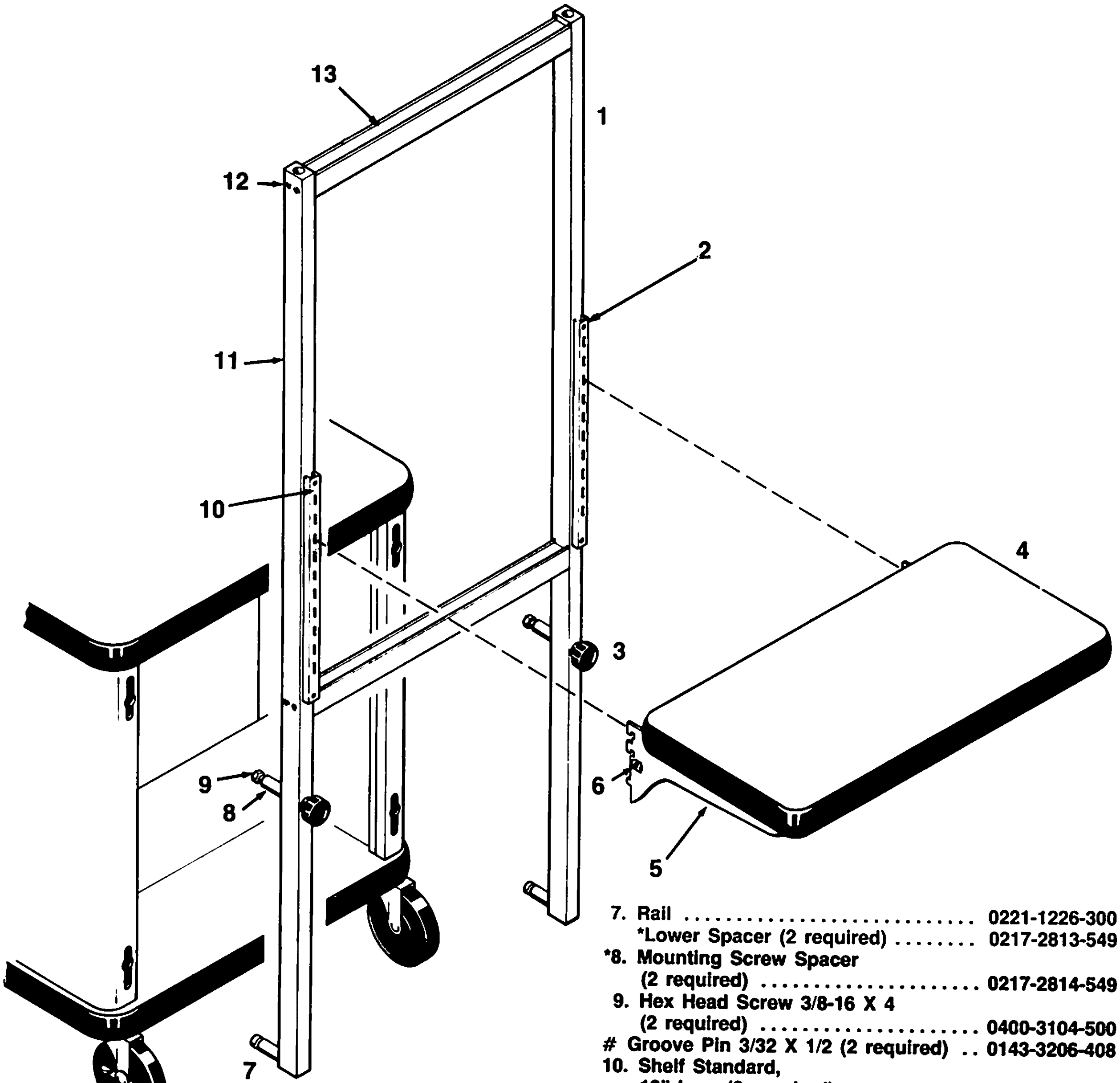
Description	Stock Number
Cabinet Assembly	0217-2950-800
1. Lower Cabinet Slab	0217-2826-300
2. Conductive Caster with Lock (2 required)	0215-8079-300
3. Conductive Caster without Lock (2 required)	0215-8077-300
4. Hex Nut 5/16-18 (4 required)	0144-3140-212
5. Washer .344 ID .875 OD (4 required)	0202-4540-342
6. Caster socket 7/16" (4 required)	0415-8956-535
7. Washer .641 ID 1.125 OD (4 required)	0402-0841-504
8. Aluminum Extrusion Leg (4 required)	0217-2824-549
9. Tie-rod (4 required)	0400-5484-300
10. Tie-rod (4 required)	0400-5485-300
11. Cabinet Leg Cover (4 required)	0214-2209-549
12. Cabinet Raceway	0214-2251-500
13. Screw #8 X 3/4 (4 required)	0142-2314-212
14. Upper Cabinet Slab	0217-2965-300
15. Screw #6 X 1/2 (4 required)	0142-4833-108
16. Screw 6-32 X 1/4 (12 required)	0140-6624-104
17. Cord Bracket (2 required)	0212-3501-100
18. Left Cabinet Side Panel	0214-2256-510
19. Spacer, Tie-rod	0217-2956-300
20. O-ring	0210-0410-300

Not Shown:

Incubator Raceway S/A	0217-2922-710
Right Cabinet Side Panel	0214-2255-510

Figure 12-33
Cabinet Assembly

12/Illustrated Parts



Description	Stock Number
Upright and Shelf Complete	0217-2990-800
Shelf Kit w/o Uprights	0217-2990-802
1. Upright Complete without Shelf	0217-2990-801
2. Screw 8-32 X 5/8 (4 required)	0140-4327-210
3. Knob (2 required)	0212-1927-300
4. Shelf (12 inch)	0217-2827-300
Shelf (18 inch)	0217-2781-300
18 inch Shelf Accessory (w/items 5 and 6)	0217-2782-800
5. Shelf Support (2 reqd) w/o item 6 ..	0203-2497-500
6. Locking Screw (2 required)	0203-2493-300
Locking Nut (2 required)	0203-2494-300
7. Rail	0221-1226-300
*Lower Spacer (2 required)	0217-2813-549
*8. Mounting Screw Spacer (2 required)	0217-2814-549
9. Hex Head Screw 3/8-16 X 4 (2 required)	0400-3104-500
# Groove Pin 3/32 X 1/2 (2 required) ..	0143-3206-408
10. Shelf Standard, 12" long (2 required)	0203-2495-300
11. Rail & Shelf Upright (2 required) ...	0217-2819-549
12. Cap Screw 10-24 X 1.5 (8 required)	0144-2130-224
13. Dual Rail 19.82" L (2 required)	0221-1226-300
Not Shown:	
+* Shelf Mounting Screw 10-24 X 1-1/4 (4 required)	0140-6130-120
Spacer for Shelf Screw (4 required)	0202-0008-500
Washer for Shelf Screw (4 required) ...	0202-4520-340

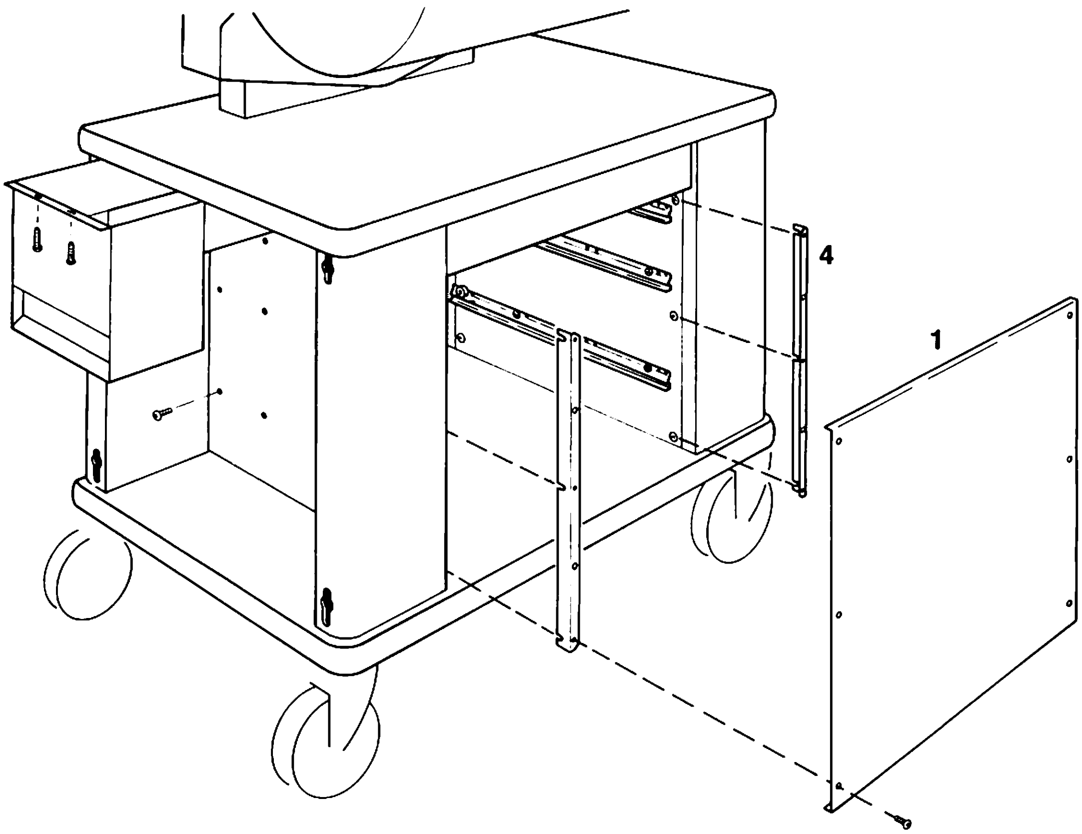
* Apply Loctite #271 (0220-5020-300) to threads

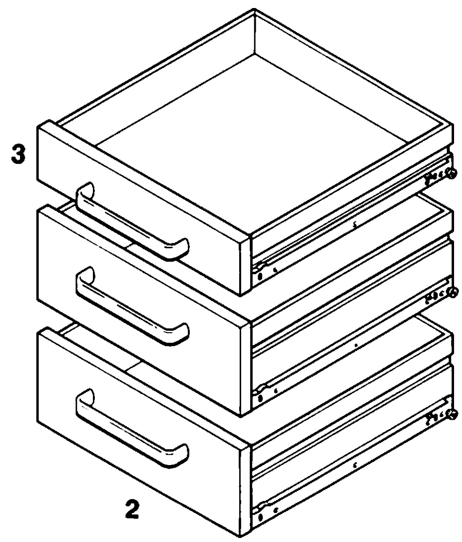
+Tighten screws only until the screw head contacts the spacer. Bracket must remain loose.

#Add pin before assembling

Figure 12-34
Upright and Shelf Assembly

12/Illustrated Parts

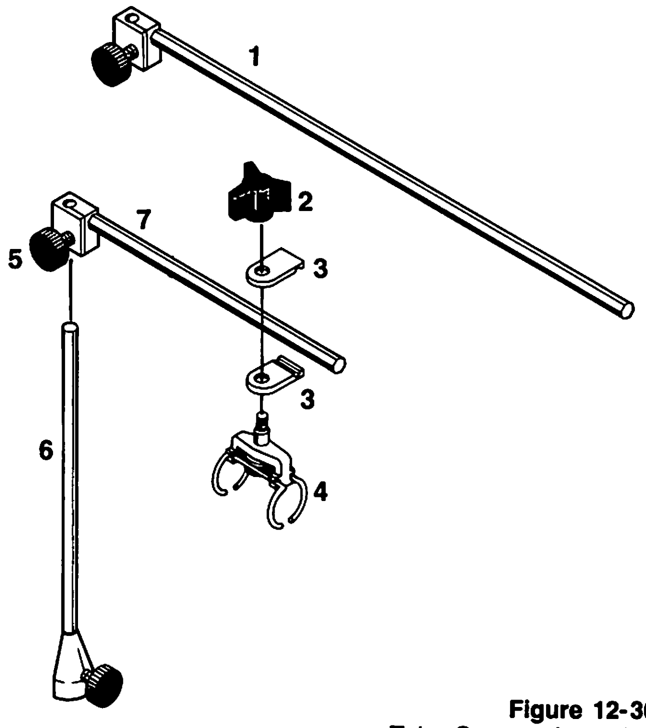




Description	Stock No.
Drawer Kit Assembly w/Instructions	**0217-2993-871**
1. Drawer End Panel	**0214-2257-510**
2. 6.0" Drawer (2 required)	**0217-2969-700**
3. 3.5" Drawer	**0217-2968-700**
Right Slide Channel	**0203-2504-300**
Left Slide Channel	**0203-2503-300**
4. Panel Mounting Bracket (2 Required)	**0214-2258-500**
Not Shown:	
Mounting Screw 6-32 X 1/4 (18 required)	**0140-6524-104**
Mounting Screw #6 X 5/16 (6 required)	**0142-2313-206**
Lock Washer #6 (18 required)	**0144-1106-131**
Hex Nut 6-32 (18 required)	**0144-3224-113**
Two Drawer Kits:	
Serial No. BECL00230 and below	0217-2993-870
Above Serial No. BECL00230	0217-2993-871

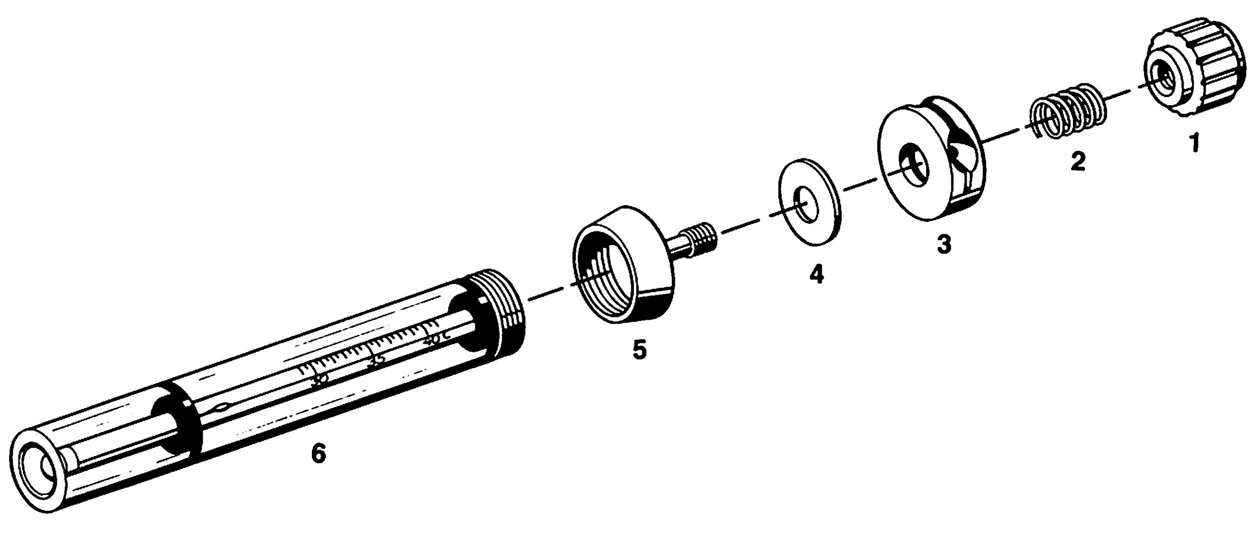
Figure 12-35
Three Drawer Kit Assembly

12/Illustrated Parts



Description	Stock No.
Tube Support Assembly	0217-2780-880
1. 15" Rod Asssembly	0217-2779-735
2. Knob for Clamp Assembly	0212-1913-300
3. Retainer Clamp (2 required)	0217-5001-100
4. Clamp Assembly	0217-5004-800
5. Knob (3 required)	0217-2973-700
6. Upright	0217-2974-700
7. 8" Rod Assembly	0217-2778-735

Figure 12-36
Tube Support Assembly



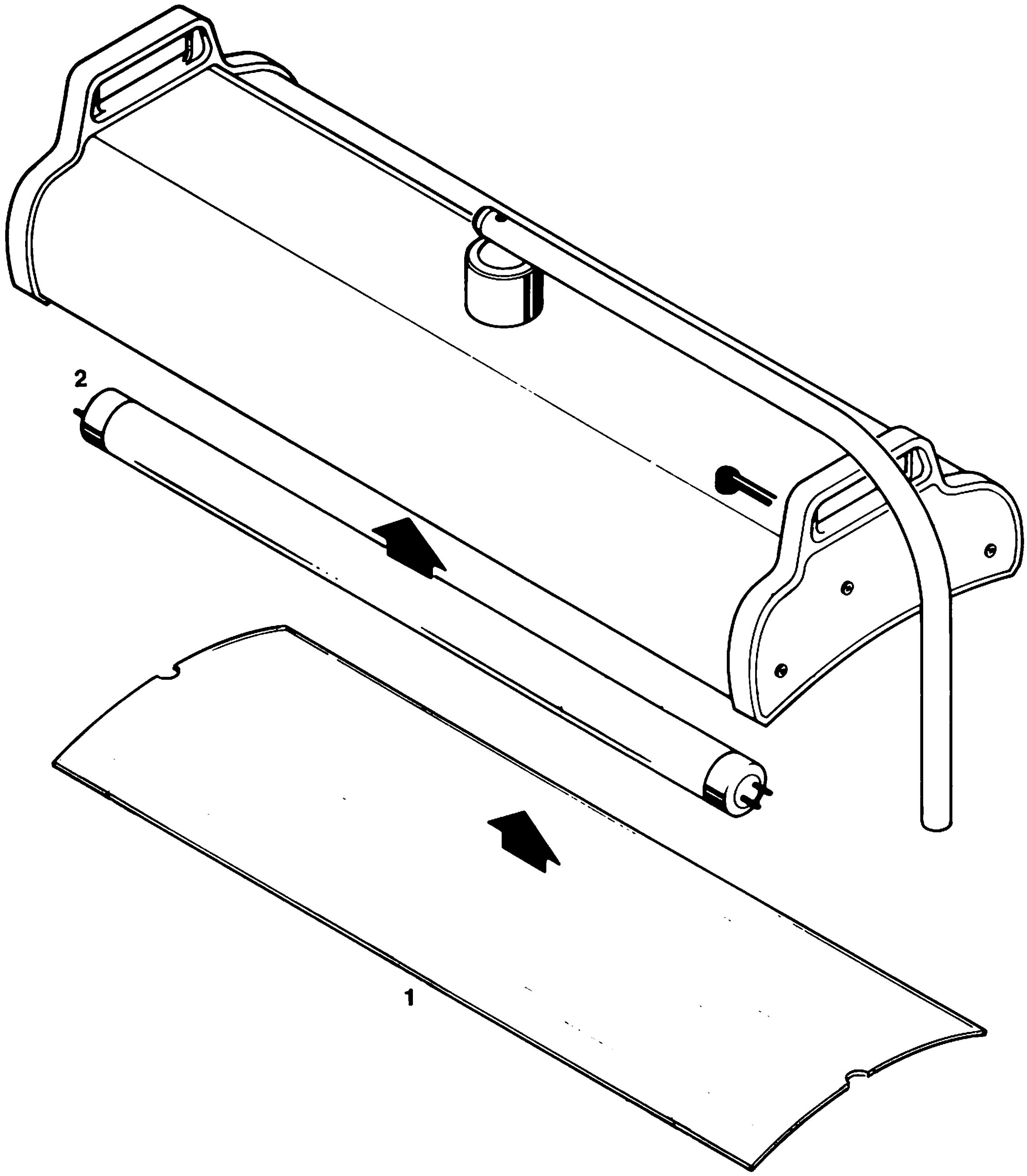
Description

Thermometer Assembly
1. Retainer Knob
2. Compression Spring
3. Thermometer Clamp Rod Holder
4. Washer
5. Thermometer Tube Support
6. Thermometer and Shield

NOTE: The electronic temperature sensing system of the incubator is much more responsive than the conventional mercury thermometer. For this reason the thermometer assembly has been obsoleted and parts are no longer available.

Figure 12-37
Thermometer Assembly

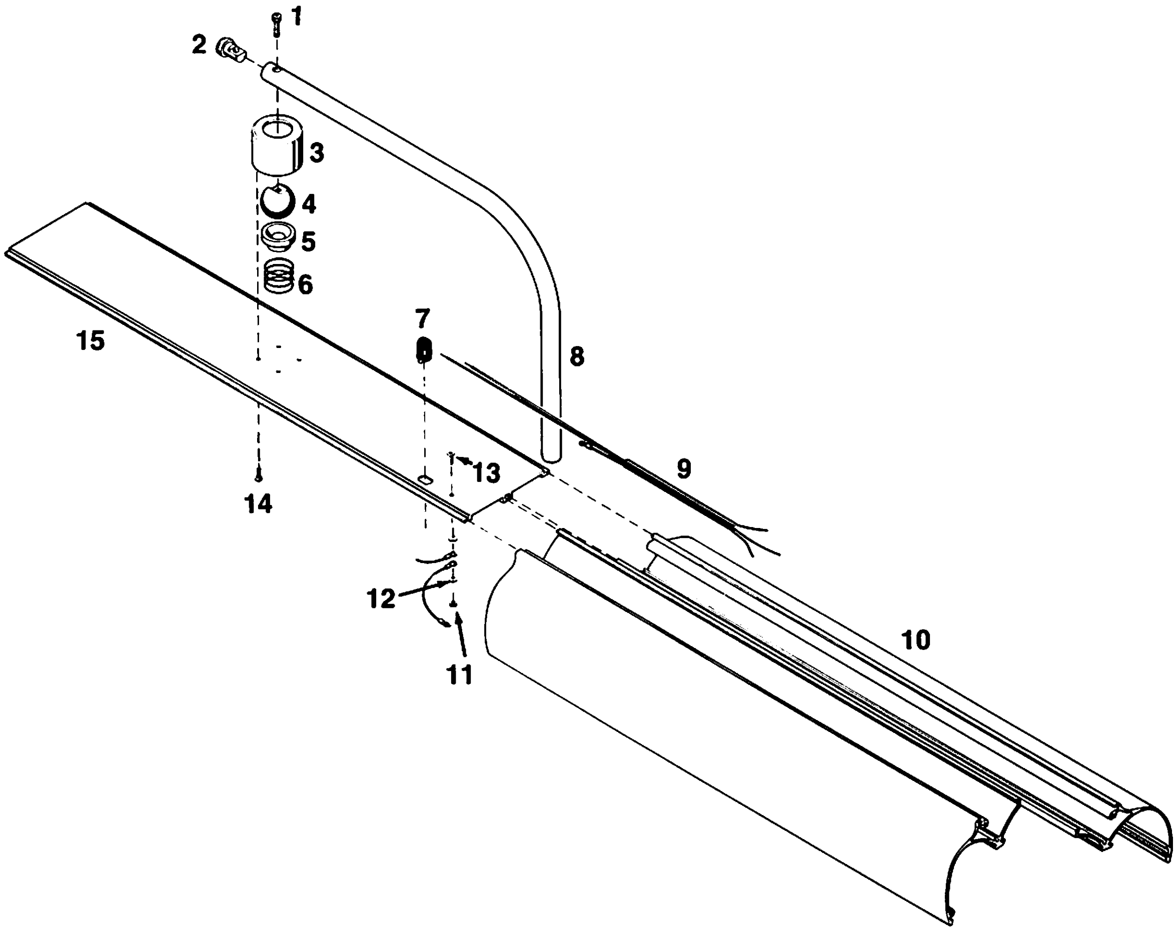
12/Illustrated Parts



Description	Stock No.
Phototherapy Lamp Lamphouse Assembly	0217-2988-800
1. Lamp Shield	0212-1009-300
2. 24 inch 20 Watt Daylight Fluorescent Lamp	0208-0588-300
24 inch 20 Watt Special Blue	0208-0639-300

3 Lamps of any combination required.

Figure 12-38
Phototherapy Lamp Cover Assembly

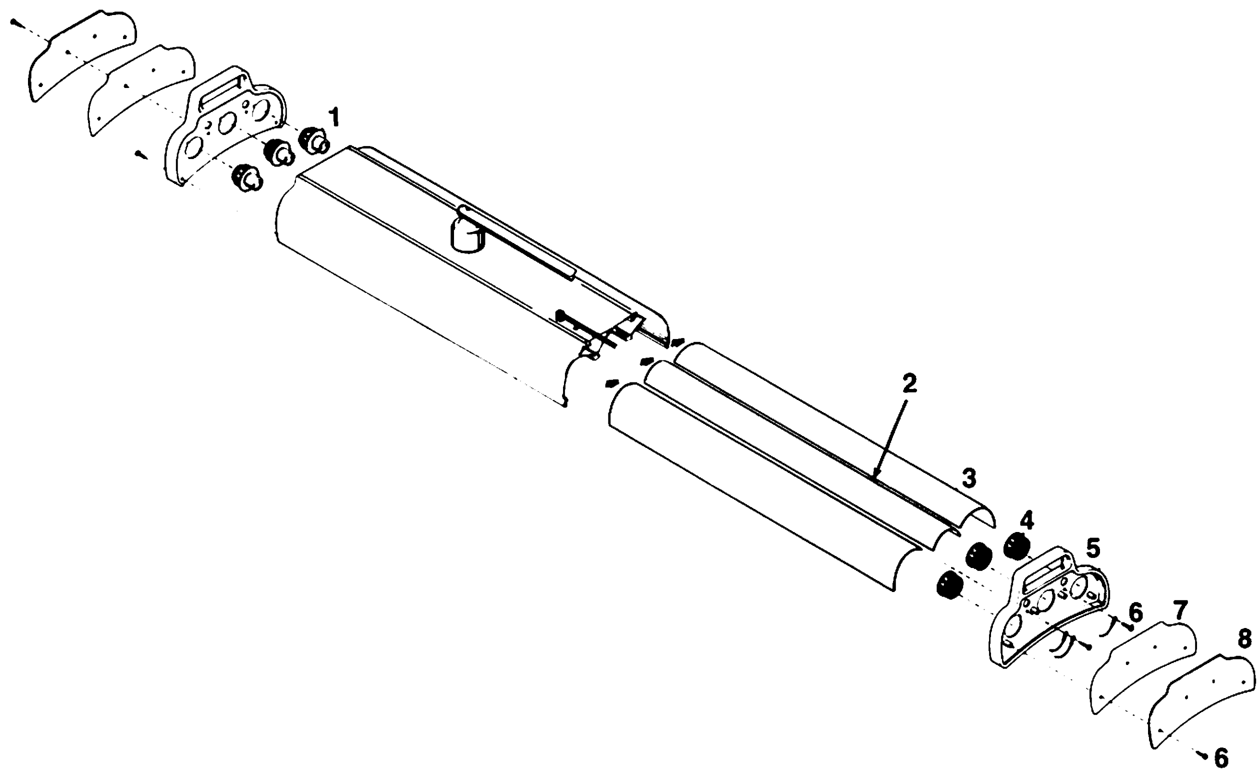


Description	Stock No.
*1. Screw 5/16-18 X 1	0144-2140-216
2. Crane Arm End Cap	0217-2879-549
3. Ball Swivel Socket	0217-2880-549
4. Ball	0217-2881-542
5. Friction Spacer	0217-2882-500
6. Spring	0203-4075-300
7. Strain Relief	0208-0323-300
8. Crane Arm	0217-2884-555
9. Lamphouse Cable SA	0208-6163-700
10. Extrusion (2 required)	0217-2886-300
11. Hex Nut 6-32	0144-3324-113
12. Lock Washer Ext–6 (2 required)	0202-3200-300
13. Screw 6-32 X 3/8	0140-6624-106
**14. Screw 8-32 X 1/2 (4 required)	0140-6227-108
15. Extrusion Cover	0217-2885-300
Not Shown:	
a. Cable Tie (2 required)	0203-5919-300
b. Harness SA Lamphouse	0208-6164-700

* Apply Loctite #242 (220-5016-300) torque to 150 in. lbs.
** Apply Loctite #242 (220-5016-300)

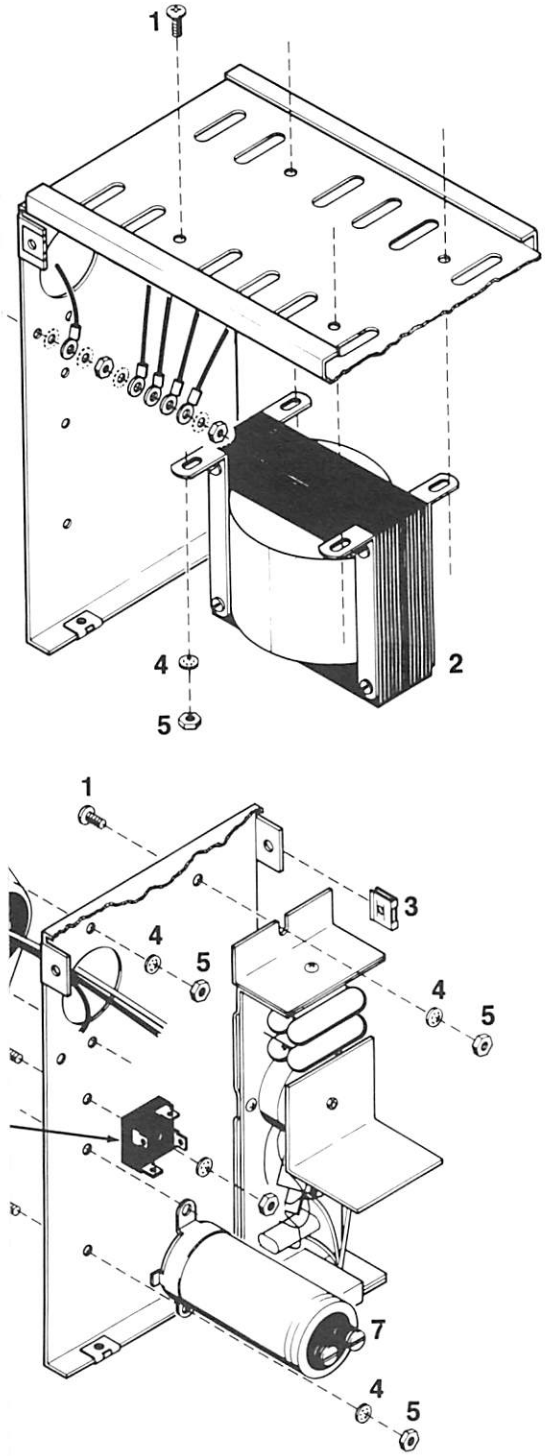
Figure 12-39
Phototherapy Lamp Crane Arm Assembly

12/Illustrated Parts



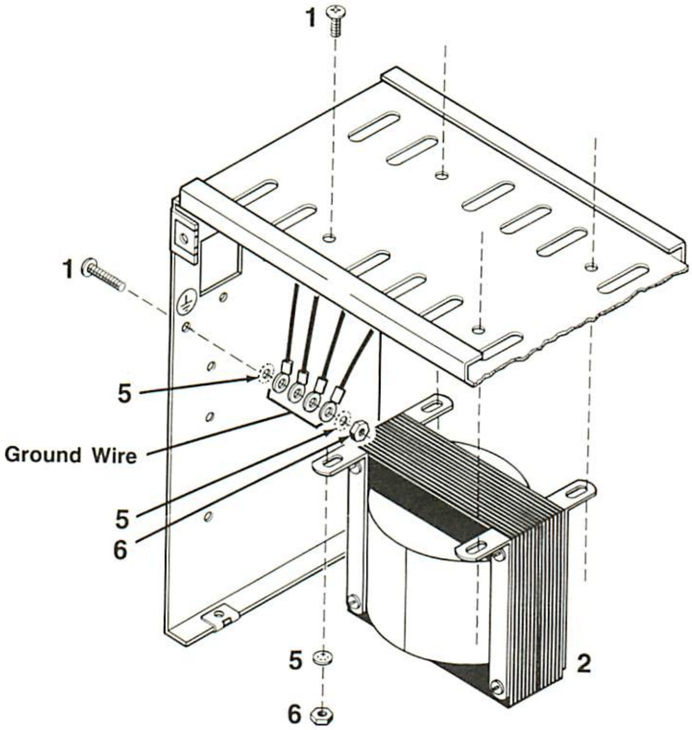
Description	Stock No.
1. Spring Loaded Lampholder (3 required)	0208-0649-300
2. Center Section Reflector	0217-2869-300
3. End Section Reflector (2 required)	0217-2870-300
4. Stationary Lampholder (3 required)	0208-0648-300
5. End Cap (2 required)	0217-2802-100
6. Screw, #6 X 1/2 (20 required)	0142-4833-108
7. End Cover Insulator (2 required)	0210-8056-300
8. Cover Plate (2 required)	0214-2241-500

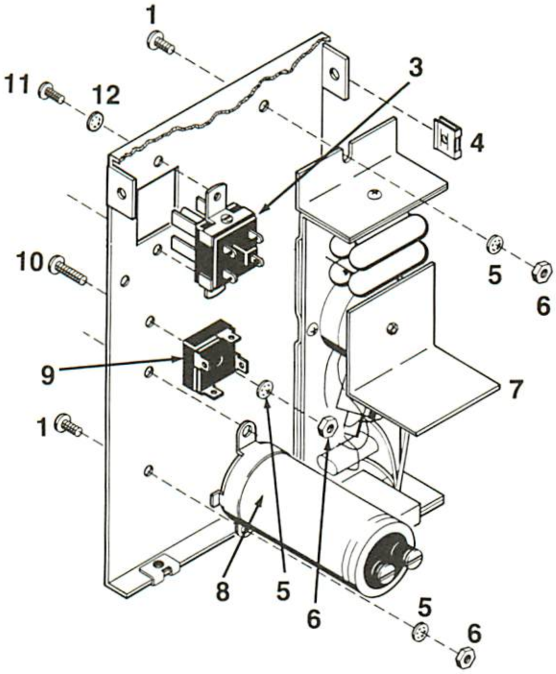
Figure 12-40
Phototherapy Lamp End Cap Assembly



Description	Stock Number
120V Phototherapy Lamp Controller Assembly	0304-3300-900
Hardwire Conversion Kit	0217-2783-810
1. Phototherapy Controller Chassis 120V	0214-2232-549
2. 120V Phototherapy Lamp Nameplate	0205-4733-300
3. Handle	0203-2500-300
4. 120V Fuse Warning Nameplate	0205-4718-300
5. Fuseholder 3 AG	0208-1041-300
6. 120V Fuse 1A Slow Blow	0690-1700-302
7. Hex Nut 6-32 (4 required)	0144-3324-113
8. Lock Washer Int-6 St. St. (4 required)	0202-3412-300
9. Controller harness S/A with connector	0208-6165-700
4" Cable Tie	0203-5915-300
Connector Housing	0690-1565-302
Female Pins (5 required)	0690-2600-340
10. Phototherapy Controller Cover	0214-2223-549
11. Screw 6-32 X 3/8 (4 required)	0140-6624-106
12. Screw 8-32 X 3/8 (10 required)	0140-6527-114
13. Toggle Switch Dpst	0690-2500-331
14. Lock Washer Ext-10 (2 required)	0202-3210-340
15. Screw 10-32 X 3/8 (2 required)	0140-6631-106
16. Lock Washer Ext.-8 (3 required)	0202-3205-300
17. Hex Nut 8-32	0144-3127-113
18. Shield	0214-2261-500
19. Ground Wire	0208-0659-700

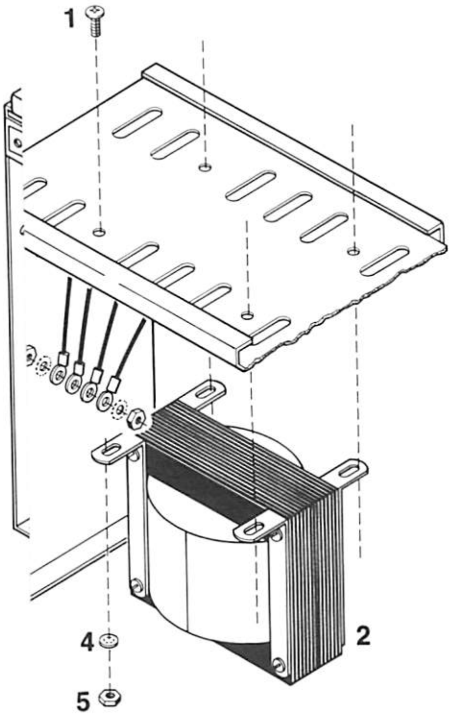
Figure 12-41B
Earlier Version
120V Phototherapy Lamp Controller Assembly
0304-3300-900

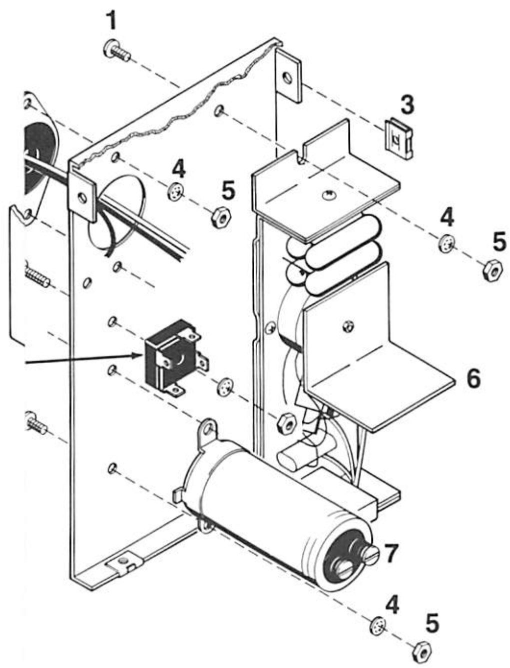




Description	Stock No.
1. Screw 8-32 X 3/8 (9 required)	0140-6627-106
2. Phototherapy Lamp Transformer ...	0208-7557-300
3. Plug 4 Contact with Ground	0208-0539-300
4. Tinnerman Speed Nut St. (8 required)	0402-2003-300
5. Lock Washer Ext-8 (10 required) ...	0202-3205-300
6. Hex Nut #8-32 (10 required)	0144-3127-113
7. Ballast Inverter 20 VDC	0690-2454-304
8. Capacitor 5800 MFD 40 VDC	0682-7181-300
9. Bridge Rectifier 15 Amp	0208-0476-300
10. Screw 8-32 X 5/8	0140-6627-110
11. Screw 6-32 X 3/8 (2 required)	0140-6624-106
12. Lock Washer Int-6 St. St. (2 required)	0202-3412-300
13. Ground Mains Label	0205-4737-300

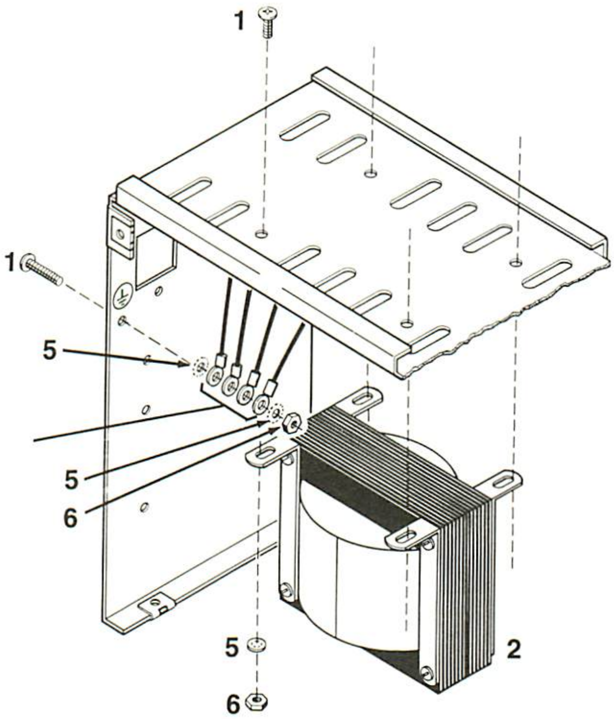
Figure 12-42B
Earlier Version
Export Phototherapy Lamp Controller Assembly

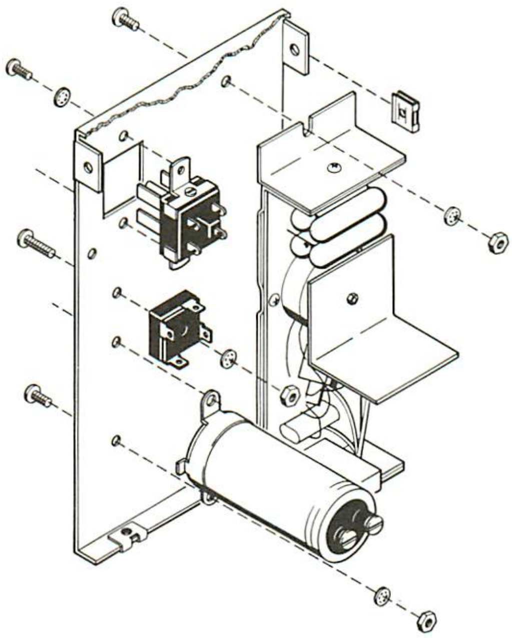




Description	Stock No.
120V Phototherapy Lamp Controller Assembly	0304-3300-900
1. 120V Phototherapy Controller Chassis	0214-2232-549
2. 120V Phototherapy Lamp Nameplate	0205-4733-300
3. Handle	0203-2500-300
4. 120V Fuse Warning Nameplate	0205-4718-300
5. 3AG Fuseholder	0208-1041-300
6. 120V Fuse 1A Slow Blow	0690-1700-302
7. Socket Connector Housing	0208-2005-300
8. Pin Connector Housing	0208-2004-300
9. Phototherapy Controller Cover	0214-2223-500
10. Screw 8-32x3/8 (11 required)	0140-6527-114
11. 90° Strain Relief	0208-0323-300
12. Phototherapy Lamphouse Cable	0208-6163-700
13. Lock Washer Ext.-8 (18 required)	0202-3205-300
14. Hex Nut 8-32	0144-3127-113
15. Shield	0214-2261-500
16. Toggle Switch DPST, 15 AMP, 125V	0690-2500-331
17. Lock Washer Ext.-10	0202-3210-340
18. Screw 10-32x3/8 (2 required)	0140-6631-106

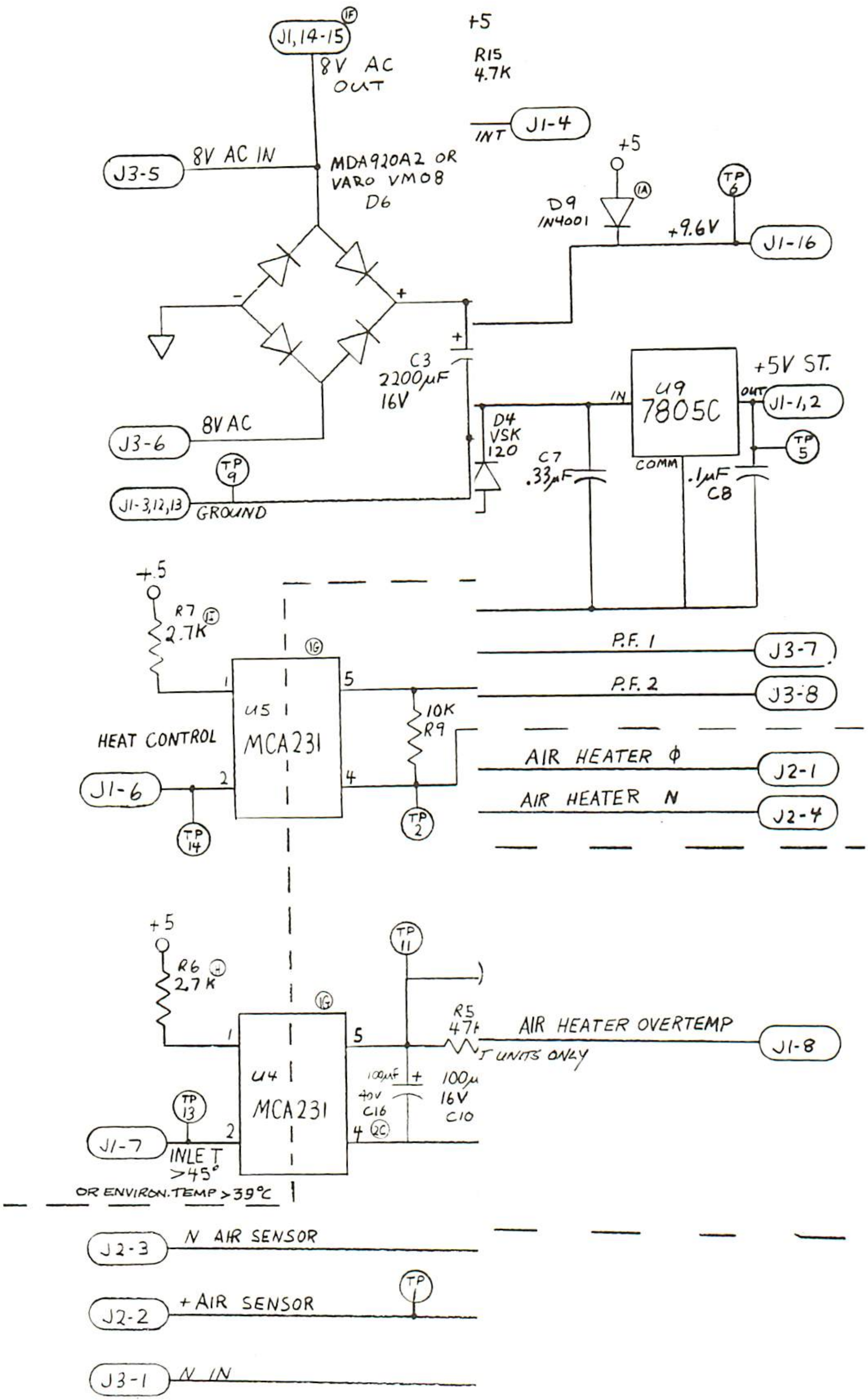
Figure 12-43B
Later Version
120V Phototherapy Lamp Controller Assembly





Description	Stock No.
1. Screw 8-32 X 3/8 (9 required)	0140-6627-106
2. Phototherapy Lamp Transformer	0208-7557-300
3. Plug 4 Contact with Ground	0208-0539-300
4. Tinnerman Speed Nut St. (8 required)	0402-2003-300
5. Lock Washer Ext-8 (10 required)	0202-3205-300
6. Hex Nut 8-32 (10 required)	0144-3127-113
7. Ballast Inverter 20 VDC	0690-2454-304
8. Capacitor 5800 MFD 40 VDC	0682-7181-300
9. Bridge Rectifier 15 Amp	0208-0476-300
10. Screw 8-32 X 5/8	0140-6627-110
11. Screw 6-32 X 3/8 (2 required)	0140-6624-106
12. Lock Washer Int-6 St. St. (2 required)	0202-3412-300
13. Ground Mains Label	0205-4737-300

Figure 12-44B
Later Version
Export Phototherapy Lamp Controller Assembly

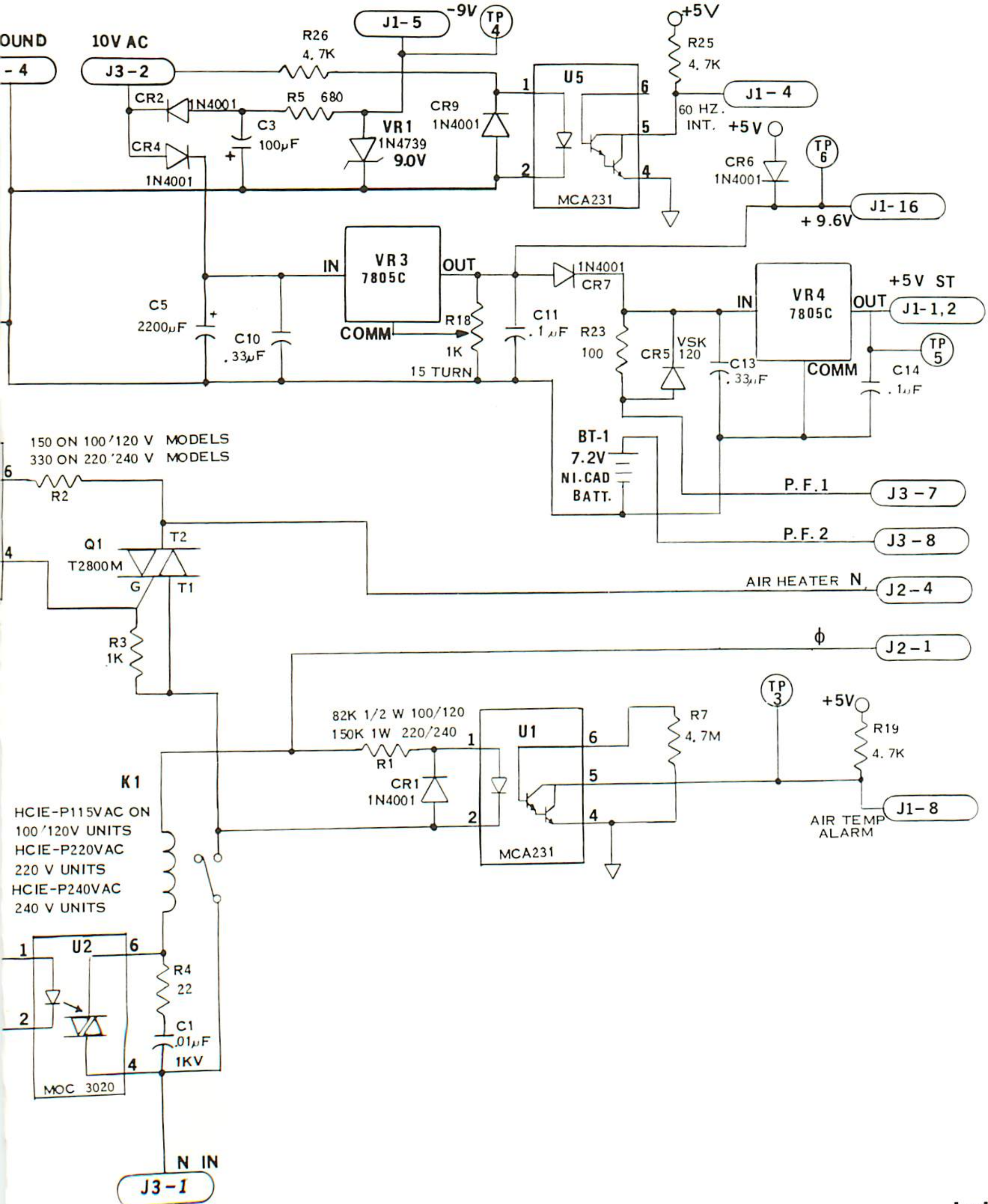


Earlier Version

Power Supply Board

0176-0104-002

Ohio® IC and GC Incubators



Later Version

Power Supply Board

Schematic No. 0176-0104-002

Ohio® IC and GC Incubators

Appendix

A. Test Equipment and Special Tools

Digital Multimeter	B&K Model No. 2815 (0175-2273-000) or equivalent
Oscilloscope	B&K Model No. 1477, 15 MHz Dual Trace Scope (0175-2302-000) or equivalent
Leakage Current Tester	Ohio Part No. 0175-2284-000 with AAMI test load or equivalent
Incubator Temperature Simulator	Ohio Part No. 0220-1114-800
Test Cable for Simulator	Ohio Part No. 0220-1117-800
Hood and Counterbalance Centering Tool	Ohio Part No. 0175-2314-000
Static Control Work Station	Ohio Part No. 0175-2311-000
Jumper Wire	24 inch, 18 gauge wire with alligator clips on each end. For use with static control work station.
Patient Probe Test Lead	40 inch, 24 gauge speaker wire with a miniature phono plug (Switchcraft No. 750 or Radio Shack No. 274-286) on both ends.
IC Extraction & Insertion Tool	OK Machine & Tool Corporation, Insertion and Extraction Kit, Model WK-7 or equivalent.
Torque Wrench	(60 in. lb. and 150 in. lb. measurements are required)
Calibration Thermometer Kit (Kit Includes Thermometer & Sheath)	Ohio Part No. 0217-2999-800 Accuracy ±0.1C, NBS traceable
Calibration Thermometer Only	Ohio Part No. 0205-8827-300 Accuracy ±0.1C, NBS traceable
Stopwatch	
Pin Extraction Tool	Amp Part No. 305-183
Pin Extraction Tool	Amp Part No. 465644-1 (for Mate-N-Lok connectors) Ohio Part No. 0175-2351-000
Loctite #242	Ohio Part No. 0220-5016-300 (Medium strength, 50cc)
Loctite #271	Ohio Part No. 0220-5021-300 (High strength, 10cc)
Loc Quic Primer	Ohio Part No. 0220-5045-300 (Grade T, 6 oz.)
Vac-Kote	Ohio Part No. 0220-0091-300 (1 oz.)
5/32 Ball Headed Hex Driver	Xcelite® LN - 25BP or equivalent (For removal of heater on some units)
Lower Unit Support Material	Use Template (0217-2823-300) for lower unit support
Low Voltage Test Cable (Display Board to Control Board)	Ohio Part No. 0690-1230-316
¼ inch Drive Universal Joint	For removal of heater on most units
¼ inch Drive 3/8 inch Socket	
¼ inch Drive 3 inch Extension	
¼ inch Drive Ratchet	

Appendix

B. Temperature Conversion Chart

°C	°F	°C	°F	°C	°F
20.0	68.0	34.5	94.1	37.6	99.7
21.5	70.7	35.0	95.0	37.7	99.9
22.0	71.6	35.1	95.2	37.8	100.0
22.5	72.5	35.2	95.4	37.9	100.2
23.0	73.4	35.3	95.5	38.0	100.4
23.5	74.3	35.4	95.7	38.1	100.6
24.0	75.2	35.5	95.9	38.2	100.8
24.5	76.1	35.6	96.1	38.3	100.9
25.0	77.0	35.7	96.3	38.4	101.1
25.5	77.9	35.8	96.4	38.5	101.3
26.0	78.8	35.9	96.6	38.6	101.5
26.5	79.7	36.0	96.8	38.7	101.7
27.0	80.6	36.1	97.0	38.8	101.8
27.5	81.5	36.2	97.2	38.9	102.0
28.0	82.4	36.3	97.3	39.0	102.2
28.5	83.3	36.4	97.5	39.5	103.1
29.0	84.2	36.5	97.7	40.0	104.0
29.5	85.1	36.6	97.9	40.5	104.9
30.0	86.0	36.7	98.1	41.0	105.8
30.5	86.9	36.8	98.2	41.5	106.7
31.0	87.8	36.9	98.4	42.0	107.6
31.5	88.7	37.0	98.6	42.5	108.5
32.0	89.6	37.1	98.8	43.0	109.4
32.5	90.5	37.2	99.0	43.5	110.3
33.0	91.4	37.3	99.1	44.0	111.2
33.5	92.3	37.4	99.3	44.5	112.1
34.0	93.2	37.5	99.5	45.0	113.0

C. Air Safety Sensor Characteristics

Temperature °C	Resistance Ohms
25	100,000
26	95,320
27	90,880
28	86,670
29	82,680
30	78,890
31	75,290
32	71,880
33	68,630
34	65,550
35	62,630
36	59,850
37	57,200
38	54,690
39	52,300
40	50,030
41	47,860
42	45,800
43	43,840
44	41,980
45	40,200
46	38,510
47	36,890
48	35,350
49	33,890
50	32,490

D. Patient Probe and Wall Sensor Characteristics

Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms
29.9	8049.1	34.0	6778.1	38.0	5731.3	42.0	4845.3
30.0	8015.4	.1	6749.8	.1	5707.3	.1	4825.0
.1	7981.9	.2	6721.5	.2	5683.5	.2	4804.8
.2	7948.5	.3	6693.4	.3	5659.7	.3	4784.6
.3	7915.2	.4	6665.4	.4	5636.0	.4	4764.6
.4	7882.1	.5	6637.5	.5	5612.4	.5	4744.6
.5	7849.2	.6	6609.8	.6	5588.9	.6	4724.7
.6	7816.3	.7	6582.1	.7	5565.4	.7	4704.9
.7	7783.7	.8	6554.6	.8	5542.1	.8	4685.1
.8	7751.1	.9	6527.1	.9	5518.9	.9	4665.5
.9	7718.7	35.0	6499.8	39.0	5495.8	43.0	4645.9
31.0	7686.4	.1	6472.6	.1	5472.8	.1	4626.4
.1	7654.3	.2	6445.6	.2	5449.9	.2	4607.0
.2	7622.2	.3	6418.6	.3	5427.1	.3	4587.7
.3	7590.4	.4	6391.7	.4	5404.3	.4	4568.5
.4	7558.6	.5	6365.0	.5	5381.7	.5	4549.3
.5	7527.0	.6	6338.3	.6	5359.1	.6	4530.2
.6	7495.5	.7	6311.8	.7	5336.7	.7	4511.2
.7	7464.2	.8	6285.4	.8	5314.3	.8	4492.3
.8	7432.9	.9	6259.1	.9	5292.1	.9	4473.4
.9	7401.9	36.0	6232.9	40.0	5269.9	44.0	4454.6
32.0	7370.9	.1	6206.8	.1	5247.8	.1	4436.0
.1	7340.1	.2	6180.9	.2	5225.8	.2	4417.3
.2	7309.4	.3	6155.0	.3	203.9	.3	4398.8
.3	7278.8	.4	6129.2	.4	5182.1	.4	4380.3
.4	7248.3	.5	6103.6	.5	5160.4	.5	4361.9
.5	7218.0	.6	6078.0	.6	5138.8	.6	4343.6
.6	7187.8	.7	6052.6	.7	5117.3	.7	4325.4
.7	7157.8	.8	6027.3	.8	5095.8	.8	4307.3
.8	7127.8	.9	6002.0	.9	5074.5	.9	4289.2
.9	7098.0	37.0	5976.9	41.0	5053.2	45.0	4271.2
33.0	7068.3	.1	5951.9	.1	5032.0		
.1	7038.8	.2	5927.0	.2	5010.9		
.2	7009.3	.3	5902.2	.3	4989.9		
.3	6980.0	.4	5877.4	.4	4969.0		
.4	6950.8	.5	5852.8	.5	4948.2		
.5	6921.7	.6	5828.3	.6	4927.4		
.6	6892.8	.7	5803.9	.7	4906.8		
.7	6863.9	.8	5779.6	.8	4886.2		
.8	6835.2	.9	5755.4	.9	4865.7		
.9	6806.6						

Appendix

E. Lower Unit Support Material

Description:
Two supports are required for the removal of the tilt mechanism and the lower unit. Use the template (Ohio Part No. 0217-2823-300) to construct the lower unit support required for those repairs.

Material:
½ inch plywood
Three wood dowels, approximately ½ inch diameter and 25 inches long

Directions:
1. Use a scissors and cut out the outline of the template.

2. Place the template on the plywood to be used.

3. Flatten the template as much as possible. Smooth out the creases and tape the template to the support material with drafting tape.

4. Use a pen or pencil and trace the outline of the template on the plywood.

5. Carefully remove the template from the support material and save it for future use.

6. Follow the outline of the template and cut out the plywood support.

7. Repeat steps 2 through 6 for the opposite support.

8. Cut three 25 inch long, ½ inch diameter wood dowels. Measure the diameter of the wood dowel and drill three holes of the exact dowel size in each plywood support. (The dowel must provide a tight fit in the plywood.) See Figure A-1 for the approximate location of each hole.

9. Assemble the lower unit support as shown in Figure A-1.

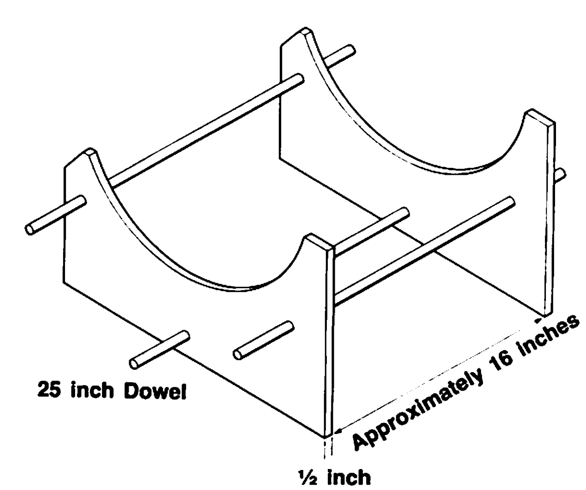
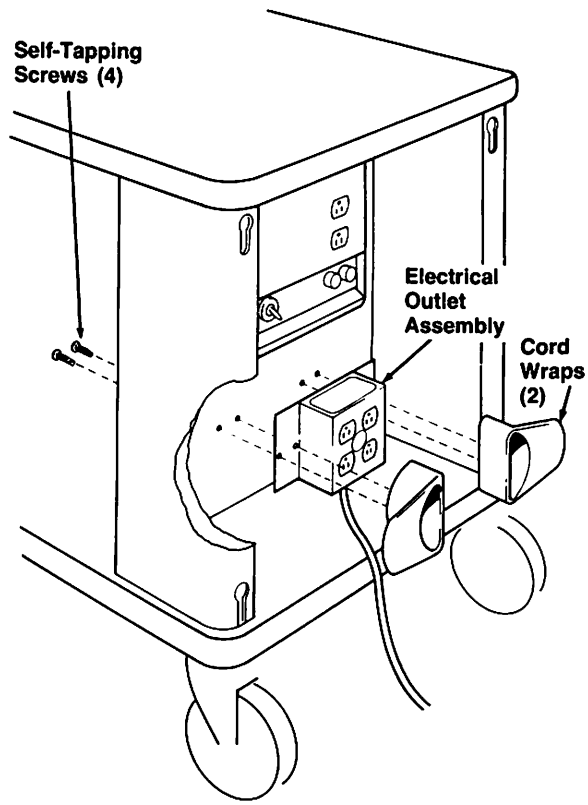


Figure A-1
Lower Unit Support

F. Electrical Outlet Accessory Kit Stock No. 0217-2991-800



1. Remove cord wraps.
2. Install outlet enclosure and cord wraps using screws removed earlier.

Figure A-2

Appendix

G. Drawer Accessory Kit with Slides Stock Number 0217-2993-871

CAUTION: Electrical shock hazard. Disconnect power to incubator and accessories.

NOTE: If the cabinet is equipped with the Electrical Outlet Accessory Kit, the outlet box must be removed to install drawer slides. Replace after installation of drawer slides.

1. Remove screws (A) securing Main Control Unit. Slide Main Control Unit out until rear is flush with cabinet edge. **CAUTION: The circuit boards installed in this Control Unit contain components which are subject to static discharge. Appropriate precautions should be observed to avoid damaging these components while performing this installation.**

Install Drawer Slides to side panels with (18) #6-32x¼" screws (B) (0144-6624-104), #6 lockwashers (C) (0202-3412-300) and #6-32 nuts (D) (0144-3324-113) provided. NOTE: Position slides with rollers on top and toward front of cabinet. Left slide is identified by notch.

3. Replace Main Control Unit to original position and retain with screws removed earlier (A).

4. Loosen (6) screws (E) from back of cabinet three turns. Slide (2) Panel Mounting Brackets (0214-2258-500) in position and secure with screws loosened earlier (E). Note position of chamfered corners shown on illustration.

5. Secure End Panel (0214-2257-500) to brackets with (6) screws (F) (0142-2313-205) provided. Install Drawers: smallest Drawer must be at top.

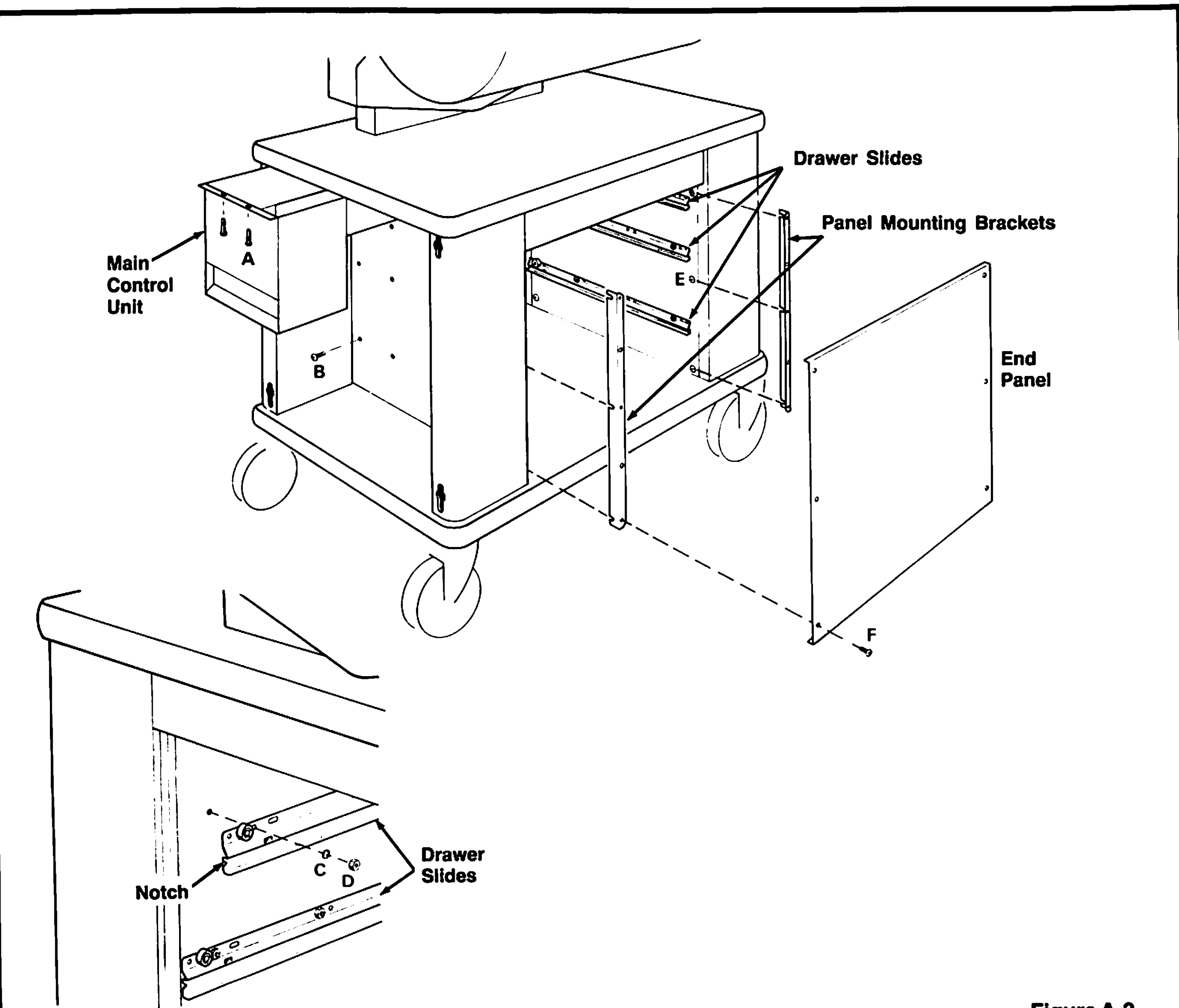


Figure A-3

Service Notes

A. Old Style Control Board Modification to Accept 2732 EPROM

Background:

If a 2716 EPROM fails it must be replaced by a 2732 EPROM. The old style control board (artwork revision 3 or before) must also be modified to accept the 2732 EPROM. The 2732 EPROM is available only in a replacement kit (Ohmeda part number 0228-4003-880). The modification procedure should only be done to the old style control board using the 2716 EPROM.

Also check that capacitor C20 has been added to the control board between the crystal and ground. See Figure S-1.

Modification Procedure:

1. Set up the static control work station.

2. Place the power switch in the OFF position.

3. Disconnect the incubator power cord.

4. Remove the control board to be modified from the incubator. See Section 9J. Control Board Replacement.

5. Place the foil side of the control board up.

6. Cut the trace between U6 pin 21 and U6 pin 24 as shown in Figure S-1.

7. Add a solid jumper between U6 pin 21 and the unused solder pad next to it as shown in Figure S-1.

8. Place the component side of the control board up.

9. Add an insulated jumper between U6 pin 12 and the unused solder pad on the trace coming from connector J4 pin 7 as shown in Figure S-2.

10. Carefully remove the 24 pin EPROM labeled U6 from the board. Note the pin 1 location.

11. Install the new 2732 EPROM in the U6 position on the board. Be sure that pin 1 of the IC is connected to pin 1 of the socket. Install the Control Board in the incubator. See Section 9J. Control Board Replacement.

12. Perform the Functional Checkout and Electrical Safety Checks.

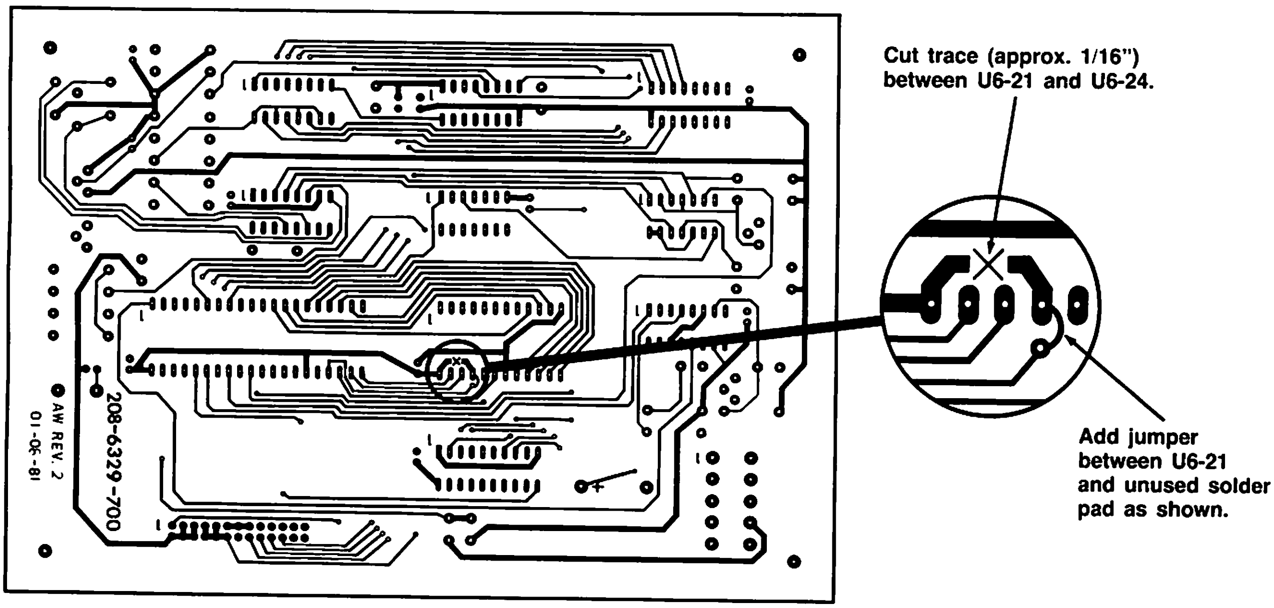


Figure S-1
Control Board, Foil Side

Service Notes

B. Addition of 2 (1 Nanofarad) Capacitors to Earlier Version Power Supply Board.

Background:

In countries that have non-polarized power outlets the following condition has been noted on rare occasions. When the incubator is connected to a non-polarized power outlet the incubator heater could remain fully on with a continuous high temperature alarm. On these rare occasions the air safety alarm circuit has remained operative. This condition can be corrected by adding 2 (1 Nanofarad) capacitors to the earlier version power supply circuit board as described in the following procedure.

Capacitor Installation Procedure:

1. Set up the static control work station.

2. Place the power switch in the OFF position.

3. Disconnect the incubator power cord.

4. Remove the power supply board to be modified from the incubator. See Section 9K. Power Supply Board Replacement.

5. Place the foil side of the control board up.

6. Add a 1 nanofarad capacitor between pin 4 and pin 6 of U5. Place the capacitor close to the circuit board to allow adequate clearance when reinstalling the circuit board.

7. Add a 1 nanofarad capacitor between pin 4 and pin 6 of U4. Place the capacitor close to the circuit board to allow adequate clearance when reinstalling the circuit board.

8. Install the Power Supply Board in the incubator. See Section 9K. Power Supply Board Replacement.

9. Perform the Functional Checkout and Electrical Safety Checks.

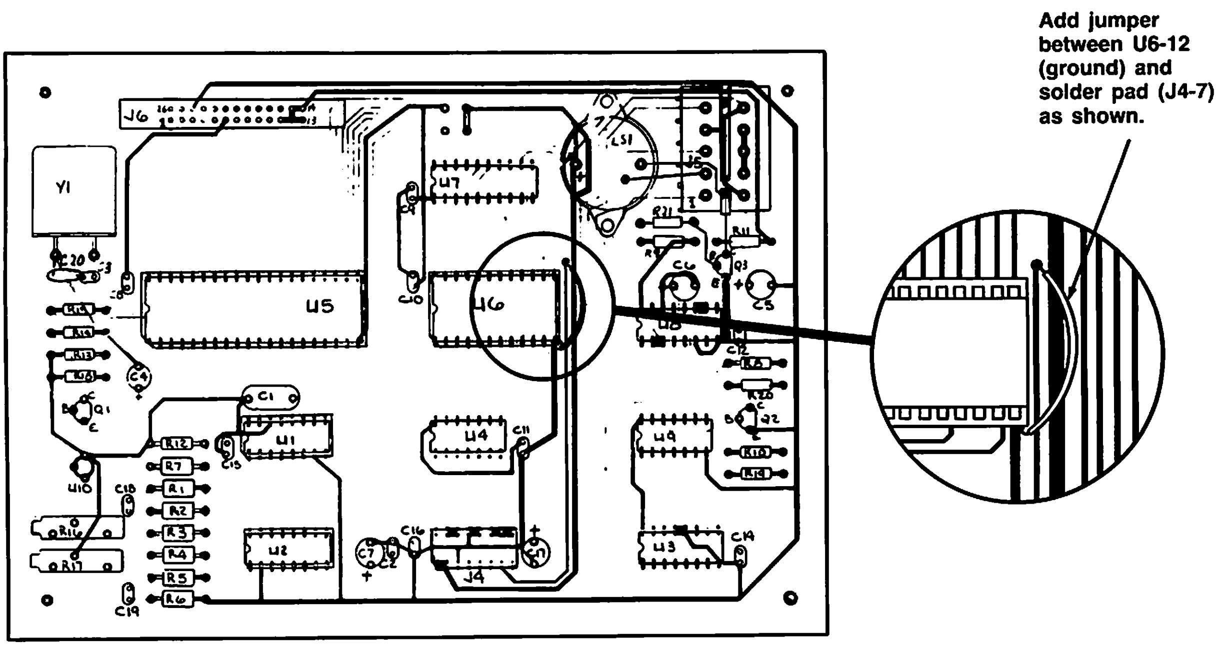


Figure S-2
Control Board, Component Side

Service Notes

C. Lower Unit Support Material

Description:
Two supports are required for the removal of the tilt mechanism and the lower unit. Use the template (Ohio Part No. 0217-2823-300) to construct the lower unit support required for those repairs.

Material:
½ inch plywood
Three wood dowels, approximately ½ inch diameter and 25 inches long

Directions:
1. Use a scissors and cut out the outline of the template.
2. Place the template on the plywood to be used.
3. Flatten the template as much as possible. Smooth out the creases and tape the template to the support material with drafting tape.
4. Use a pen or pencil and trace the outline of the template on the plywood.
5. Carefully remove the template from the support material and save it for future use.
6. Follow the outline of the template and cut out the plywood support.
7. Repeat steps 2 through 6 for the opposite support.
8. Cut three 25 inch long, ½ inch diameter wood dowels. Measure the diameter of the wood dowel and drill three holes of the exact dowel size in each plywood support. (The dowel must provide a tight fit in the plywood.) See Figure A-1 for the approximate location of each hole.
9. Assemble the lower unit support as shown in Figure S-3.

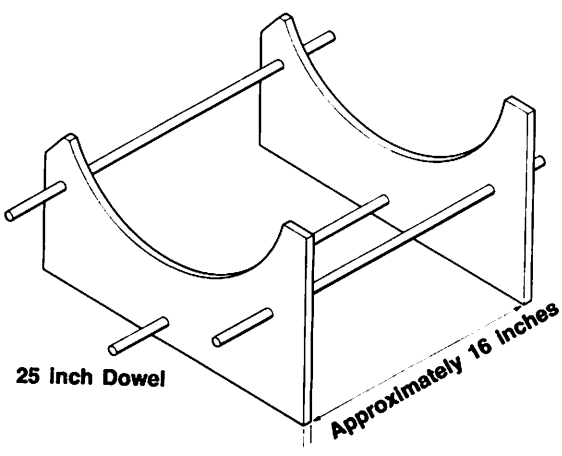
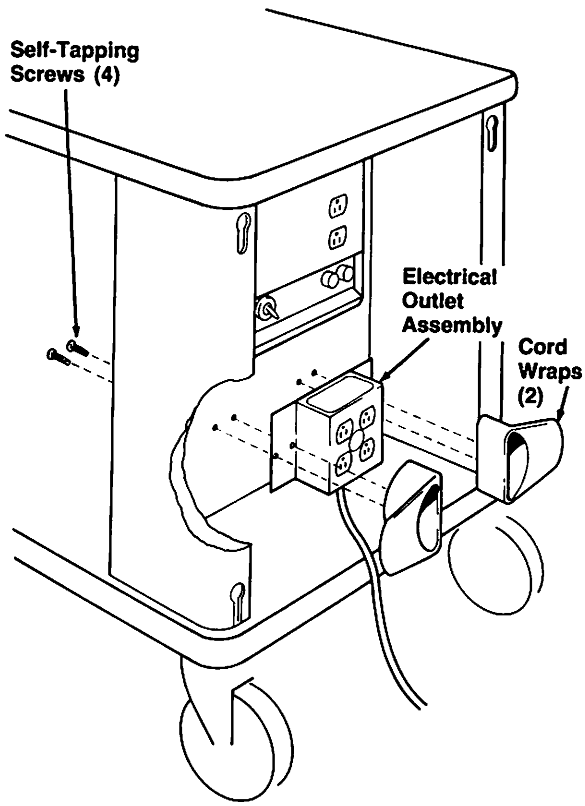


Figure S-3
Lower Unit Support

D. Electrical Outlet Accessory Kit Stock No. 0217-2991-800



1. **Remove cord wraps.**
2. **Install outlet enclosure and cord wraps using screws removed earlier.**

Figure S-4

Service Notes

E. Drawer Accessory Kit with Slides Stock Number 0217-2993-871

CAUTION: Electrical shock hazard. Disconnect power to incubator and accessories.

NOTE: If the cabinet is equipped with the Electrical Outlet Accessory Kit, the outlet box must be removed to install drawer slides. Replace after installation of drawer slides.

1. Remove screws (A) securing Main Control Unit. Slide Main Control Unit out until rear is flush with cabinet edge. **CAUTION: The circuit boards installed in this Control Unit contain components which are subject to static discharge. Appropriate precautions should be observed to avoid damaging these components while performing this installation.**

Install Drawer Slides to side panels with (18) #6-32x¼" screws (B) (0144-6624-104), #6 lockwashers (C) (0202-3412-300) and #6-32 nuts (D) (0144-3324-113) provided. NOTE: Position slides with rollers on top and toward front of cabinet. Left slide is identified by notch.

3. Replace Main Control Unit to original position and retain with screws removed earlier (A).

4. Loosen (6) screws (E) from back of cabinet three turns. Slide (2) Panel Mounting Brackets (0214-2258-500) in position and secure with screws loosened earlier (E). Note position of chamfered corners shown on illustration.

5. Secure End Panel (0214-2257-500) to brackets with (6) screws (F) (0142-2313-206) provided. Install Drawers: smallest Drawer must be at top.

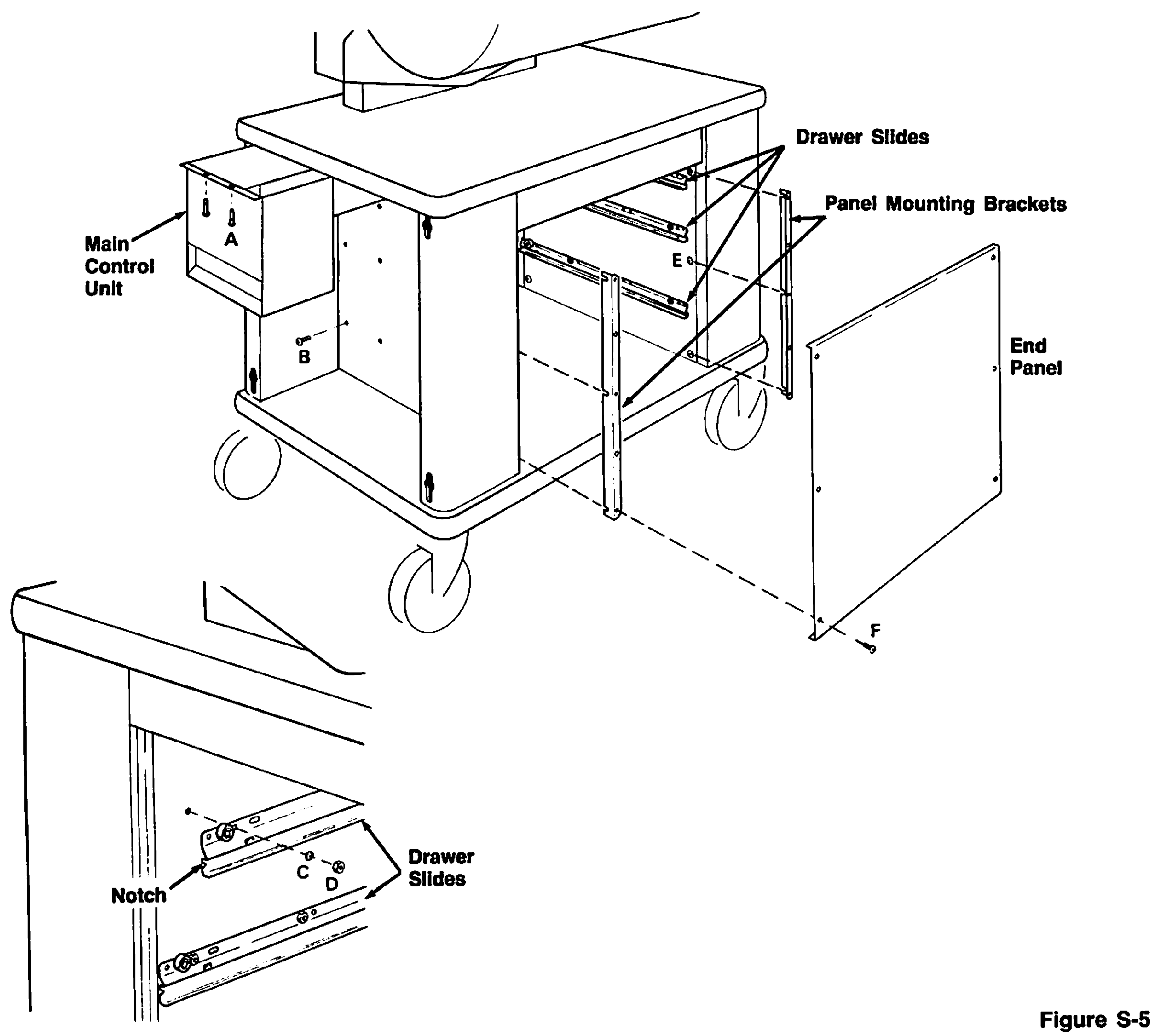


Figure S-5

Ohmeda

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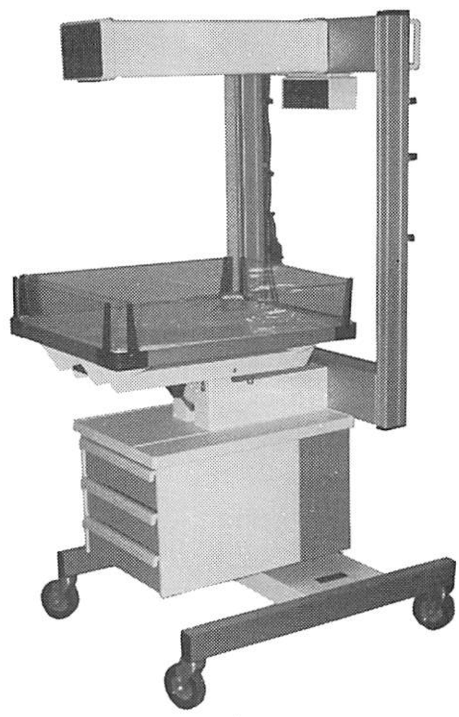
Printed in USA

BOC Health Care

Ohmeda

5000 Infant Warmer System
Service Manual



BOC Health Care

CONTENTS

Important:

The information contained in this manual pertains only to those models of products which are marketed by Ohmeda as of the effective date of this manual or the latest revision thereof. This manual was prepared for exclusive use by Ohmeda service personnel in light of their training and experience and the availability to them of proper tools and test equipment. Consequently, Ohmeda provides this manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that customer has received said information from Ohmeda does not imply in any way that Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstance may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review and customers are cautioned to obtain and consult the latest revision thereof and suggestions are invited from our customers for consideration by Ohmeda with these periodic reviews.

WARNING: After completing a repair of the infant warmer system the appropriate calibration procedure must be performed to make sure the infant warmer system is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

WARNING: After completing any portion of the calibration and adjustments procedure for the infant warmer system the checkout procedure must be performed to make sure the infant warmer system is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

CAUTION: Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

(X) CAUTION: This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

WARNING: Use of electrosurgical units or other electrical field radiating equipment can affect the operation of the Radiant Warmer system. Do not allow excess electrosurgical cables to be laid on the warmer table.

WARNING: Use of electrosurgical units or other electrical field radiating equipment can cause indirect heating of the thermistor probe, by several tenths of a degree, through absorbed electrical energy. Operate the Infant Warmer system in the Manual Mode for maximum safety when these conditions are present.

REPAIR POLICY:

Note: Service must be performed by a "Technically Competent" individual.

Do not use malfunctioning equipment. Make all necessary repairs, or have the equipment serviced by an Authorized Ohmeda Service Representative. After repair test the equipment to ensure that it is functioning properly, in accordance with manufacturer's published specifications.

To ensure full reliability, have all repairs and service done by an authorized Ohmeda Service Representative. If this cannot be done, replacement and maintenance of those parts listed in this manual may be undertaken by a competent, trained individual having experience in the repair of this type of equipment.

CAUTION: No repair should ever be undertaken or attempted by anyone not having such qualifications.

Replace damaged parts with components manufactured or sold by Ohmeda. Then test the unit to ascertain that it complies with the manufacturer's published specifications.

Contact the nearest Ohmeda Service Office for service assistance. If you send the unit to the Ohmeda Service Center, package it securely in the original shipping container, if possible, and ship it prepaid. Enclose a letter with the unit describing in detail any difficulties experienced and the repairs felt necessary. In all cases, other than where Ohmeda's warranty is applicable, repairs will be made at Ohmeda's current list price for the replacement part(s) plus a reasonable labor charge.

CAUTION: Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda.

TECHNICAL COMPETENCE

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should be undertaken only by competent individuals who have a general knowledge of and experience with devices of this nature.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

DEFINITIONS

Note: A note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note but used for greater emphasis.

CAUTION: A CAUTION statement is used when the possibility of damage to the equipment exists.

WARNING: A WARNING statement is used when the possibility of injury to the patient or the operator exists.

PRECAUTIONS

Warnings:

After completing a repair of the infant warmer system the appropriate calibration procedure must be performed to make sure the infant warmer system is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

After completing any portion of the calibration and adjustments procedure for the infant warmer system the checkout procedure must be performed to make sure the infant warmer system is in proper operating condition. In addition a final electrical safety check and leakage current test must be performed. Record the information for future reference.

Use of electrosurgical units or other electrical field radiating equipment can affect the operation of the Radiant Warmer system. Do not allow excess electrosurgical cables to be laid on the warmer table.

Use of electrosurgical units or other electrical field radiating equipment can cause indirect heating of the thermistor probe, by several tenths of a degree, through absorbed electrical energy. Operate the Infant Warmer system in the Manual Mode for maximum safety when these conditions are present.

If the bed level is greater than or less than 27 +/- 2 inches, the Infant Warmer System will not operate properly.

Overloading the shelves can affect the stability of the unit.

Do not perform the Check-Out Procedure while a patient occupies the Infant Warmer System.

Use extreme care while performing calibration and adjustment procedures, or while working on the 5000 Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

When ever lowering or lifting the Infant Warmer System to its side, use two people for safety.

Whenever the unit must be laid on its side for a repair procedure, lay it on the right side (as viewed from the front), the lamp-house assembly swings freely to the left and attempting to lay the unit on the left side could cause injury to a repair person or damage to the equipment.

Observe all safety precautions to avoid electrical shock hazard from high voltage.

Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote* is the oxygen service lubricant recommended (Order No. 0220-0091-300).

Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

When replacing gauges, be sure to use identical pressure ranges.

Do not use oil or oil bearing materials on or near the regulator. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. All metallic parts of the regulator must be discarded if contaminated with oil or grease.

Cautions

Servicing of this product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision of this service manual which is clearly and thoroughly understood.

This static control precaution symbol appears throughout this manual. When this symbol appears next to a procedure in this manual, static control precautions MUST be observed. Use the static control work station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground and not through static sensitive devices.

No repair should ever be undertaken or attempted by anyone not having such qualifications.

Detailed drawings and procedures for more extensive repairs are included herein solely for the convenience of users having proper knowledge, tools, and test equipment, and for service representatives specially trained by Ohmeda.

Insulation on the electrical wiring can deteriorate with age. Check for brittle or deteriorated insulation on the power cord and all other electrical wires.

Use the Static Control Work Station (Part No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

Do not idle the motor at these stop positions; equipment damage may result.

Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the alarm light.

Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the examination light. The lamp normally operates at a high temperature.

When lowering or lifting the Infant Warmer System to the floor for inspection or repair, use two people for safety. Always check to ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater housing does not lock and pivots to the left for bed access.

Take care to ensure that the tension on the spring is released carefully.

Depending on the position of the upper column in relation to the lower column, the springs could be heavily or lightly tension loaded. Use care when releasing the springs.

For safety have at least 2 people available to replace a caster.

1/ FUNCTIONAL DESCRIPTION

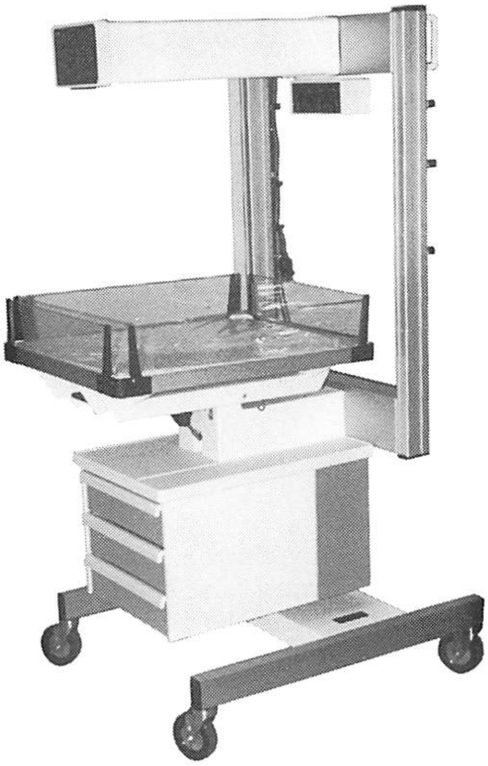


Figure 1-1. Ohmeda 5000 Infant Warmer System

A. POWER SUPPLY BOARD

This is a functional description for the Infant Warmer System Power Supply Board Part No. 0631-5028-700. Refer to Schematic No. 6600-0004-100 for a detailed circuit diagram.

The power supply board contains circuitry for the control and monitoring of line voltage devices. The board also provides power to the control board and the display board. Also found on the board is a line voltage sensing circuit that provides an indication of line voltage magnitude to the microcontroller.

The control circuits for each line voltage device on the power supply board are functionally identical with a logic HIGH signal from the control board switching ON the desired device. This is performed with an isolator so low/line voltage circuits can interact but remain electrically isolated (2500 volt dielectric).

The heater is controlled from the supply board with a solid state relay switching line voltage. There is also an electro-mechanical relay contact connected in series with the neutral to the solid state relay. This is used to switch OFF the heater if the solid state relay fails or there is a failure on the control board.

The regulator circuits provide a +5 vdc supply to the display board and +5 vdc, and +9 vdc, supplies to the control board. A NI-CAD battery supplies the 5 vdc supply and a de-rated 9 vdc supply for standby power, in the case of a power loss. Standby power of 9 volts is used to activate the transducer alarm, while the 5 volt supply provides power to the microcontroller and associated IC's for memory retention purposes.

5 VOLT LEDS

A nominal 8 vac is input to the power supply board at J11 pins 3 and 4. The line frequency is also connected to the control board via J12 pin 2. The bridge rectifier CR2 and capacitor C11 provide a filtered unregulated 8 vdc to the relay, opto-isolators, and the regulator VR2. The 8 vdc unregulated supply can be measured at TP-1. The unregulated supply must be a minimum of 7.32 volts for proper operation of the relay circuit.

The output of regulator VR2 is nominally +5 vdc and supplies power to drive the LED displays on the display board. The output is measurable at TP-10 (J12, Pin 12). When the supply voltage is within 10% of nominal, the output voltage should be between 4.8 and 5.2 volts dc with a maximum load of 500 ma. The maximum allowable ripple voltage is 150 millivolts.

LINE VOLTAGE SENSING

A voltage of approximately 11 vac from the transformer secondary is input to the board at J11 pins 1 and 2. Bridge rectifier CR1 and capacitor C12 provide a full wave, filtered voltage of approximately 12 vdc. Variable resistor R3 is preset to produce an output of approximately 0.6 volts at J12 pin 11 (TP-11) when the line voltage is at the nominal value for the unit. The analog voltage signal at J12 Pin 11 connects to the control board and is fed into the A/D Converter, ADC 3711 (U6), via the multiplexer, MC14051B (U-13). The digital output of the A/D converter is input to the microcontroller where the measured value determines the duration of power pulses to the heater to compensate for variations in line voltage.

9 VOLT STANDBY

The output of regulator VR3 is adjusted by R4 to provide 9.0 +/- 0.2 volts (TP12). This voltage is used for charging the NI-CAD battery, and supplying the input voltage to the +5 vdc standby regulator.

5 VOLT STANDBY

When line voltage is available, current flows from the output of VR3 and through CR5 to provide 9.0 +/- 0.2 volts to the input of VR4, and to J12 pin 3 (TP-12). In turn, regulator VR4 outputs a voltage of 5.0 +/- 0.2 volts to J12 pin 14 (TP-9) with a maximum ripple voltage of 150 millivolts.

If power loss occurs with the unit switched ON, the 7.2 volt NI-CAD battery maintains a de-rated output voltage of approximately 6.5 volts to pin 3 of J12 (TP-12). It also provides input to VR4.

Note: The output of VR4 only regulates to approximately 5.0 volts as the input voltage drops below 7.0 volts.

HEATER CONTROL AND STATUS

The heater circuitry consists of a controller for the heater, a monitoring circuit, and a relay to switch OFF the heater in the event of a relay or system failure.

The heater control circuit uses a solid state relay to isolate the line voltage from the low voltage circuits. Operation of the heater control and other line voltage controls differ only in the type of isolator used and the use of snubber circuits. When a logic HIGH signal is sent to the heater control circuit from J12 pin 9 the output of the solid state relay will not switch ON until the ac signal of the heater crosses the zero potential from a negative voltage. After the input line from the microcontroller goes LOW, heat will not switch OFF until the first zero crossing preceded by the negative half cycle. This provides zero voltage crossing control of the heater switching. The time that the heater is ON depends on the percent heat desired (controllable in 5% increments).

The microcontroller also monitors the line voltage and adjusts the number of ac cycles that the heater is switched ON. This provides heater power compensation. If the line voltage is not at the nominal value, the combination of percentage power settings and power compensation can produce 60 durations of heater power pulses.

The full wave bridge rectifier CR6 takes a low voltage sample (through R 13) of the ac signal supplied to the heater and provides rectified dc to the opto-isolator U3. If the heater is ON the dc output switches ON the LED in the opto-isolator, except at voltage levels below the forward bias voltage. When the LED is ON the transistor goes into saturation causing the output at J12 pin 1 to go LOW (about 0.3 volts). When the heater is OFF the dc bridge output is in the region of zero potential and there is insufficient forward bias voltage for the LED. This switches OFF the transistor allowing capacitor C10 to charge and causes J12 pin 1 to go high (5 volts). When the heater is switched ON the LED switches the transistor ON again, and the capacitor discharges. The low output shows small glitches caused by the charge/discharge of the capacitor at every half cycle. The glitches are acceptable provided they do not exceed the trigger voltage of 1.4 volts for the 74LS132 on the Control Board.

RELAY

The relay circuit is used to switch OFF the heater in the event of a triac or microcontroller failure. Under normal conditions the input line from J12 pin 10 is a logic HIGH, 2.4 volts minimum. A logic HIGH signal on the input from the control board switches ON the FET causing the relay coil to energize and close the relay contacts. If the FET input is a LOW from the control board, (0.5 volts max.) the FET switches OFF and the relay contacts open. The signal at J12 pin 10 comes from U1 on the control board which is a part of a logic/timing circuit independent of the microprocessor

A minimum voltage of 7.2 volts is required to energize the relay coil. Therefore the minimum allowable voltage for the 8 volt unregulated supply is 7.32 volts since the FET has an internal voltage drop of 0.12 volts.

MOTOR UP/DOWN CONTROL

The bed up/down movement is controlled by separate raise bed or lower bed signals. When the raise bed or lower bed switch is selected the logic high control signal (J12 pin 5 for raise and J12 pin 6 for lower) is buffered by an FET (U2 pin 5 for raise, U2 pin 3 for lower) which powers an opto-isolater. The output of the opto-isolator (U6 for raise, U5 for lower) triggers the triac gate (Q4 for raise, Q3 for lower) which then switches the neutral supply for the motor. The motor is a combination inductive, capacitive and resistive load which requires a snubber network to minimize switching noise. This is achieved by R21/C17 for raise bed and R18/C16 for lower bed signals. Note; when the bed is raised or lowered the heater control signal is inhibited, stopping heater power to minimize the units total current until the movement is completed.

ALARM LIGHTS CONTROL

The alarm lights are controlled by a triac switching line voltage to the lamps. If the control lines are logic LOW, less than 0.45 volts, this keeps the FET, triac driver, and triac switched OFF. The triac acts as a switch to the line voltage circuit, removing voltage from the load.

When the lamps should be switched ON, a logic HIGH of 2.4 volts minimum is output to the corresponding U1, Pin 10 FET. The FET switches ON causing the LED of the isolator-driver (U8) to switch on. The isolator/driver output drives sufficient current to the triac gate, switching the triac (Q5) ON allowing the alarm lights to switch ON. The alarm light is a resistive load and does not have a snubber circuit in parallel with the load.

OBSERVATION LAMP CONTROL

The observation lamp is controlled by a relay which switches line voltage to a transformer outputting 12 vac to the lamp. The FET U1 pin 5 buffers the microprocessor control signal and switches the control relay. The 12 volts ac powers the observation lamp which is rated at 12 volts 50 watts.

B. CONTROL BOARD

This is a functional description for the Infant Warmer System Control Board Part No. 6600-0048-700. Refer to Schematic No. 6600-0059-100 for a detailed circuit diagram. See Section 8.

The control board contains electronic circuitry involved with the measurement, control, computation, memory, logic, and decision making functions of the Infant Warming System. The principle IC on this board is the 8031 single component, 8-bit microcontroller. The 8031 has: an internal read/write memory (RAM)of 128 bytes, 32 I/O lines configured as four 8-bit parallel ports, two 16-bit timers, a five source two priority nested interrupt, a programmable serial I/O port, and an on-chip oscillator with clock circuitry. The program memory is stored in a 2764 64k bit (8k x 8), or a 27128 128K bit (16k x 8) UV EPROM. An octal transparent latch (74LS373) is connected to address inputs of the EPROM to permit the use of the bi-directional data bus port of the microcontroller for addressing the EPROM and receiving program instructions.

Four ICs with a network of precision resistors are used to interface the microcontroller. The temperature sensor, calibration resistors, or line voltage scaler are selected by an MC14051B 8 Channel Multiplexer. An LM-10 precision reference with adjustable reference buffer, and on-board operational amplifier furnishes a stable reference supply. This is required by the temperature measurement circuits and the ADC 3711 Analog to Digital Converter. An 8243 I/O expander is used to interface the microcontroller with the multiplexer and the A/D converter.

The control board is also equipped with several ICs that form the triac watchdog circuit, watch-dog timer, and the audio alarm tone generator. The audio transducer for the alarm signals and its driver circuit are also included on the control board.

Detailed operation of the circuits listed in the preceding paragraph is explained in the following sections.

ANALOG TO DIGITAL CONVERTER

Temperatures are measured using a negative temperature coefficient thermistor that is calibrated for specific resistance values and interchangeability. Analog voltage signals inversely proportional to temperature are derived from a voltage divider network consisting of a 5.76k +/- 0.1% resistor in series with the temperature sensor. The voltage source for the measuring circuit is obtained from the LM-10's internal precision reference source of 200 mv amplified to a nominal 1.0 volts by the reference buffer of the LM-10. The Op-amp portion of the LM-10 provides an adjustable reference of 2.0 volts nominally, which is required by the A/D converter, U6. In addition to the patient probe, there are three other voltage divider networks on the control board. Two have fixed output and are used for calibration check points of the A/D system at 25.0 and 37.9 degrees C. The third divider network is unused.

A separate input to the control board A/D circuit comes from the line voltage monitor network located on the power supply board.

The outputs of all the voltage dividing networks are connected to individual switch input terminals of U13, the MC14051B Analog Multiplexer. The MC14051B contains eight normally open switches with a common output terminal. The common output of the MUX (pin 3) is tied through R9 to the analog input (pin 9)of the A/D converter. The microcontroller selects which sensor is to be measured by toggling the control lines, pin 11(A), pin 10(B), and pin 9(C) of the MUX via the 8243 #2, U5. The following table shows the digital codes used to select the individual switches of the MUX:

CONTROL INPUTS A B C	ON SWITCHES	PIN NO.	
0 0 0	X0	13	calibration value 25C
0 0 1	X1	14	calibration value 37.9C
0 1 0	X2	15	line voltage monitor
0 1 1	X3	12	unused
1 0 0	X4	01	patient probe
1 0 1	X5	05	unused
1 1 0	X6	02	unused
1 1 1	X7	04	unused

Note: Inhibit terminal (pin 6) of the MUX has no effect on the switch selection because it is tied LOW through R19 (200 ohms).

The ADC 3711, U6, uses a pulse modulation analog to digital conversion technique. The conversion rate is set by the frequency of an internal oscillator whose frequency is determined by the external components R4 and C14. The exact oscillator frequency is not critical and may vary by +/- 15% from the nominal 400 kHz. The oscillator frequency may be measured on pin 18 of U6. With a nominal 400 kHz clock frequency, conversions within the ADC 3711 will take place at an approximate rate of 3 per second.

The ADC 3711 will output BCD data on demand in accordance with the coded digital signals applied to the digit select inputs D0 and D1, pins 20 and 21 respectively. The data latch enable is tied LOW, therefore, the BCD data of the A/D converter will be output to the microcontroller through 8243 #2 in conformance to the following codes that are applied to the digit select inputs:

D0	D1	SELECTED DIGIT
L	L	Digit 0 LSD
L	H	Digit 1
H	L	Digit 2
H	H	Digit 3 MSD

Note: The magnitude of the selected digit is present at pins 3, 4, 23 and 24.

The ADC 3711 is continuously converting the analog voltage present at its input to a number of counts between 0 and 3999 (BCD format). Therefore, the start conversion, input at pin 7, and the conversion complete, output at pin 6, are misnomered. The start conversion input only controls the transfer of information from the internal counter to the digital latches. The conversion complete output goes to a logic LOW on the rising edge of the start conversion pulse which is issued by the microcontroller. The conversion complete will go to a logic HIGH sometime later when the new conversion information has been transferred to the display latches. The start conversion pulse may occur at any time in the conversion cycle because the microcontroller is running asynchronously to the A/D clock. Therefore, the amount of time from the start to finish will vary. The maximum time difference between the start conversion and conversion complete pulses in this application is about 300 msec.

The operation of the temperature and line voltage measurement circuits can be summarized as follows: The analog voltage signal derived from a voltage divider network and a precision reference source is directed to the input of the A/D converter through an eight channel analog multiplexer. For the line voltage measurement, the voltage source is obtained from the rectified, filtered, and unregulated output of the power transformer. Switch selection is software controlled by the microcontroller which toggles the A, B, and C input lines of the multiplexer.

The analog voltage is converted in the ADC 3711 to a digital signal in four digit BCD format (0 to 3999 counts). The microcontroller sends a start conversion pulse to the ADC 3711 which then starts to update the digital data in the output latches. When all of the counts have been internally transferred, the A/D converter toggles the conversion complete output line. The microcontroller then reads the individual BCD digits using coded signals to the digit select lines of the A/D converter.

ADC CALIBRATION

The A/D converter is calibrated by connecting a 5900 +/- 0.1% ohm resistor to the patient probe jack and placing the DIP switch on the control board in the following position:

Switch #1	OPEN (OFF)
Switch #2	OPEN (OFF)
Switch #3	OPEN (OFF)
Switch #4	CLOSED (ON)

Potentiometer R44 on the control board is then adjusted until the elapsed time display reads exactly 1122. With the DIP switches in the given position, the patient temperature display will read out the actual patient temperature, even if it is outside of the normal range and the control temperature display will read out the percent of nominal line voltage.

During operation, the calibration of the A/D conversion system may be checked by pressing and holding the hidden switch located above the ALARM SILENCE SWITCH on the control panel. After 2 seconds, the patient temperature display should read 25.0 and the control temperature display should be 37.9. The elapsed timer should read the applied line voltage, expressed as a percentage of the nominal voltage, +/- 2%.

MICROCONTROLLER

The control system is located in the 8031 microcontroller. It operates at a clock speed of 6MHz and can be verified by measuring the frequency at the Address Latch Enable (ALE) pin to be 1 MHz (ON = 0.33 usec and OFF = 0.67 usec). The EA pin is grounded which enables the 8031 to execute instructions from an external memory device.

When the microcontroller performs a read instruction from EPROM, the low order address (8 bits) is output from Port 0 while the high order address (6 bits) outputs from Port 2. (Note: Bit 6 is configured only to provide expansion compatibility with a fully programmed 27128 EPROM). The ALE pin goes HIGH allowing the LS373 to appear transparent between the EPROM and the microcontroller. After the ALE output goes LOW, the low order address is latched to the outputs of the D flip flops within the LS373. This allows the EPROM to remain addressed by the microcontroller, and return 8 bits of data while using only two ports.

Port 1 of the 8031 is used to communicate to the three 8243 I/O expanders. Bits 5-7 are connected to the Chip Select (CS) line of the first, second, and third respective I/O expanders. Providing a LOW signal on one and only one of the outputs activates the corresponding IC. Bits 0-3 hold the instruction to be carried out by an 8243 when the enable bit 4 transitions between HIGH and LOW.

Port 3 is used to perform remaining tasks required by the control system. Connections 3.0 and 3.1, (receive and transmit respectively), are used in conjunction with the serial interface chips so that communication to an external microcomputer is possible. Connection INT0/P3.2 is a line frequency interrupt line that is used to aid in timing subroutines found within the system software. Connection T0/P3.4 sends serial data to the display driver while connection T1/P3.5 provides clocking to the driver.

LINE FREQUENCY

The line frequency circuit converts the 60 or 50 Hz sinusoidal line voltage signal into a square wave signal. The output of the circuit is used to clock the 4020B counter (U9) and to provide a low frequency clock source for the system software. The 1N4001 diode (CR1) half-wave rectifies the 8 vac (nominal) signal which is divided by potential divider R45/R16 and inputted to the Schmitt trigger NAND gate (U8, pin 5) With one line tied HIGH, the output of the trigger will be inverted. Since the gate will not respond until the input exceeds 1.9 volts minimally, the duty cycle of the output will be slightly more than 50%.

HEATER STATUS

The HEATER STATUS function signals the microcontroller and the safety circuitry as to whether or not the heater is ON or OFF. The input to the Schmitt trigger (U8, pin 13) is HIGH if the heater is OFF and LOW if the heater is ON. Small glitches appear when the heater is ON. Consult the Functional Description of the power supply board for further explanation. The output of the NAND gate is inverted because one input is tied HIGH.

HARDWARE TRIAC TEST

The 4020B 14 bit binary counter, U9, counts at a rate equal to the line frequency and responds to the negative edge of the clock pulse. The clock signal is received from a Schmitt trigger NAND gate, pin 6 of U8. The counter resets when the 74LS123 retriggerable one shot flip flop outputs a HIGH level pulse on the Q output line. With CLR tied HIGH and A tied LOW, the counter will reset when B of the 74LS123, U3, is HIGH at a time equal to (Q5) +(Q13) +(Q14) or after 12304 counts (Q5 = 16, Q13 = 4096, Q14 = 8192). Approximately 6.19 usec. later the output of the one shot will return to its initial LOW state.

Q13 and Q14 of the 4020B are tied to a 2 input AND gate (U2, pins 1 and 2) which will go HIGH after 12288 counts. After 8 counts Q4 of the counter goes HIGH. Q4 is tied to the CLR pin of D flip flop U1. When CLEAR goes HIGH, the output of Q1 (U1 pin 5) is allowed to equal the input D on the next positive edge of the clock pulse. Therefore the output at pin 5 will update after 9 counts. After 12288 counts (3.4133 minutes on 60Hz units, or 4.096 minutes for 50Hz units) the signal at the D input of the flip flop goes HIGH. This signal is also input to the microcontroller through the I/O expander U4. The software will then switch OFF the heat. Nine counts later the HIGH input on D is clocked to the output Q. The heater status (OFF-LOW, ON-HIGH) sent from the Schmitt trigger NAND gate pin 11 of U8 is always present at the input of U2 pin 5. If the heater is still ON after 9 counts, the output of the AND gate pin 6 of U2 will clock the second D flip flop. The outputs of the flip flops switch - Q goes HIGH and NOT Q goes LOW. A LOW on NOT Q sets off the audio alarm and drops out the non-resettable safety relay causing the heater to switch OFF.

HEATER STATUS LED

A heater status LED is located on the control board for troubleshooting. The LED can be seen through the rear of the controller assembly cover. When the status line from the Schmitt trigger is HIGH, (heater ON) the transistor Q2 switches ON causing the LED to emit light. If heat is OFF, the LED is OFF.

WATCHDOG TIMER

A watch dog timer is used to "check" that the microcontroller is working properly. After every cycle through the system software the microcontroller sends a LOW pulse to the A input of U3, a 74LS123. The RC network connected to the RxCx and Cx pins create a time constant, t = 0.45 x R x C = 0.263 seconds. If a pulse is not received at the input before the time constant expires, the output will go LOW. The high priority alarm will then be activated due to the microcontroller failure. Note when the microcontroller detects a high priority alarm condition, pulses to the watch dog circuit stop.

ALARM TONE GENERATOR AND CONTROL CIRCUITS

The alarm circuit consists of an alarm tone generator and control circuitry for high or low priority alarm conditions. Under a no alarm condition the 7556 timers are both inactive,(reset lines low).

LOW PRIORITY ALARM

Under normal operating conditions the input to U8 pin 9 is HIGH. When the microcontroller detects a low priority alarm a 1 Hz square wave is output to U8 pin 9. The timer activates, causing a 2 kHz audio output. This results in a one second ON, one second OFF audio alarm. The 2 kHz signal is adjusted within +/- 100 Hz by R38. The volume of the audio alarm is adjusted by R37. This should be adjusted fully CCW for maximum volume.

HIGH PRIORITY ALARM

The high priority alarm is activated if the microcontroller quits sending pulses to the watchdog timer. This occurs when a high priority alarm condition is detected or if the microcontroller fails. The high priority alarm is also activated if the hardware triac test circuitry detects a failed triac. Both timers become active with one timer feeding a 1 Hz signal to the control line of the second. The 1 Megohm resistor changes the output frequency of the second timer to produce a warbling effect (two tone alternating alarm). If high and low priority alarms are both ON, the output of the AND gate overrides the low priority signal, keeping both timers active.

HEAT CONTROL ROUTINE

Proportional control of the heater power is obtained by varying the number of full heat cycles of ac current delivered to the heater. To allow for line voltage compensation and still have at least 20 discreet levels of heat, a proportioning range of 0 to 60 full heat cycles is used. In other words, at very low line voltages, 100% heat will be output by having the heat ON for 60 full cycles out of a possible maximum of 60. Similarly, at this low line voltage 90% heat is obtained by having the heat ON for 54 out of 60 cycles.

In the "manual" mode of operation, the heat output is determined by the bar-graph setting selected by the operator. There are 20 steps on the bar-graph so each step represents a 5% heat increment. To accomplish the desired compensation for line voltage variations, the maximum number of heat cycles is calculated based on the last measurement of the power line voltage. For 115v nominal units, a line voltage of 106 volts or less will increase the maximum number of heat cycles to 60. At greater than 125 volts the maximum number of heat cycles is limited to 40 cycles out of a possible 60. Therefore, the number of cycles of current furnished to the heater in the manual mode is determined by multiplying the maximum for the line voltage present by the bar-graph setting. For example: assume the line voltage is 115v (maximum number of cycles ON = 50) and the bar-graph setting is 30%; the number of heat cycles to be output will be 0.3 times 50 = 15 cycles. Under these conditions the heat will be ON for 15 cycles and OFF for 45 cycles, this sequence will continue until the line voltage changes or the setting is changed on the bar-graph.

In the "servo" mode, the heater power is controlled by comparing the patient's skin temperature to the selected value of control temperature. The difference between the control temperature and the patient temperature is referred to as "PTG"(patient temperature gradient). A positive PTG indicates a patient is cooler than the control temperature and a negative PTG occurs when the patient temperature is higher than the control temperature. Based on the magnitude and sign of the PTG, a software look-up table is used to find the percent heat required. The percent heat is then converted to the appropriate number of bar-graph steps and then the selected amount of heat is output by the same process used in the manual mode.

A hardware circuit is used to interrupt the microcontroller once every cycle of the ac power line. During the interrupt routine, two registers are decremented to keep track of the heater ON and OFF cycles. One register is used for counting the number of cycles in one second (60) and another register is loaded on every sixtieth count with the number of heat cycles to be output. A flag is set whenever this register is not zero, the heat is ON only when this flag is set.

The operation of the heat control software and the heat output hardware are repeatedly tested during operation of the warmer. An opto-isolator connected with a series resistor directly across the heater terminals is used to monitor heater power. The output of the opto-isolator is fed into a Schmitt trigger, which outputs directly to an input port of the microcontroller. Therefore, the microcontroller can verify if the heat is actually on when it is supposed to be on. If not, a system fail alarm will be activated. Approximately every three minutes, an external hardware network (safety circuit) signals the microcontroller to switch OFF the heat. This hardware also monitors the output of the Schmitt trigger (heater status line). If the heater power is not switched OFF after a short delay, the hardware circuit will de-energize the "safety" relay to switch OFF heater power and also initiate an alarm which cannot be silenced without switching the power OFF.

SERVICE FEATURES

The electronic controller assembly is easily removed for servicing or calibration. This controller contains all the circuitry and components except for the heater, alarm lamps, and observation lamps.

All indicators and the audio alarm are activated on power-up for operator verification of proper display operation. These can also be activated by depressing the alarm silence switch for 2 seconds. In addition the software revision number and the line frequency are displayed.

Test points on the printed circuit boards are accessible for troubleshooting and calibration without removal of the boards. In addition integrated circuits with 24 pins or more have sockets to aid in troubleshooting and repair.

Software routines are built into the warmer to provide test functions, to aid in troubleshooting, calibration, and operation verification. These test routines are activated using a DIP switch located on the control board. Some of the test routines can be activated using the display panel.

Calibration may be verified on the controller display without disassembly. A high calibration point and a low calibration point are displayed when the service test switch is pressed for 2 seconds.

Line voltage is monitored by the warmer and fluctuations of +/- 10% from nominal voltage are compensated for so that heat output is held constant. If the voltage exceeds +/- 17.5% from nominal an alarm is activated and the heater switches off.

SELF TEST FUNCTIONS

The following text is a description of the self test functions performed by the infant warmer. If an error results on any of the power-up or on-line tests then the error number will be displayed on the elapsed time display in the format E ##. The high priority alarm (SYSTEM FAILURE LED) will be ON and cannot be silenced. Power must be switched OFF to reset this alarm.

POWER UP TESTING

On power up the following tests are performed.

1. INSTRUCTION TEST (ERROR #01)
Selected instructions are tested and verified operational.

2. CHECKSUM (ERROR #04)
The hex values of Eprom locations from 0000 to 1FFD are added together and a 2 byte sum is stored. Eprom locations 1FFE and 1FFF contain a 2 byte number which when added to the calculated checksum should total zero.

3. RAM TEST (ERROR #05)
Rams 10 through 7F are tested with patterns of 00,FF,AA, and 55.

4. TEST PORT 1 LINES (ERROR #06)
The port one I/O lines are tested to verify they can be toggled.

NOTE: At power up the software revision number is displayed for 1 second in the elapsed time display, after the LED segment test.

ON LINE TESTING

The following tests are run during the normal operation of the software. An error on any of these tests results in a SYSTEM FAILURE alarm.

1. ADC CALIBRATION TEST (CAL HIGH ERROR #02, CAL LOW ERROR #03)

Verifies that readings of the precision calibration resistors are within 0.3 degrees of the nominal values.

These readings can be checked by depressing the hidden switch on the display panel (located directly above the alarm silence switch) for 2 seconds.

After 2 seconds the displays should indicate as follows:

Patient Temperature is 25.0 +/- 0.3 degrees.
Control Temperature is 37.9 +/- 0.3 degrees.

2. HARDWARE TRIAC TEST

A circuit independent of the microcontroller monitors that the micro can switch the heat OFF. Every 3 minutes 24 seconds in 60 Hz operation (4 minutes and 5 seconds for 50 Hz operation) a request is made to the micro to switch the heat OFF. If the heat does not go OFF, a hardware latch is latched and a relay contact is opened so there is no heat. This verifies that the triac is not shorted and that the micro is still able to control the heat. This failure does not display an error number because it is not controlled by the micro but will cause the software triac test to fail when heat is called for by the program.

3. ADC CONVERTER NOT CONVERTING (ERROR #07)

Verifies that the ADC conversion complete occurs within 1 second.

4. HARDWARE TRIAC TIMER NOT RUNNING (ERROR #08)

Verifies that the request from the hardware triac test circuit occurs within 256 seconds.

5. SOFTWARE TRIAC TEST (ERROR #09)

The heater status line is checked to verify that the heat is ON when the micro is switching it ON. This verifies that the triac is not failed open.

6. LINE VOLTAGE OUT OF RANGE (ERROR #10) Verifies that the line voltage is within the range of 82.6% to 117.4% of nominal input voltage. (95v to 135v, for 115v units)

DIAGNOSTIC TESTING

Diagnostic testing can be accessed by one of the following:

1. Depressing and holding the APGAR TONES switch while powering up unit. This causes the unit to cycle in the self

test loop until power is removed. See SELF TEST LOOP in step 5.

2. Selecting one of the test positions on the 4 position DIP switch located on the control board. Following is a description of the functions of the DIP positions:

a. SWITCHES ALL OPEN (OFF) NORMAL OPERATING POSITION (00).

b. SWITCHES 2,3,4, CLOSED (ON) and SWITCH 1 OPEN (OFF) HARDWARE TRIAC TEST (0E)

This mode can be used to test the hardware triac test circuit. The heat is switched ON all the time to simulate a failed triac. The elapsed time display will start at zero on power up and display the elapsed time. At about 3 minutes 24 seconds for 60Hz operation (4 minutes and 5 seconds for 50 Hz operation) a failed triac should be detected. The high priority audio alarm should come ON and the heat should go OFF. The heat indicator LED located on the control board should be checked to verify that the heat is OFF.

c. SWITCHES 1,2,3, OPEN (OFF) and SWITCH 4 CLOSED (ON) ADC CALIBRATION (08)

The system displays the actual ADC counts on the elapsed time display, the patient temperature on the patient display even if outside of the normal displayed range, and the % of nominal line voltage on the control display. This position is used for calibrating the analog to digital converter and the line voltage compensation circuit.

d. SWITCHES 1,2,4 OPEN (OFF) and SWITCH 3 CLOSED (ON) ALARM CALIBRATION (04)

All segments of all LEDs are lit. The heater, overhead alarm lamps, and the observation lamp are on. The audio alarm emits a steady low priority alarm sound. The 2 kHz alarm frequency can be adjusted using this mode.

e. SWITCHES ALL CLOSED (ON) SELF TEST LOOP (0F)

In this mode the unit cycles through a display test, checks ADC calibration, cycles the heater, alarm lights, and observation lights, and steps through the tests described in power up testing. It also monitors the touch switches and sounds the critical alarm while any switch is depressed. If any error occurs the error number will be displayed on the elapsed time display and the critical alarm will sound for two seconds. The program will then continue to loop through this test, even if the 4 DIP switches are returned to OPEN (OFF).

If the test loop is entered on power up by depressing the APGAR TONES switch the program will loop until an error is detected. If an error is detected the unit will then stop the test loop, the error code will be displayed in the elapsed time display, and the critical alarm will sound. The power must be switched OFF to exit this mode.

SELF TEST LOOP

The unit cycles in the following loop until the power is removed.

Power up tests performed:

Instruction test	(ERROR #01)
Check calibrate high	(ERROR #02)
Check calibrate low	(ERROR #03)
Checksum	(ERROR #04)
Ram test	(ERROR #05)
Test port 1 lines	(ERROR #06)
Check if ADC is converting	(ERROR #07)

Display loop test:

SEVEN SEG DISPLAY'S	BAR GRAPH SEGMENTS	ALARM LEDs	MODE LEDs	HEATER & LIGHTS
All 1's	1,11	Probe fail	Servo	ON
All 2's	2,12	Pat temp	Servo	OFF
All 3's	3,13	Sys fail	Servo	ON
All 4's	4,14	Heater OFF	Manual	OFF
All 5's	5,15	Reset timer	Manual	ON
All 6's	6,16	Spare LED	Manual	OFF
All 7's	7,17	All OFF	Apgar	ON
All 8's	8,18	All OFF	Apgar	OFF
All 9's	9,19	All OFF	Apgar	ON
All 0's	10,20	All OFF	All OFF	OFF
All OFF	All OFF	All OFF	All OFF	OFF

The unit returns to start of self test loop.

Error Codes

ERROR	DESCRIPTION	POSSIBLE CAUSE
#01	Instruction test fails	Microprocessor 8031 defective
#02	Calibrate high fails	ADC calibration Cal high resistor defective
#03	Calibrate low fails	ADC calibration Cal low resistor defective
#04	Checksum fails	Eprom defective Microprocessor 8031 defective
#05	Ram test fails	Microprocessor 8031 defective
#06	Port 1 lines	I/O expander 8243 defective Microprocessor 8031 defective
#07	ADC not converting	A/D Converter ADC3711 defective Voltage Reference LM10 defective I/O expander 8243 #2 defective
#08	Hardware triac timer	Logic gate 4020B defective IC in triac test area defective
#09	Heat not controlled	Heater triac defective Microprocessor 8031 defective Heater opto-isolator or driver defective
#10	Line voltage out of range.	Line voltage compensation pot. on power supply board not calibrated.

C. DISPLAY BOARD (PART # CHECK, BOARD & SCHEMATIC)

This is a functional description for the Infant Warmer System Display Board Part No. 0631-5031-700. Refer to Schematic No. 0676-0325-000 for a detailed circuit diagram. See Section 8.

The display board provides the interface between the operator and the control system. It displays the status of the unit, the patient status, and can also be used as a diagnostic aid. The operator controls the system by depressing the various switches on the front display. Operation of the display board is simplified with the use of two ICs: the 8243 I/O expander which is used in conjunction with the switches; and the MM5451 (or MM5450) driver used in conjunction with the LED display.

SWITCH DECODING

The I/O expander, U1, is always enabled in the read mode because its' sole purpose is to detect switch depressions. The 8243 is activated by the microcontroller sending a LOW signal on the Chip Select (CS) line. A control word (4 bits) is latched from the input port 2 on the HIGH to LOW transition of the PROG pin. The word is decoded as follows.

P23	P22	INSTRUCTION CODE	P21	P20	ADDRESS CODE
0	0	Read	0	0	Port 4
0	1	Write	0	1	Port 5
1	0	OR	1	0	Port 6
1	1	AND	1	1	Port 7

As soon as the read instruction and the port address are decoded the corresponding port lines are set to a HIGH impedance state and the input buffers within the 8243 are switched ON. When a switch is depressed on the display, the respective line switches LOW and is loaded into the input buffer. The LOW to HIGH transition on the PROG line terminates the read instruction and transfers information back to port 2. When the microprocessor sets the CS line HIGH the 8243 is disabled.

LED DISPLAY DRIVER

The LED display, driver, U2, controls the LED displays. The displays are multiplexed with a duty cycle of 20% and a refresh rate of 60 hertz. Data is input to pin 22 synchronously with the clock (pin 21). The first "1" bit activates the driver and 35 data bits will follow. After the 35th bit is loaded the data is latched to provide direct output. Note that a logic HIGH at the input switches the output LOW and switches ON the LED connected to the output (output is inverted).

BRIGHTNESS ADJUST

R9 is used to adjust the output current from U2 and in turn change the brightness of the LEDs. R9 is adjusted to produce 3.30 +/- 0.10 volts across R10 (3.3V / 221 ohms = 15ma). C6 is used to prevent oscillations at pin 19.

MULTIPLEXING OF DISPLAYS

Since there are not enough data bits to drive the entire display, the displays are divided into four sections. Bits 1-28 are used to supply the necessary information to each section. Bit 29 is unused. Bit 30 is tied to a 221 ohm +/- 1% resistor which is used for calibration. Bits 31-34 select which channel of the display is activated by switching ON a Darlington transistor. The Darlington provides a large gain so that a small drive current will sustain the large current draw from the LEDs.

A string of 35 zeroes are sent on the data line every fifth update cycle. The driver has a serial input and does not have a master reset. This string of zeroes resets the driver in case an extra pulse was entered by a noise spike.

The basic circuit for one LED segment consists of the 5 volt LED supply (reduced to 4.3 volts by a series 1N4001 diode,) a Darlington switch to enable the supply to the LED group, and the MM5451 driver to select a low voltage return for the segment (if selected).

2/ SPECIFICATIONS

All specifications are subject to change without notice.

2.1 ELECTRICAL

POWER REQUIREMENTS

0305-0404-910	120 V 50/60 Hz Models	115V~ +/- 10%	6.6 amps
0305-0404-911	220 V 50/60 Hz Models	220V~ +/- 10%	3.7 amps
0305-0404-912	240 V 50/60 Hz Models	240V~ +/- 10%	3.3 amps
0305-0404-913	100 V 50/60 Hz Models	95V~ +/- 10%	8.2 amps

This model is designed to conform to IEC 601-1 requirements.

NOMINAL POWER CONSUMPTION
600 watts at maximum %power setting.

HEATER OUTPUT
540 watts +/- 5% at maximum %power setting.
Average Energy at Mattress Level is 35 mw/cm2 at
Maximum % power setting
Peak wavelength 2.4 micron at 100% power.

RECOMMENDED BED LEVEL
27 inches +/- 2inches from the bottom of heater module.

WARNING: If the bed level is greater than or less than 27 +/- 2 inches, the Infant Warmer System will not operate properly.

LINE VOLTAGE COMPENSATION
Input voltage is monitored and the heater drive output is adjusted to compensate for variations of line voltage.

CIRCUIT BREAKER (All except 100v units)
Rated Current: 7 amps
Trip Point: 9.45 amps Minimum
Type: Manual Resetting
Model: Airpax Snapak

CHASSIS LEAKAGE CURRENT
With the ground wire open or connected, less than 8 microamperes on 100V and 120V units (18 microamperes on 220v and 240v units) measured at the patient probe connection.

With the ground wire open or connected, less than less than 90 microamperes on 100v and 120v units (180 microamperes on

220v and 240v units) measured at an exposed metal surface.

2.2 CONTROLLER

ELECTRONICS

Microprocessor based control system. Self test functions are performed at power up and during normal operation.

POWER CONTROL METHOD

Proportional heat control with zero voltage switching to minimize radiated and conducted EMI.

EXAMINATION LIGHT

Nominal illuminance output: 100 foot candles at center of mattress. Estimated lamp life: 3,000 hours.

TEMPERATURE SENSING SYSTEM

Range: 22-42 degrees C
Accuracy: +/- 0.3 degrees C
Resolution: +/- 0.1 degrees C
Probe interchangeability: +/- 0.1 degrees C
Probe Model Number: LA003

ELAPSED TIMER

60 minute elapsed timer with hold mode and Apgar tones.

MANUAL MODE

Manual mode heat selector range: 0 to 540 watts in 20 increments (5% per step).

SERVO MODE

Servo control range 35.0 to 37.5 degrees C in increments of 0.1 degrees C.

BED HEIGHT

Control for raising and lowering the bed and heater assembly.

2.3 ALARMS

Multiple audio tones

1. Operator prompt tone
2. Alternating single tone
3. Alternating two tone

OVERHEAD ALARM LIGHT

Large alarm light located on the front of the heater assembly for easy visual identification.

PROBE FAILURE ALARM

Activates when the skin temperature probe fails electrically open or short, or is disconnected from the warmer. The alarm is only active in the servo mode. The heater is turned off and the patient temperature display flashes HH.H when this alarm condition exists.

PATIENT TEMP. ALARM

The Patient Temp. alarm activates in the servo mode when the difference between the patient temperature and the control temperature is greater than one degree C. The alarm cancels when the patient temperature returns to within 0.8 degrees C of the control temperature.

SYSTEM FAILURE ALARM

The system failure alarm activates and turns the heater off if the analog to digital converter calibration drifts by more than 0.3 degrees C., the heater triac fails, the microprocessor fails, or the self check functions fail on power-up. This alternating two tone alarm cannot be silenced. Refer to the Trouble Shooting and Repair sections of this manual.

HEAT OFF ALARM

The LED activates whenever the heater is in the x-ray position. The audio alarm activates after 5 minutes in the X-ray position.

CHECK PATIENT ALARM

Activates in the manual mode if the heater has been energized at greater than 25% heat for 12 continuous minutes. In the servo mode the alarm activates when the heater has been at full power for 12 continuous minutes.

POWER FAILURE ALARM

The power failure alarm activates if line power is interrupted. A rechargeable maintenance free ni-cad battery powers the audio alarm and the microprocessor. If power is restored within 10 minutes the mode of operation and the set point are recalled.

2.4 ENVIRONMENTAL

Operating temperature range: 10 to 40 degrees C
Storage temperature range: -25 to 60 degrees C
Humidity: 0 to 95%

2.5 MECHANICAL (WITHOUT ACCESSORIES)

Dimensions:

Height: 71-79 in.
Depth: 37.25in.
Width: 31.5in.

Mattress: 23.2 x 29.2 inches (58.9 x 74.2 cm)

Tilting Positions +/- 10 degrees

Weight: Approx. 225 pounds (102 kg.)

Casters: 5 inch(12.7 cm) diameter, 2 locking, 2 non-locking

2.6 ACCESSORIES

Oxygen yoke and regulator(P/N 6600-0011-800).
Pin indexed yokes accommodate two E size oxygen cylinders
DISS oxygen fittings
52 +/- 2 psig regulator
Cylinder pressure gauges, 0 to 3000 lbs. (0 to 210 kg/cm2)

Air/Oxygen Yoke and Regulator(P/N 6600-0023-800).
Pin indexed yokes accommodate two E size oxygen cylinders
Pin indexed yoke to accommodate one E size air cylinder
DISS oxygen fittings
DISS air fitting
52 +/- 2 psig regulator for oxygen
52 +/- 2 psig regulator for air
Cylinder pressure gauge, 0 to 3000 lbs. (0 to 210 kg/cm2)

Rail mounted accessories
Monitor shelf: Dimensions 12 x 30.5 inches
30 x 77.4 centimeters
Load limit: 50 pounds (22.5 kg)
Instrument shelf: Dimensions 12 x 12 inches
30 x 30 centimeters
Load limit: 20 pounds (9 kg)

WARNING: Overloading the shelves can affect the stability of the unit.

Oxygen flowmeter w/DISS fittings (0 to 15 LPM)
Air flowmeter w/DISS fittings (0 to 15 LPM)
Manometer (-20 to +100 centimeters of water)
IV pole
Vacuum manifold w/DISS fittings
Gas manifold w/ 1/8 in. NPT fitting
3.5 inch(8.9cm) utility post
22 inch(56cm) utility post for mounting infusion pumps, humidifiers, proportioners, ventilators etc.
Ventilator mounting accessory

TABLE 1. INFANT WARMER SYSTEM ALARMS

	Alarm Condition	Alarm Sound	Alarm Silence Period	Heater
1.	Probe Failure	Alternating Two Tone	1 Minute	Off
2.	Patient Temp.			
	Greater than 42 C	Alternating Two Tone	1 Minute	Off
	More than 2 C from control temperature	Alternating Single Tone	5 Minutes	*
	Between 1 & 2 C of Control Temp.	Alternating Single Tone	15 Minutes	*
	Less than 30 C	Alternating Two Tone	1 Minute	Off
3.	System Failure	Alternating two tone	can not be silenced	Off
4.	Heat Off	Alternating Single Tone	5 Minutes	Off
5.	Check Patient			
	After 12 minutes	Alternating Single Tone	12 minutes	*
	After 15 minutes	Alternating Single Tone	12 minutes	Off

* The heater output is dependent on the Patient Temperature and the Control Temperature Settings in the servo mode, and the Percentage(%) Power setting in the manual mode.

3/ SETUP AND CHECKOUT PROCEDURE

3.1 SETUP

Refer to the setup instructions shipped with the Infant Warmer System for initial unpacking and setup of the unit after shipment.

Inspect the Infant Warmer System and all accessory items after removal from the shipping containers for any signs of damage that may have occurred during shipment. File a damage claim with the shipping carrier if damage has occurred. Also confirm the presence of all accessory items as listed on the packing slip.

Figure 3-1. 5000 Infant Warmer Front and Rear View

3.2 CHECKOUT PROCEDURE

WARNING: Do not perform the Check-Out Procedure while a patient occupies the Infant Warmer System.

Perform the Checkout Procedure before each use on a patient. Refer servicing to qualified service personnel if the unit does not perform as specified. Refer to the Troubleshooting Guide and the Disassembly and Repair Sections if the unit fails any steps of the Checkout Procedure.

A. Mechanical Checks

Overall Appearance

1. Disconnect the power cord for the Infant Warmer System for the mechanical checks portion of this procedure.

2. Check the overall appearance of the Infant Warmer System. There should be no obvious damage.

3. Place the Infant Warmer System on a level surface. Check that all four casters are in firm contact with the floor and that the warmer moves freely.

4. Lock the two front casters and check that the warmer is held in place.

5. Examine the power cord for damage. Replace the power cord if damage is evident.

CAUTION: Insulation on the electrical wiring can deteriorate with age. Check for brittle or deteriorated insulation on the power cord and all other electrical wires.

Heater Rotation

1. Rotate the heater to the X-ray position and back to the normal position. Check for smooth rotation.

Mechanical Checks

1. Check the operation of the bed sides. The bed sides should operate smoothly.

2. Check the operation of the tilt mechanism. Verify that the bed platform operates smoothly and locks in any position.

Optional Accessory Checks

Check that all accessories are mounted securely to the uprights.

Gas Yoke and Regulator Checks

1. Check that all gas cylinders are mounted securely.

2. Check that the output from the regulator(s) is 52 +/- 2 psig with a 500 cc flow. If adjustment is required refer to Section 4H.

B. Control Unit Checks

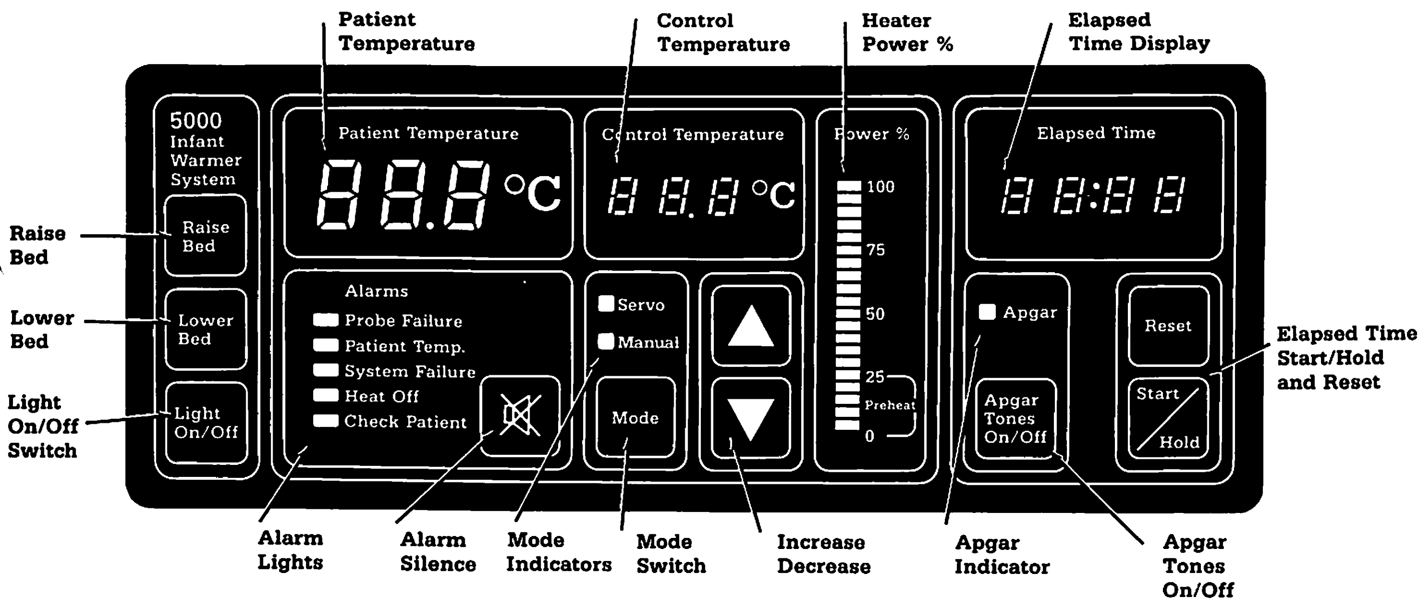


Figure 3-2. Control and Display Panel

1. Connect the Infant Warmer power cord to an appropriate power source (see rating plate for proper voltage etc.). Switch the power ON and verify the following:

   a. The alternating two tone audible alarm sounds and all displays and indicators are lit for approximately two seconds.

      Note: During this time the controller also performs self check functions and displays the software revision number. If the controller detects a failure the alarm stays on and service is required.

   b. The manual mode indicator is lit.

c. An operator prompt tone sounds and the % power display flashes.

2. Adjust the heat output with the increase and decrease touch switches to the high and low limits as indicated by the % power display.

3. Connect the skin temperature probe to the Infant Warmer System.

4. Press the mode touch switch to place the warmer in the servo mode and verify the following:

   Note: An alternating two tone alarm and a flashing overhead alarm light may occur here if the skin temperature probe is below 30 degrees C. Warm the probe with your fingers or silence the alarm.

   a. The servo mode indicator is lit.

   b. An operator prompt tone sounds and the control temperature display flashes 36.5 degrees C.

5. Press the increase touch switch and verify that the maximum servo control temperature attainable is 37.5 degrees C.

   Note: A patient temperature alarm occurs if the difference between the patient temperature and the control temperature is greater than one degree C.

6. Press the decrease touch switch and verify that the minimum servo control temperature attainable is 35.0 degrees C.

7. Disconnect the skin temperature probe. Verify the following:

   a. The probe failure indicator light is lit.

   b. There is an alternating two tone alarm.

   c. The overhead alarm light is flashing.

   d. The patient temperature display flashes "HH.H".

8. Press the alarm silence touch switch and verify the following:

   a. The probe failure indicator light is lit.

   b. The alternating two tone alarm is silenced.

   c. The overhead alarm light is lit.

   d. The patient temperature display indicates "HH.H".

    e. After one minute the alternating two tone alarm sounds, the overhead alarm flashes and the patient temperature display flashes HH.H.

9. Switch to the manual mode and set the heat at 25% power.

Elapsed Timer Check

1. Press the start/hold switch to activate the elapsed timer. Verify that the timer starts operation.

2. Press the on/off switch for the Apgar tones. Verify that the indicator light for the Apgar tones is not lit.

3. Press the on/off switch for the Apgar tones again. Verify that the indicator light for the Apgar tones is lit.

4. Press the start/hold touch switch. Verify that the present elapsed time is held.

5. Press the start/hold touch switch and verify that the timer updates to the current elapsed time and the Apgar tones continue to sound at the specified times (at 1 minute and at every 5 minute interval after the elapsed timer is started).

6. Press the reset touch switch and verify that the timer indicates 00:00. If the elapsed timer is not used for one minute the display is switched off.

Examination Light Check

1. Press the Light ON/OFF touch switch. Verify that the examination light functions.

Interlock Switch Check

1. Place the warmer in the manual mode at 25% power output.

2. Rotate the heater assembly to the X-ray position. Verify that the heater off indicator light is ON and the % power display indicates 0% heat.

3. Rotate the heater assembly to the normal operating position. Verify that the heater off indicator light is OFF and the % power display indicates 25%.

Display and Alarm Check

1. Press and hold the alarm silence switch for more than 2 seconds, then check for the following:

    a. Every segment of each digital display should be lit. All segments should be of uniform brightness and visible under ordinary room lighting conditions.

b. All LED indicators should be lit.

c. The warbling two-tone audio alarm should be on.

Battery Test and Memory Test

The battery is charged in normal operation by a trickle charge current from the regulated 9 volt supply. If the battery is discharged it must be recharged before allowing a patient to occupy the Infant Warmer. The battery may be recharged by placing the unit in the manual mode at a 0% heat setting. If the battery is defective, replace it. Battery replacement is recommended every two years. There is no maintenance required for the battery.

Note: The battery must be fully charged to pass the 10 minute test or partially charged to pass the two minute test.

1. Disconnect the patient temperature probe.

2. Place the Infant Warmer in "servo" mode.

3. Silence the probe failure alarm.

4. Set the control temperature at 37.0 degrees C.

5. Remove the Infant Warmer power plug from the power source for two minutes. Do not switch the power OFF. The power failure alarm should sound for two minutes.

   Note: If the power failure alarm is tested for 10 minutes, the Infant Warmer must be connected to the correct power source and operated for 24 hours to recharge the battery before allowing a patient to occupy the Infant Warmer.

6. Reconnect the Infant Warmer to the power source. Verify the following:

   a. The Infant Warmer is operating in the servo mode.

   b. The control temperature is 37.0 degrees C.

   c. The audio power failure alarm is off.

Calibration Check

1. Press and hold the hidden control panel switch (directly above the alarm silence switch).

2. After 2 seconds the displays should indicate as follows:

   a. Patient Temperature displays 25.0 +/- 0.1 degree.

   b. Control Temperature displays 37.9 +/- 0.1 degree.

c. Elapsed Time displays % nominal line voltage +/- 2%.

Note: Line voltage may be measured on terminals marked with the phase symbol and "n" on the power supply board. Measure the voltage with the heat off. The percent of line voltage can be calculated by:

(Measured voltage / Nominal voltage) x 100 = % of Nominal Line voltage.

Nameplate voltage	Nominal voltage
100	95
120	115
220	220
240	240

Raise and Lower Bed Switch check

CAUTION: Do not idle the motor at stop positions, equipment damage may result.

1. Press the RAISE bed touch switch and verify that the bed raises to a maximum of 44-1/2 inches off the floor.

2. Press the LOWER bed touch switch and verify that the bed lowers to a minimum of 36-1/2 inches off the floor.

4/ CALIBRATION AND ADJUSTMENTS

WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the 5000 Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-00) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

Note: The audio alarm will sound for about 2 seconds whenever powering up the unit.

Note: Warm up the unit for 5 minutes before making these adjustments.

A. Control Unit Access

1. Disconnect the power cord for the Infant Warmer System from the wall outlet.
2. Remove the mounting screws for the back panel.

B. Power Supply Board Voltage Checks

1. Set the test switch (S1) located on the control board to the following test positions:

Switch #1,#2,#4	OPEN (OFF)
Switch #3	CLOSED (ON)

2. Connect the controller assembly to a 115 volt +/- 10% power source and switch the Infant Warmer ON.
3. Check that all display segments are ON, the observation lamp is ON, the alarm light is ON, the heater radiates heat, and a continuous alarm tone sounds.

4. Check that the following D.C. voltages are present at the test connector (T1) located on the control board. Voltages should be within the tolerances specified:

TP7	Ground (common)		
TP3	(9.0 vdc ST.)	+9V +/- 0.2V	(adjust R4 on P.S. Bd.)
TP4	(5.0 vdc LEDS)	+5V +/- 0.2V	(replace P.S. Bd.)
TP5	(5.0 vdc ST.)	+5V +/- 0.2V	(replace P.S. Bd.)

C. Display Brightness Check

Note: The display brightness is precalibrated at the factory and should only require adjustment if replacing a component on the display board.

With the test switches set as follows:

Switch #1,#2,#4	OPEN (OFF)
Switch #3	CLOSED (ON)

Check that all the displays are lit and are of uniform brightness. If the displays are acceptable proceed to Section D. If the displays are not illuminated adequately proceed with the adjustment procedure.

Adjustment Procedure

CAUTION: The back panel and display panel may drop down when the bottom cover mounting screws are removed. Be sure to secure the panels with tape before disassembly.

1. Set the test switch (S1) located on the control board to the following test positions:

Switch #1,#2,#4	OPEN (OFF)
Switch #3	CLOSED (ON)

2. Tape the display panel and back panel to the top cover.

3. Remove the four outside corner mounting screws from the bottom of the display panel. Do not remove the two inside mounting screws.

4. Connect a digital voltmeter across R10 located on the bottom edge of the display board.

5. Adjust R9 on the display board until the voltage across R10 is 3.30V +/- 0.2V.

6. Verify that all segments of all displays are lit and are of uniform brightness.

D. Alarm Volume Adjustment

Note: The alarm volume and frequency are precalibrated at the factory and should only require adjustment if replacing a component on the control board.

1. With the test switches set as follows:

Switch #1,#2,#4	OPEN (OFF)
Switch #3	CLOSED (ON)

2. Ensure the alarm tone and volume are adequate. Verify that the audio alarm level is adequate in a location with a background noise level of 55 dBA max. If the audio alarm level is acceptable go to step E. If the audio alarm level is unacceptable proceed with the adjustment procedure.

   Adjustment Procedure

3. Verify the frequency output at U7 pin 9 is 2 kHz +/- 0.1 kHz. Adjust R38 on the control board as required.

   Note: If test equipment is not available for checking the 2 kHz frequency, adjust R38 for maximum sound level.

4. Verify that R37 on the control board is set fully CCW (maximum volume).

E. Analog to Digital Converter (ADC)

Note: The following resistance values are available on the Temperature Simulator and the switch positions are listed in parentheses.

1. Switch the power switch OFF.

2. Set the control board test DIP switch (located on the upper edge) to the calibration positions as follows:

Switch #1, #2, #3	OPEN (OFF)
Switch #4	CLOSED (ON)

3. Connect a resistance of 5900 OHMS +/- 0.1% (I7) to the patient jack connector.

4. Switch the power switch ON and allow the unit to stabilize for 5 minutes.

5. Verify that the ADC counts displayed on the elapsed time display is 1122 +/- 2 counts. Slowly adjust R44 on control board as required.

6. Input resistance values into patient probe connector and verify patient temperature readings are within tolerances specified.

RESISTANCE INPUT		PATIENT TEMPERATURE
5900 ohm +/- 0.1%	(I7)	37.3 +/- 0.1 degrees
7060 ohm +/- 0.1%	(I3)	33.0 +/- 0.1 degrees
6190 ohm +/- 0.1%	(I11)	36.2 +/- 0.1 degrees
5496 ohm +/- 0.1%	(I2)	39.0 +/- 0.1 degrees

F. Line Voltage Sensing

WARNING: Use extreme care while performing calibration and adjustment procedures, or while working on the 5000 Infant Warmer System with power connected. An electrical shock hazard does exist; be certain to observe all safety precautions.

1. Use a DVM and measure the line voltage at the wall outlet.

2. Calculate the displayed % variance of the supply voltage from the rated nominal voltage using the following formula:

   (Actual line voltage / Nominal Voltage) x 100 = Displayed %

3. Slowly adjust R3 on power supply board as required until the control temperature display equals the calculated value for the supply voltage measured.

   Note: For domestic 115V units and an input voltage of 115 Volts the reading on the control temperature display should be 100 % +/- 2%.

4. Switch the power switch OFF.

G. Triac Safety Circuit Test

1. Place the individual switches in the following positions:

sw.#1 OPEN (OFF)
sw.#2, #3, and #4 CLOSED (ON)

2. Switch the Infant Warmer power ON.

3. The front panel should display the following:

Pat. Temp.	EEE
Cont. Temp.	EEE
Elapsed Time	Running in Stop Watch Mode

4. Confirm that the heat indicator LED on the control board is lit.

5. Use a stop watch and verify that elapsed time display is accurate within +/- 1 second per minute.

6. After approximately 3 minutes and 24 seconds (60 Hz models) or approximately 4 minutes and 5 seconds (50 Hz models) a warbling alarm which cannot be silenced occurs.

7. The heat indicator LED on the control circuit board (viewed from the rear of unit) must be off.

8. Switch the power OFF for the Infant Warmer and restore the test switch to the original configuration (all switches OPEN).

H. Test Loop

Complete Unit Testing

1. Switch the power OFF.

2. Place the test switches on the control board in the test loop position. All 4 switches CLOSED (ON).

3. Switch the power switch ON.

4. Verify that the following sequence occurs:

   a. For the first second:

      All segments, LEDs, and high-low alternating tone audible alarm are ON.

   b. For the next second:

      High-low alternating tone audible alarm ON.
      Patient display - 60.H (60 Hz)
      Elapsed time display - software revision number.

   c. The unit should then loop in the following order until the power is removed.

SEVEN SEG DISPLAY'S	BAR GRAPH SEGMENTS	ALARM LEDs	MODE LEDs	HEATER & LIGHTS
All 1's	1,11	Probe fail	Servo	ON
All 2's	2,12	Pat. temp.	Servo	OFF
All 3's	3,13	Sys. fail	Servo	ON
All 4's	4,14	Heater OFF	Manual	OFF
All 5's	5,15	Reset timer	Manual	ON
All 6's	6,16	Spare LED	Manual	OFF
All 7's	7,17	All OFF	Apgar	ON
All 8's	8,18	All OFF	Apgar	OFF
All 9's	9,19	All OFF	Apgar	ON
All 0's	10,20	All OFF	All OFF	OFF
All OFF	All OFF	All OFF	All OFF	OFF

      While looping through this test loop the program also does ram tests, memory checksum, and ADC calibration tests. If any error occurs an error number will be displayed on the Elapsed Time display and the critical alarm will sound for 2 seconds. The program will then continue to loop and display any additional error numbers. See section 6 for error code descriptions.

5. Switch the power OFF.

6. Set control board test DIP switches to the normal operating position. (All OPEN or OFF)

7. Replace the back panel.

Separate Controller Unit Testing

Note: If required the controller unit can be tested separately from the warmer. The following test load may be connected in place of a heater assembly.

With the power OFF connect the controller assembly to a test load as follows:

Between J17 pin 3 (phase) and J17 pin 1 (heater N) a 400 watt resistive load for 115 volts.

Between J17 pin 3 and J17 pin 2 (alarm light N) a 12 watt resistive load for 115 volts.

Between pin 1 and pin 3 of observation light connector a 50 watt resistive load for 12 volts.

I. Oxygen / Air Regulator Checks and Adjustments

Check that the output from each regulator is 52 +/- 2 psig with a 500 cc flow. If adjustment is required perform the adjustment procedure.

Gas Regulator Adjustment Procedure

1. Disconnect the gas pipeline connection and remove the gas cylinder(s).

2. Remove the eight mounting screws for the Gas Yoke and Regulator Assembly and then remove the assembly.

3. Disconnect the copper tubing from the outlet port of the regulator.

   Note: The regulator must be reset to 52 +/- 2 psig with a 500 cc flow passing through it.

4. Attach the special fitting and gauge assembly (Tool Number 0175-0543-000) to the regulator outlet. This special tool has a (0.025 in.) orifice to maintain a 500 cc flow for proper regulator adjustment.

5. Attach a gas cylinder to the yoke and open the cylinder valve. Adjust the regulator adjustment screw until the pressure gauge reads 52 +/- 2 psig.

6. Tighten the adjustment screw lock nut.

7. Remove the special fitting and gauge assembly.

8. Reconnect the copper tubing to the regulator outlet.

9. Place the Gas Yoke and Regulator Assembly in position on the Infant Warmer System and replace the eight mounting screws for the assembly.

J. Electrical Safety Check

Power Cord Inspection

1. Disconnect the Infant Warmer System power cord.

2. Examine the power cord for damage and wear.

3. Examine the power plug for loose or bent pins. Replace the power cord if the cord or plug is damaged.

K. Ground Resistance Check

1. Disconnect the Infant Warmer System power cord from the a-c power source.

2. Perform a ground resistance check on the Infant Warmer System. Use a low range ohmmeter or electrical safety analyzer to measure the resistance between the ground pin on the line cord plug and the controller unit. Tug and flex each end of the power cord during the measurement. The ground resistance must be less than 0.15 ohms. Higher readings may indicate loose or oxidized connections in the power cord or the grounding circuits.

L. Leakage Current Tests

Use approved equipment, safety precautions and measurement techniques to test the unit's leakage current and ground continuity.

There must be less than 8 microamps on 100v and 120v units (18 microamps on 220v and 240v export units) measured at the patient probe connection. Replace the patient probe if necessary.

There must be less than 90 microamps on 100v and 120v units (180 microamps on 220v and 240v units) measured at an exposed metal surface.

Measure the leakage current under all of the following wiring configurations:

1. Normal and reversed polarity.

2. Equipment power ON and OFF.

3. Ground open and intact.

Make sure the heater is ON full during the test. Set the unit for 100% power in the manual mode. Repeat the tests while raising and lowering the bed to ensure that the leakage currents remain within limits.

Use the leakage current tester OMP #0175-2284-000 (for 120 volt units) and digital multimeter (DMM) for the following procedure:

Note: For other units of various voltages, use a general purpose leakage current tester.

1. Connection

    a. Connect the device under test to the outlet on the leakage current tester.

    b. Make sure the polarity switch on the leakage tester is in the OFF Position then plug the line cord into a grounded wall outlet.

    c. Connect the positive lead of the DMM to the positive + METER OUT output.

    d. Connect the negative lead of the DMM to the negative - METER OUT output.

    e. Set the DMM on the AC millivolt scale.

    f. Connect one end of the test cable to the EXTERNAL GROUND jack on the Leakage Current Tester.

    g. Use the other end of the test cable (needle probe tip) to contact the exposed conductive surface of the device under test.

2. Normal Polarity Leakage Current Test

    a. Place the polarity switch of the Leakage Current Tester in the NORMAL position. (This is in the grounded mode.)

    b. Switch ON the power of the device under test.

    c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps (i.e., 100 mv is equivalent to a leakage current of 100 microamps).

d. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.

e. Switch the power switch of the device under test OFF and then repeat steps 2c and 2d.

3. Reverse Polarity Leakage Current Test

a. Place the polarity switch on the Leakage Current Tester in the REVERSE position. (This is the grounded mode.)

b. Switch ON the power of the device under test.

c. Measure the voltage on the DMM in millivolts. The millivolt reading is directly related to leakage current in microamps, (i.e., 100 mv is equivalent to a leakage current of 100 microamps).

d. Push the GROUND DISCONNECT switch to measure the ungrounded leakage current.

e. Switch the power switch of the device under test OFF and then repeat steps 2c and 2d.

M. Bed Motor Raise and Lower Test

1. Press the Raise Bed switch.

a. Ensure that the bed elevates smoothly

b. Ensure that the motor continues operating with a slipping clutch action at the upper limit (44-1/2 inches off the floor).

a. Press the Lower Bed switch.

b. Ensure that the bed lowers smoothly

c. Ensure that the motor continues operating with a slipping clutch action at the lower limit (36-1/2 inches off the floor).

CAUTION: Do not idle the motor at these stop positions; equipment damage may result.

5/ DISASSEMBLY AND REPAIR

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

WARNING: Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

5.1 HEATER MODULE REPAIRS

A. Heater Housing Disassembly (Figures 5-1 and 5-2)

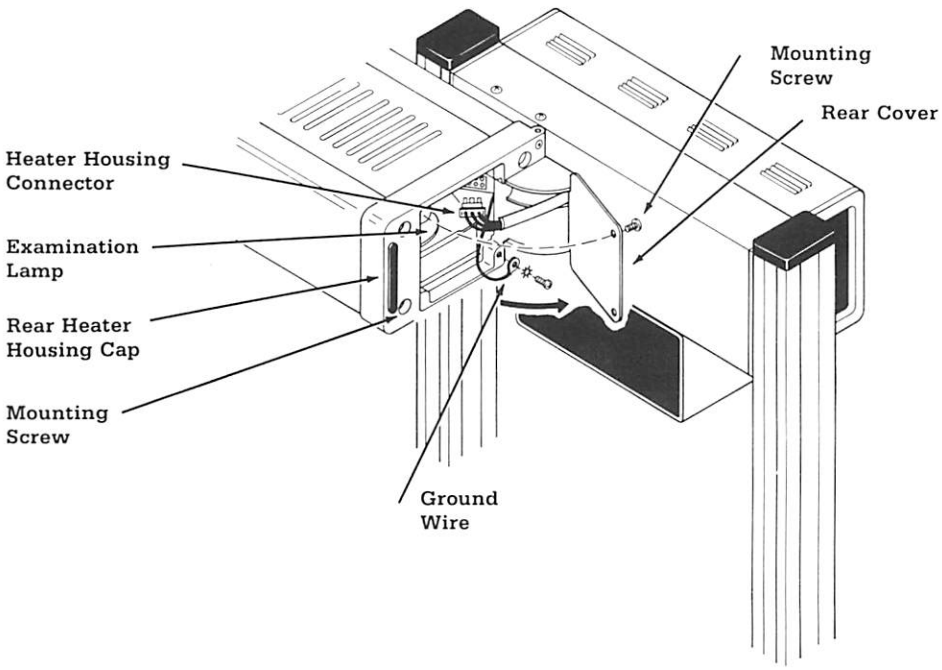


Figure 5-1. Removal of Back Cover from Heater/Lamp Assembly.

1. Disconnect the Infant Warmer System Power Cord.

2. Rotate the heater to the X-ray position.

3. Remove the three Phillips head mounting screws for the back cover, and remove the cover.

4. Disconnect the heater housing connector. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Remove the ground wire for the heater housing.

6. Remove the four mounting screws for the front cover plate and remove the plate.

7. Remove the four mounting screws for the front heater housing cap and remove the cap.

8. Push the heater assembly from the rear out the front of the heater housing. Avoid bending the rear portion of the heater assembly.

9. To ease disassembly the four mounting screws for the rear heater housing cap may be loosened. Do not remove the mounting screws.

Note: The heater, alarm lamp sockets, examination light socket, and wiring harness can be replaced when the heater assembly is removed.

B. Heater Replacement (Figure 5-2)

1. Remove the cover plug above the heater terminal, adjacent to the observation lamp.

2. Hold each terminal on the heater rod to ensure no strain is placed on the element while removing the heater wire connection screws from both ends of the heater.

3. Remove the four mounting bolts for the front mounting plate and move it to the side.

4. Slide the heater rod out from the front of the heater assembly.

5. Slide the replacement heater rod in from the front of the heater assembly.

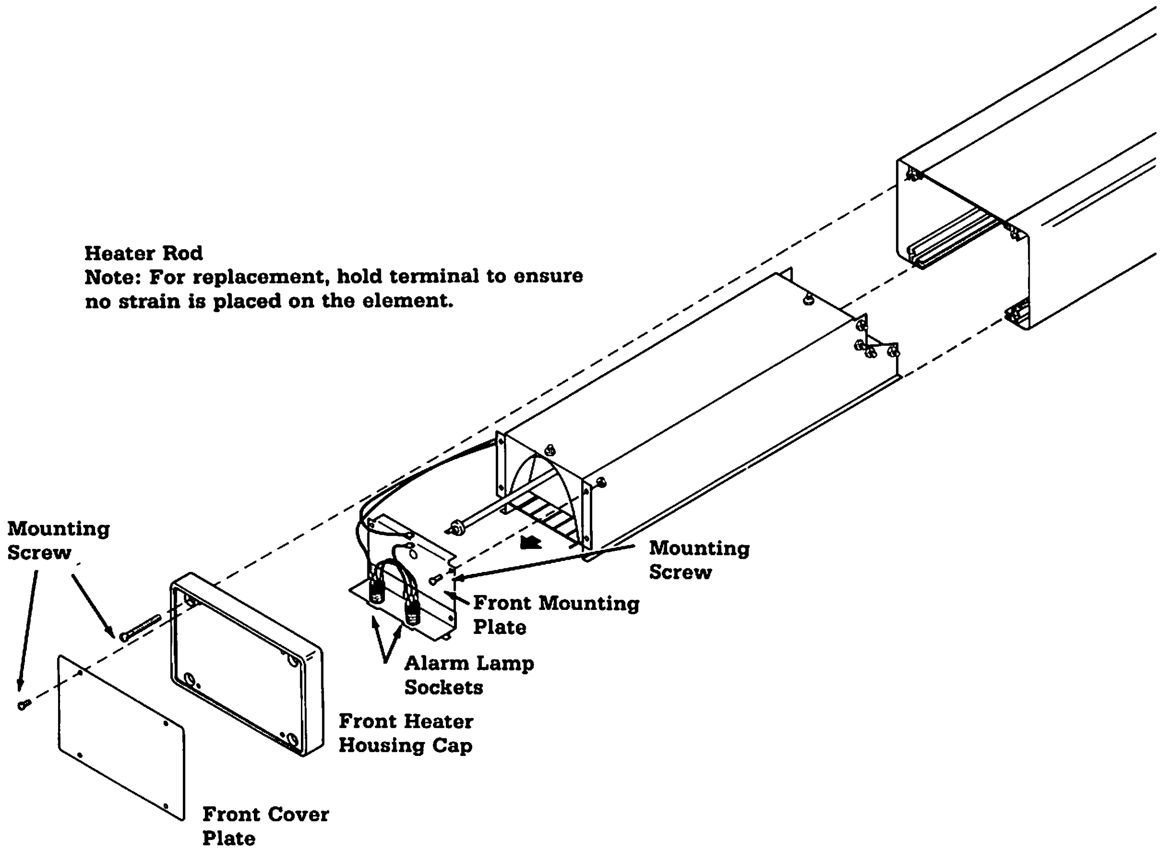


Figure 5-2. Heater/Lamp Housing Assembly

6. Hold each terminal on the heater rod to ensure no strain is placed on the element while replacing the heater wire connection screws on both ends of the heater.

   Note: Position the wires at a 90 degree angle to the heater rod to provide maximum wire spacing.

7. Place the front mounting plate in position and replace the four mounting bolts.

8. Replace the cover plug above the heater terminal adjacent to the observation lamp.

C. Heater Housing Assembly (Figures 5-1 and 5-2)

1. Slide the rear section of the heater assembly into the front of the heater housing. Guide the rear panel while pushing the assembly all the way in.

   Note: Avoid bending the rear panel of the heater assembly.

2. Attach the ground wire for the heater housing.

3. Reconnect the heater assembly wiring.

4. Place the front heater housing cap in position and replace the four mounting screws.

5. Tighten the four mounting screws for the rear heater housing cap if they were loosened.

6. Place the front cover plate in position and replace the four mounting screws.

7. Place the rear cover in position and replace the three Phillips head mounting screws.

8. Rotate the heater to the normal position.

9. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

D. Alarm Lamp Replacement (Figures 5-3)

Lamp: GTE Sylvania 120MB 6W, Ohmeda Part No. 0690-2100-315

CAUTION: Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the alarm light.

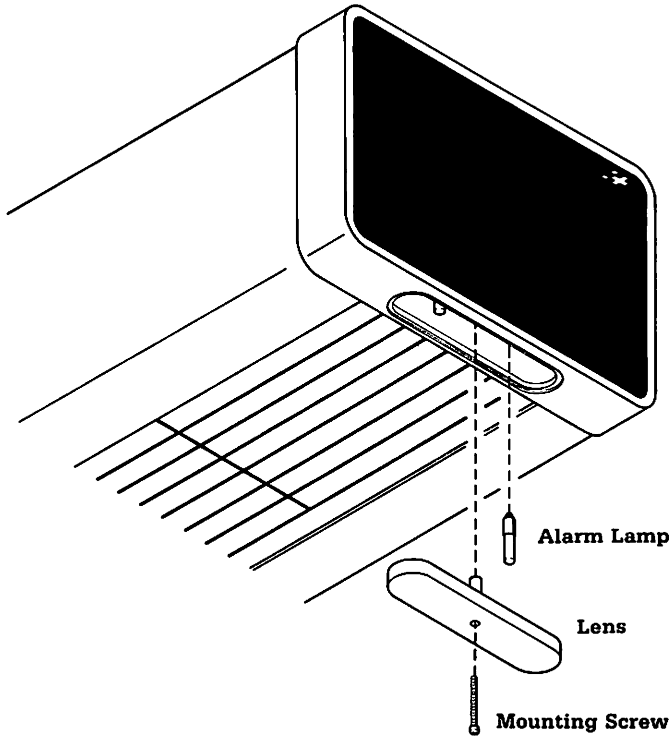


Figure 5-3. Alarm Lamp Replacement.

1. Disconnect the Infant Warmer System power cord and allow the unit to cool for 10 minutes.

2. Use a Phillips head screw driver and remove the lens mounting screw located in the center of the alarm light.

3. Remove the lamp by pushing in and turning it counterclockwise.

4. Install the new lamp by pushing in and turning it clockwise.

   Note: When one lamp burns out it is recommended to replace both lamps. Replacing both lamps ensures maximum reliability.

5. Place the lens cover in position and secure it with the mounting screw.

6. Plug the power cord in and check for proper operation.

E. Examination Lamp Replacement (Figures 5-4 and 5-5)

Lamp: GE EXZ(Q50 MR16/NFL) Ohmeda Part No. 0208-0516-300 or GE EXN(Q50 MR16/FL)

CAUTION: Disconnect the Infant Warmer System power cord and allow the unit to cool before replacing the examination light. The lamp normally operates at a high temperature.

Note: Do not touch the center glass bulb. This will reduce the life of the lamp.

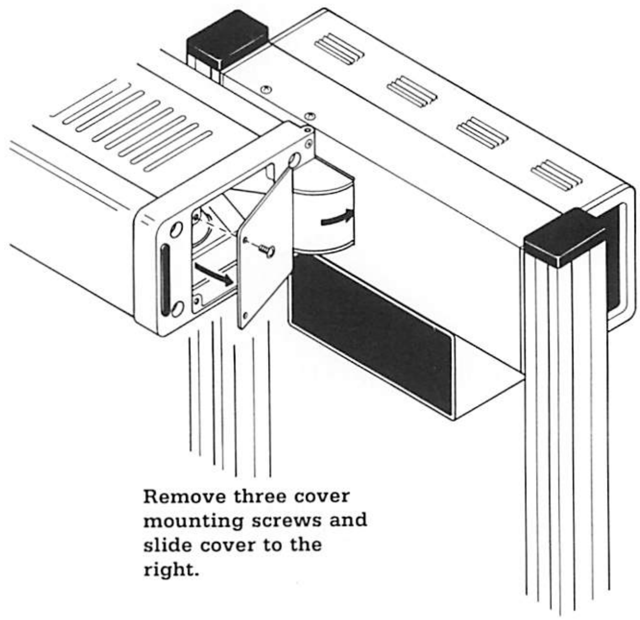


Figure 5-4. Examination Lamp Cover Removal.

1. Disconnect the power cord for the Infant Warmer System and allow the unit to cool for 10 minutes.

2. Rotate the heater assembly to the X-ray position.

3. Use a Phillips head screw driver to remove the three back panel mounting screws and slide the back panel to the right side.

4. While holding the lamp with one hand, use the other hand to pull the lever (next to the lamp) forward and remove the lamp.

5. Place the new lamp in position and push it into the lamp socket.

6. Replace the back panel and mounting screws.

7. Rotate the heater assembly back to the normal operating position.

8. Plug the power cord in and switch the examination lamp on. Check for proper operation.

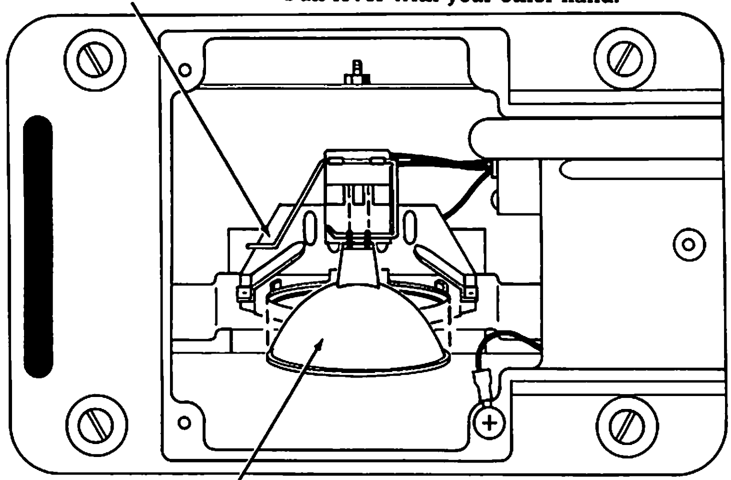


Figure 5-5. Examination Lamp Replacement.

5.2 CONTROL MODULE REPAIRS

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

A. Control Module Removal (Figure 5-6)

1. Disconnect the Infant Warmer System power cord.

2. Remove the two inside mounting screws from the bottom of the display module.

3. Remove the two mounting screws for the control unit cover and remove the cover.

4. Disconnect the three connectors (J17, the motor connector and the observation light connector) from the heater housing. Squeeze the locking tabs on the rear of the plug to disengage the lock mechanism.

5. Loosen the four mounting screws for the control unit and carefully remove the control module. Place the control unit on a flat surface so it rests on the transformers.

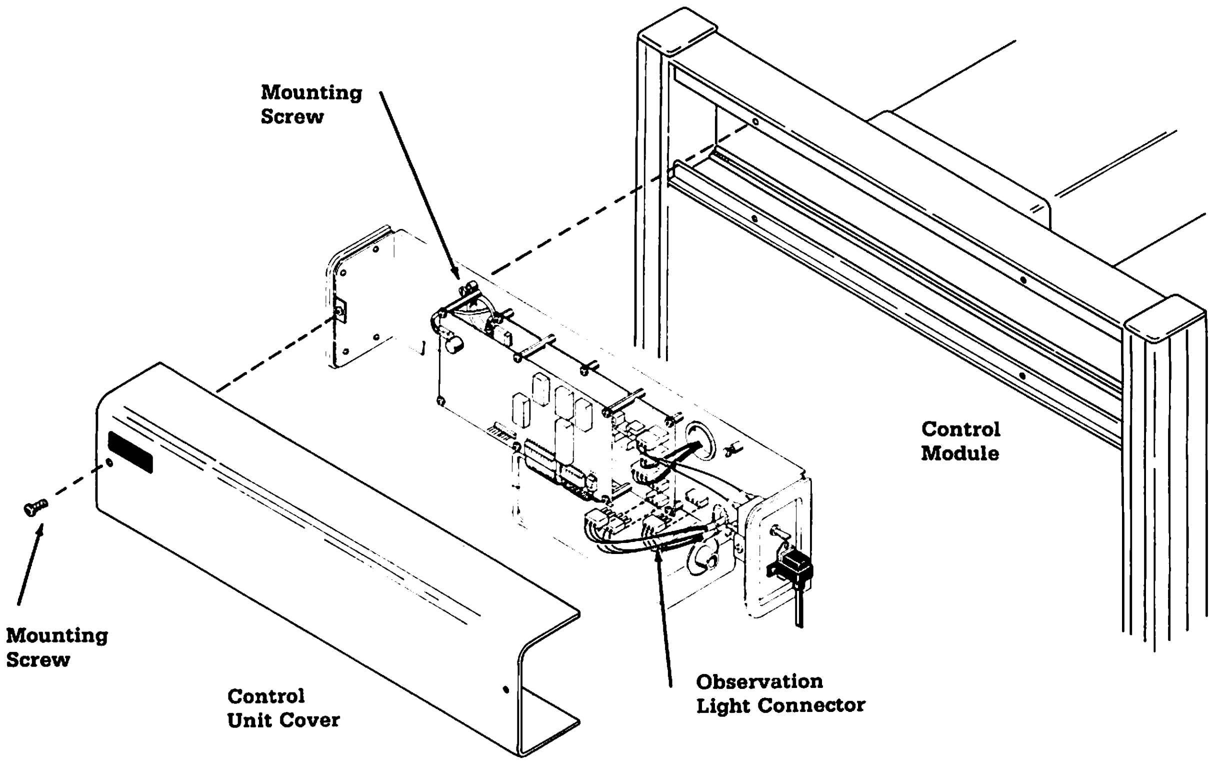


Figure 5-6. Control Module Assembly.

B. Control Board and Power Supply Board Replacement (Figure 5-7)

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

1. Disconnect the Infant Warmer System power cord.

2. Disconnect the four connectors (J1, J5, J6, and J7) from the control board. Disengage the locking tab on the socket by inserting a small screwdriver between the tab and the rear of the plug.

3. Use a 5/16 inch socket to remove the six mounting nuts for the control board.

4. Remove the control board.

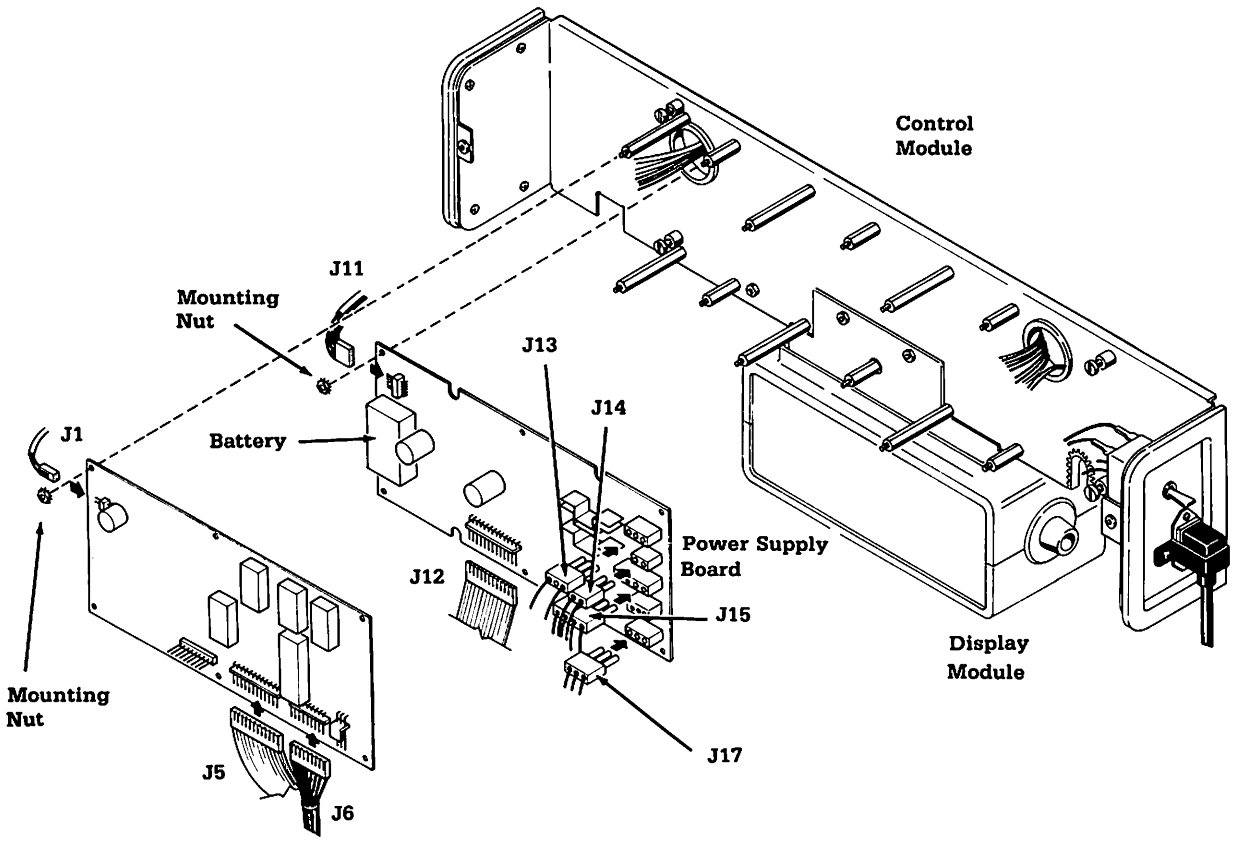


Figure 5-7. Control Board and Power Supply Board Assembly.

Power Supply Board Removal

Note: Remove the Control Board first.

1. Disconnect connectors J11, J12, J13, J14, J15, J16 and J17 from the power supply board. To remove connectors J11 and J12, disengage the locking tab on the socket by inserting a small screwdriver between the tab and the rear of the plug. Remove connectors J13, J14, J15, J16 and J17, by squeezing the locking tabs on the rear of the plug to disengage the lock mechanism. J12 is a short connector which connects to J5 on the control board.

2. Use a 5/16 inch socket to remove the six mounting nuts for the power supply board.

3. Remove the power supply board.

Power Supply Board Installation

1. Place the new power supply board in position on the six mounting posts.

2. Replace the six mounting nuts for the power supply board.

3. Reconnect connectors J12, J13, J14, J15, J16 and J17 to the power supply board. J12 is a short connector which connects to J5 on the control board.

4. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

Control Board Installation

1. Place the new control board in position on the six mounting posts.

2. Replace the six mounting nuts for the control board.

3. Reconnect the four connectors (J1, J5, J6, and J7) to the control board.

4. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

C. Display Module Disassembly (Figures 5-8 and 5-9)

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

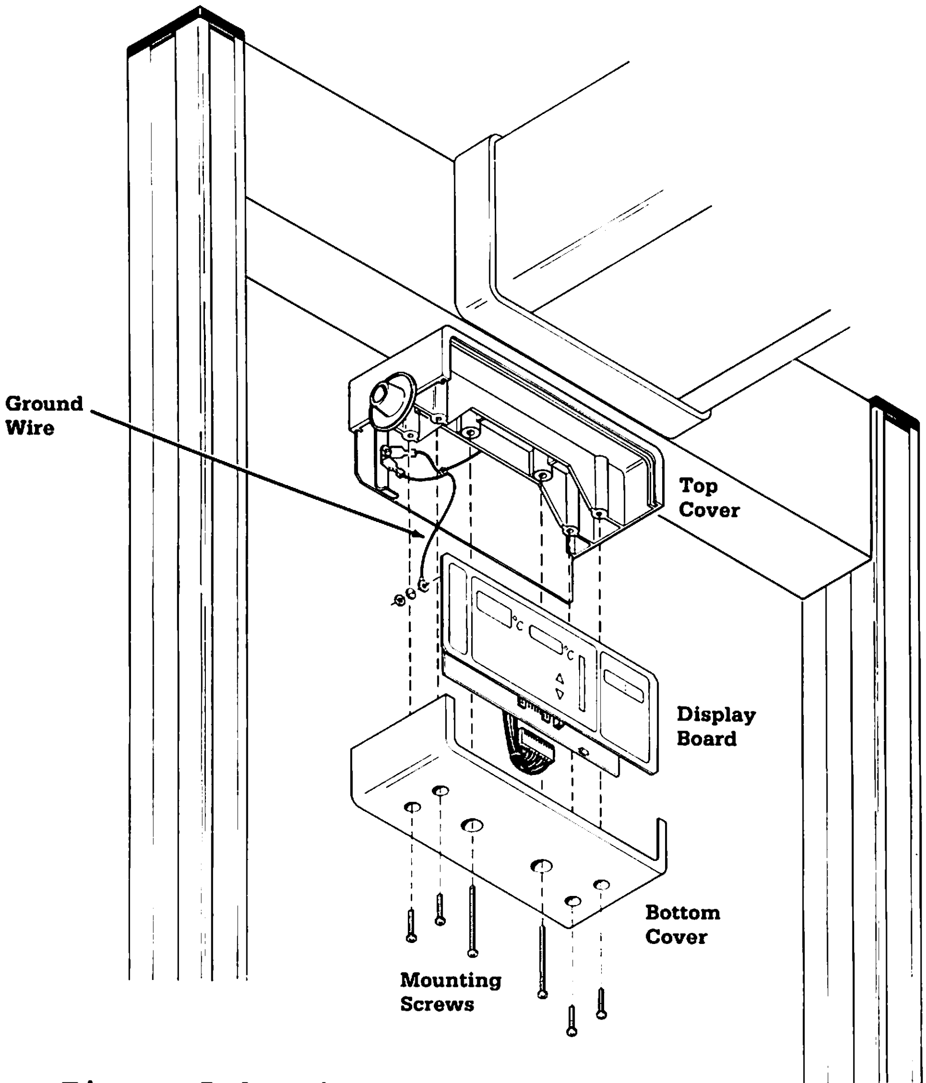


Figure 5-8. Display Module Assembly.

1. Disconnect the Infant Warmer System power cord.

2. Remove the 4 bottom cover screws from the Display Module.

3. Slide the bottom cover with the display board from the top cover.

4. Slide the display board out of the bottom cover.

5. Disconnect the ground wires from the bottom cover.

6. Disengage the locking tab on the socket of the 12 pin connector (J22)by inserting a small screwdriver between the tab and the rear of the plug. Disconnect the connector.

7. Remove the 5 mounting nuts with lock washers and the one ground wire from the display board. See Figure 5-9.

8. Separate the display board from the display panel.

D. Display Module Assembly (Figures 5-8 and 5-9)

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

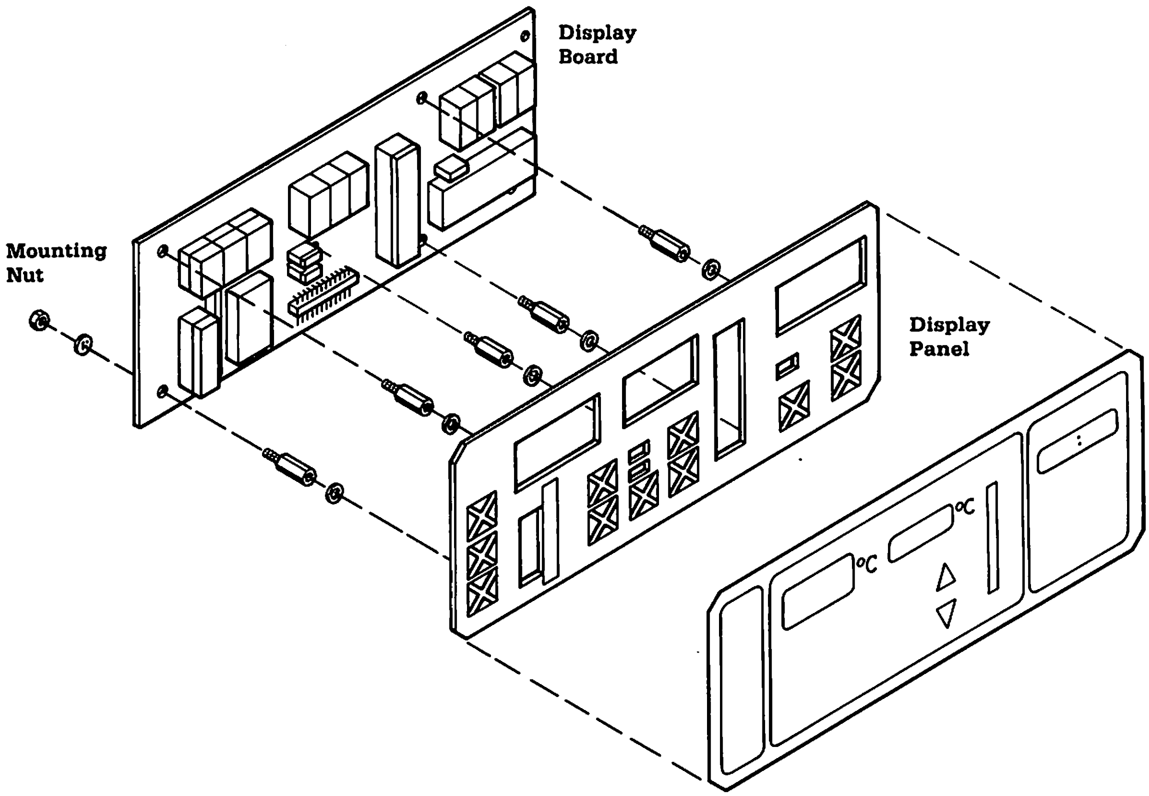


Figure 5-9. Display Board Assembly

1. Place the display board on the display panel.

2. Replace the 5 mounting nuts with lock washers and the one ground wire for the display board.

3. Connect the 12 pin connector J22 from the control board to the display board.

4. Connect the ground wires to the bottom cover.

5. Slide the display board into the bottom cover.

6. Slide the bottom cover with the display board and back panel into the top cover. Take care to ensure that all the cables are clear of the covers and screws.

7. Replace the 4 bottom cover mounting screws for the display panel.

8. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

E. Control Module Replacement (Figure 5-6)

CAUTION: Use the Static Control Work Station (Part No. 0175-2311-000) to help ensure that static charges are safely conducted to ground. The Velostat material is conductive. Do not place electrically powered circuit boards on it.

1. Carefully place the control module in position, ensuring that all the cables are clear of the covers and screws. Tighten the four mounting screws for the control unit.

2. Reconnect the two connectors (J17 and J15) from the heater housing to the control board.

3. Hold the display module in position and replace the two inside mounting screws on the bottom.

4. Place the control unit cover in position and replace the two mounting screws.

5. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

F. Battery Replacement (Figures 5-6 and 5-7)

The maintenance free battery should be tested regularly. To ensure maximum performance replace the battery every two years. Refer to Section 3.2 for testing the battery.

1. Disconnect the Infant Warmer System power cord.

2. Remove the two mounting screws for the control unit cover and remove the cover.

3. Disconnect connector J1 from the control board. Disengage the locking tab on the socket by inserting a

small screwdriver between the tab and the rear of the plug.

4. Remove the 6 mounting nuts for the control board.

5. Slide the control board off the mounting posts and rotate it down. You do not have to remove any other connectors.

6. Remove the battery and install a replacement battery.

7. Place the control board in position on the mounting studs.

8. Replace the 6 mounting nuts for the control board.

9. Reconnect connector J1 to the control board.

10. Replace the two mounting screws for the control unit cover.

11. Perform the Electrical Safety Procedures in Section 4 and the Checkout Procedures in Section 3.

G. Circuit Breaker Reset

The Infant Warmer is equipped with a combination power switch and manual resetting circuit breaker. If the circuit breaker trips the power switch is deactivated. To reset the circuit breaker return the switch to the ON position. If the circuit breaker trips again, service is required.

5.3 BED PLATFORM REPAIRS

A. Side Panel Replacement (Figure 5-10)

To remove a side panel, first lower the side panel then press the end pins in and lift the side panel out. To replace a side panel hold the end pins in, place the side panel in position and release the end pins.

To lower the side panel pull up and rotate away from the bed.

To raise the side panel rotate it to the upright position; then allow it to engage in the latched position.

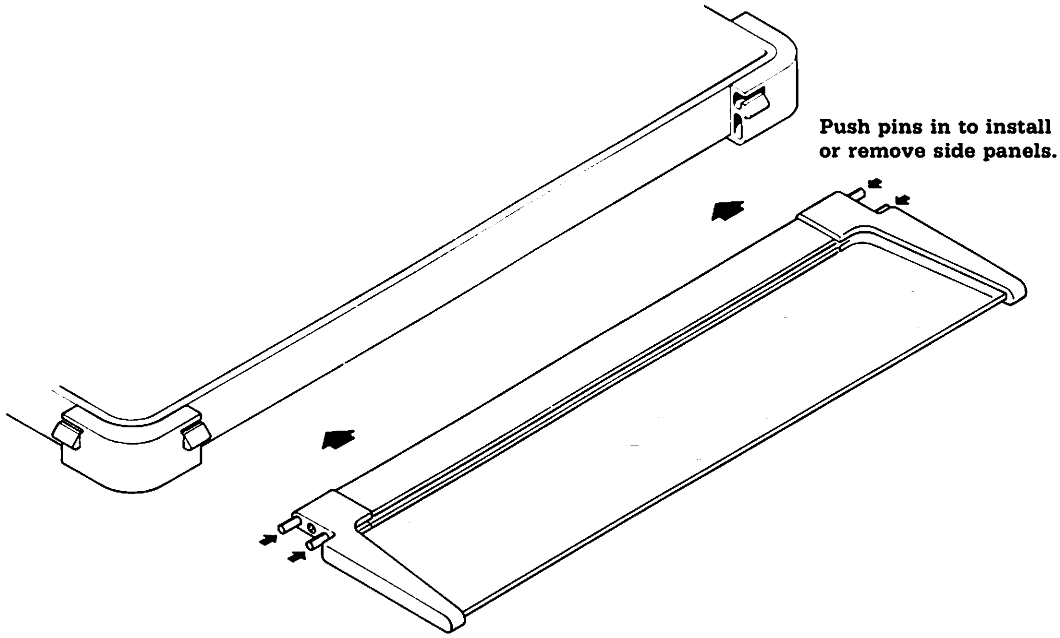


Figure 5-10. Side Panel Operation.

B. Side Panel Repairs (Figure 5-11)

Disassembly:

1. Remove the mounting screw from the end bracket.
2. Remove the other mounting screw and end bracket if the bed side or window need replacement.
3. Disassemble the end bracket, support button and spring from the bed side.
4. Replace damaged parts as necessary.

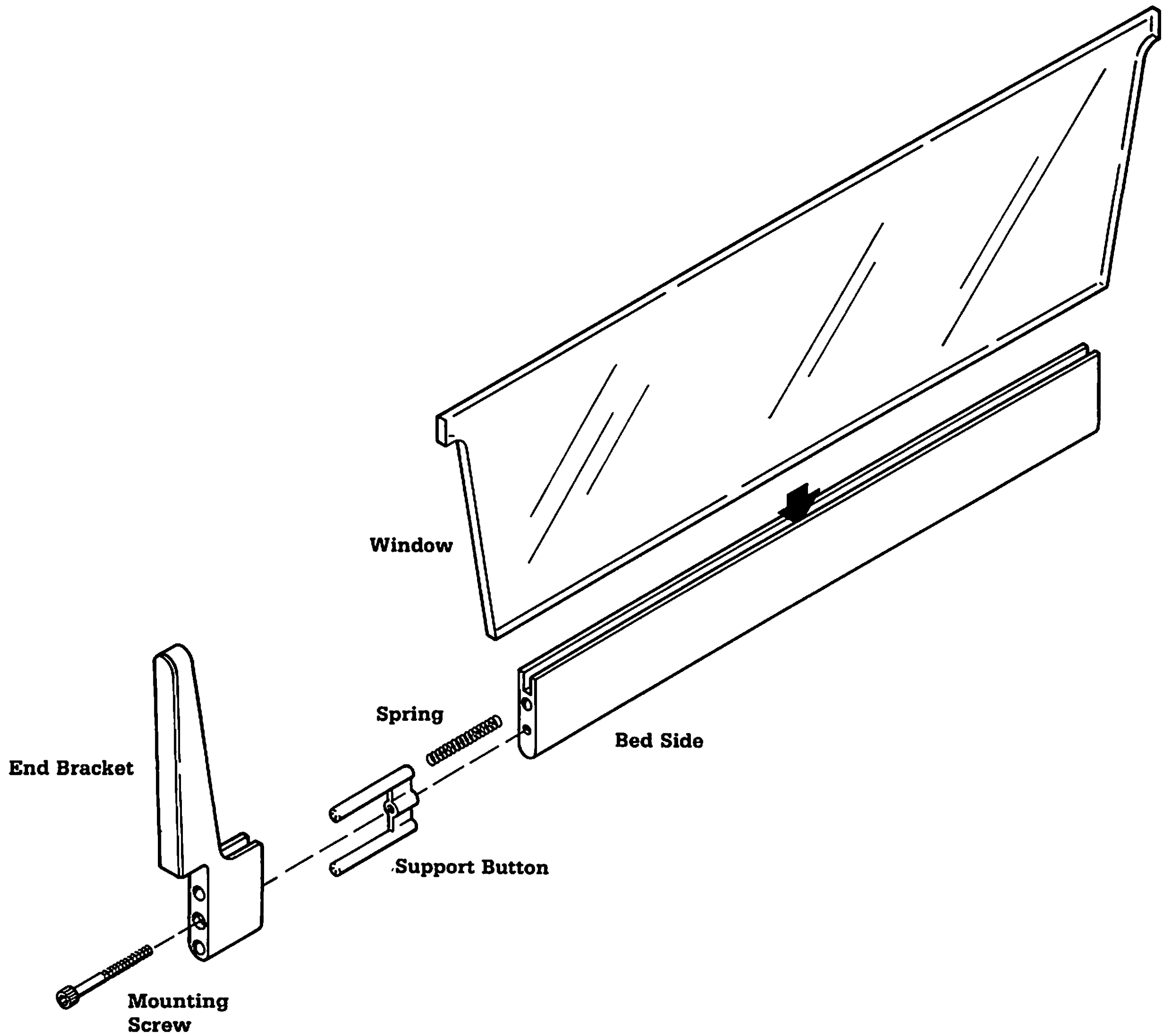


Figure 5-11. Side Panel Assembly.

Assembly:

1. Mount the spring, support button, and end bracket on the bed side and window.

2. Replace the mounting screw and tighten securely.

C. Bed Platform Disassembly (Figure 5-12)

WARNING: Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

1. Remove the mattress and the Plexiglas cover.

2. Remove the four side panels from the bed platform.

3. Remove the four corner blocks from the bed platform.

4. Use a 1/2 inch wrench and 7/16 inch wrench to remove the hydraulic system mounting nut and stud from the lower support.

5. Use a No. 2 Phillips screw driver and remove the four retaining rods and hooks from the bottom of the bed platform.

6. Slide the two bed pivot rods out from each side.

7. Lift the bed platform off the lower support.

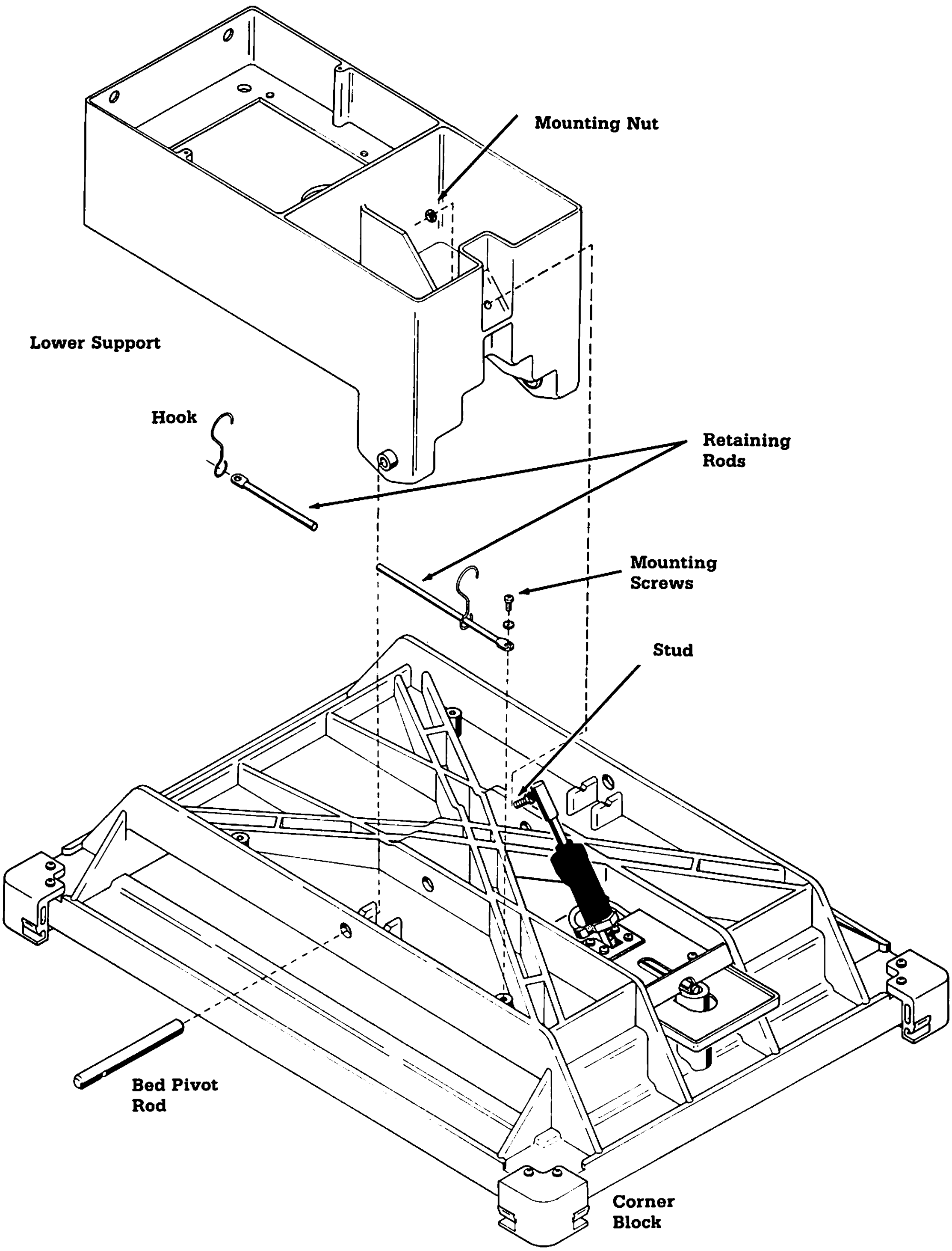


Figure 5-12. Bed Platform Assembly

D. Bed Platform Assembly (Figure 5-12)

1. Place the bed platform in position on the lower support.

2. Insert the two bed pivot rods into position on the lower support. The notch must face the bed platform (upwards) and be positioned between the notches in the bed platform.

3. Use a No. 2 Phillips screw driver and install the four retaining rods and hooks on the bottom of the bed platform. The open end of the hooks should face away from the bed platform.

4. Use a 1/2 inch wrench and 7/16 inch wrench to install the hydraulic system mounting nut and stud on the lower support.

5. Replace the four corner blocks on the bed platform.

6. Replace the four side panels on the bed platform.

7. Replace the Plexiglas cover.

8. Replace the mattress.

E. Hydraulic System Removal (Figures 5-13 and 5-14)

CAUTION: When lowering or lifting the Infant Warmer System to and from the floor for inspection or repair, use two people for safety. Always check to ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater/lamp housing does not lock and pivots to the left for bed access.

Note: Ohmeda recommends replacing the hydraulic system as an assembly. The system uses a standard synthetic hydraulic oil.

1. Use a 1/2 inch wrench and 7/16 inch wrench to remove the hydraulic system mounting nut and stud from the lower support.

2. Remove the two Phillips head mounting screws which hold the outer (triangular shaped) cover plate in position.

3. Remove the four Phillips head mounting screws which hold the inner (square shaped) cover plate in position. CAUTION: Take care to ensure that the tension on the spring is released carefully.

Note: The tilt lever, rod, spring, and mounting pin can be removed for replacement if necessary. Remove the pin from the top of the bed to remove the spring and rod.

4. Note how the tubing is installed in parallel and does not overlap until it reaches the storage area.

5. Remove the hydraulic system assembly for replacement.

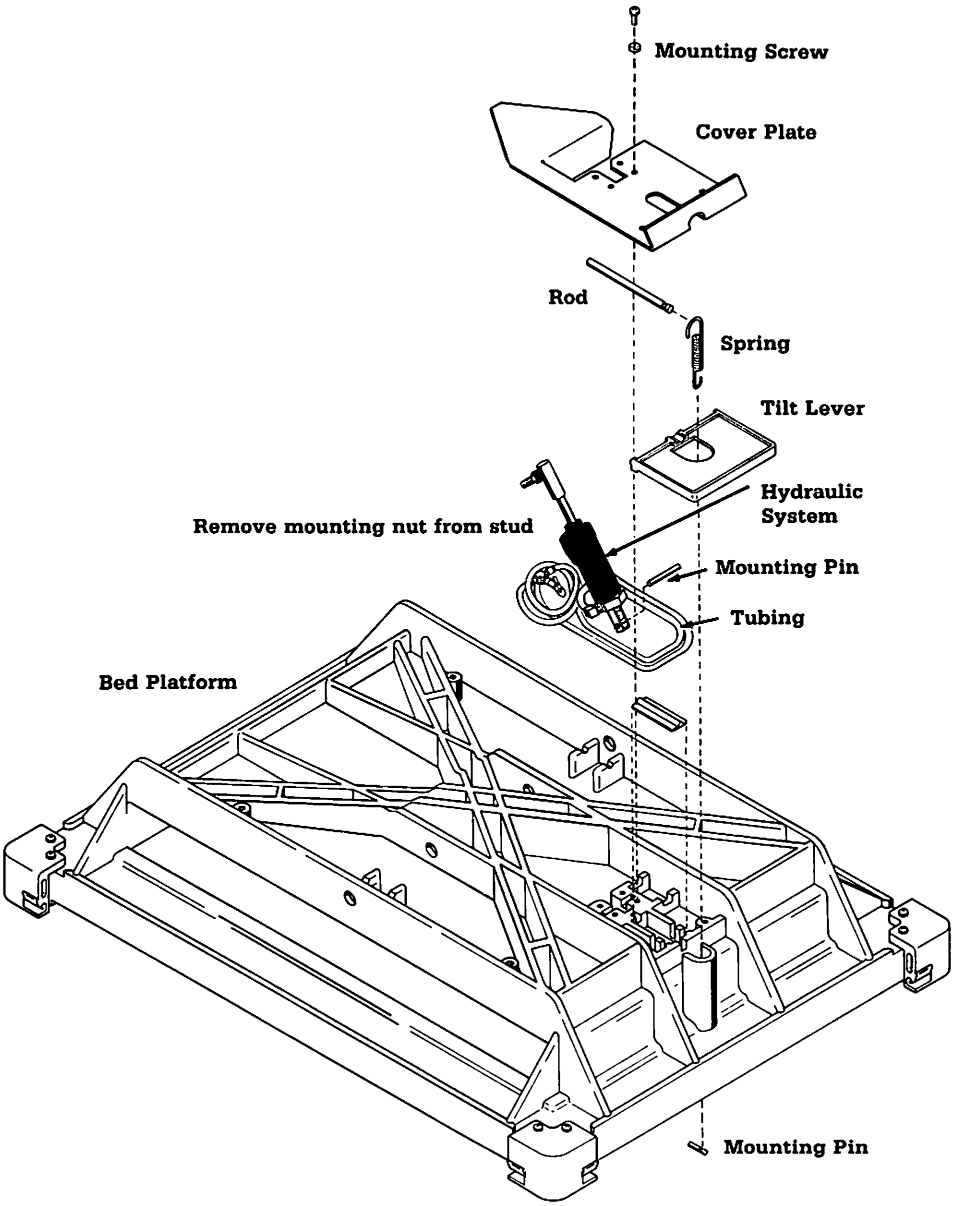


Figure 5-13. Hydraulic System Assembly.

F. Hydraulic System Installation (Figures 5-13 and 5-14)

1. Transfer the mounting pin from the old hydraulic cylinder to the new hydraulic cylinder.

2. Place the hydraulic cylinder (with pin) in position.

3. Install the tubing for the hydraulic system in parallel and make sure it does not overlap until it reaches the storage area.

   Note: The tubing must not be stretched, pinched or kinked during reassembly. If the tubing is pinched the bed will not tilt.

Install the tubing for the hydraulic system in parallel and make sure it does not overlap until it reaches the storage area. The tubing must not be stretched, pinched or kinked during reassembly.

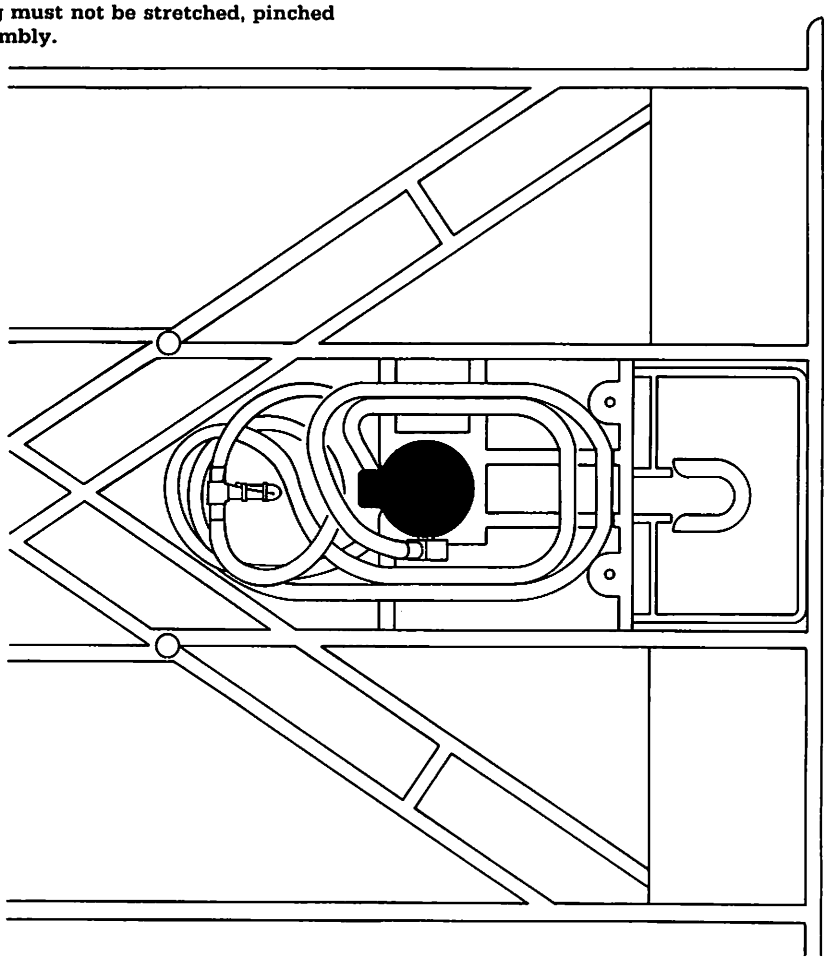


Figure 5-14. Hydraulic Tubing Installation.

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4. Place the inner (square shaped) cover plate in position.

5. Install the two mounting screws closest to the tilt lever.

6. Install the two mounting screws closest to the cylinder at the edge of the cover plate.

7. Coil the tubing so it fits in the triangle area.

8. Place the outer (triangular shaped) cover plate in position and replace the two Phillips head mounting screws.

5.4 ELECTRIC MOTOR/JACK-SHAFT ASSEMBLY AND DISASSEMBLY.

(See Figures 5-15, 16, 17 and 18)

GENERAL DISASSEMBLY PROCEDURES

Note: This procedure requires two people, since the Infant Warmer must be carefully laid on its right-hand side (as viewed from the front of the unit) during the operation.

In order to replace the lift motor, phase capacitor, gear box/ jack-shaft unit or motor power cable, the following steps are necessary.

WARNING: Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

1. Remove the bed assembly mattress, Plexiglas cover and side panels, as described in Section 5 C.

2. Remove the drawers of the unit.

3. Remove the cover plate from the bed support casting. See item 3, Figure 7-1.

4. Disconnect the motor cord plug and socket located inside the bed support casting.

   WARNING: When ever lowering or lifting the Infant Warmer System to its side, use two people for safety.

5. Carefully lay the Infant Warmer on its right-hand side, as viewed from the front.

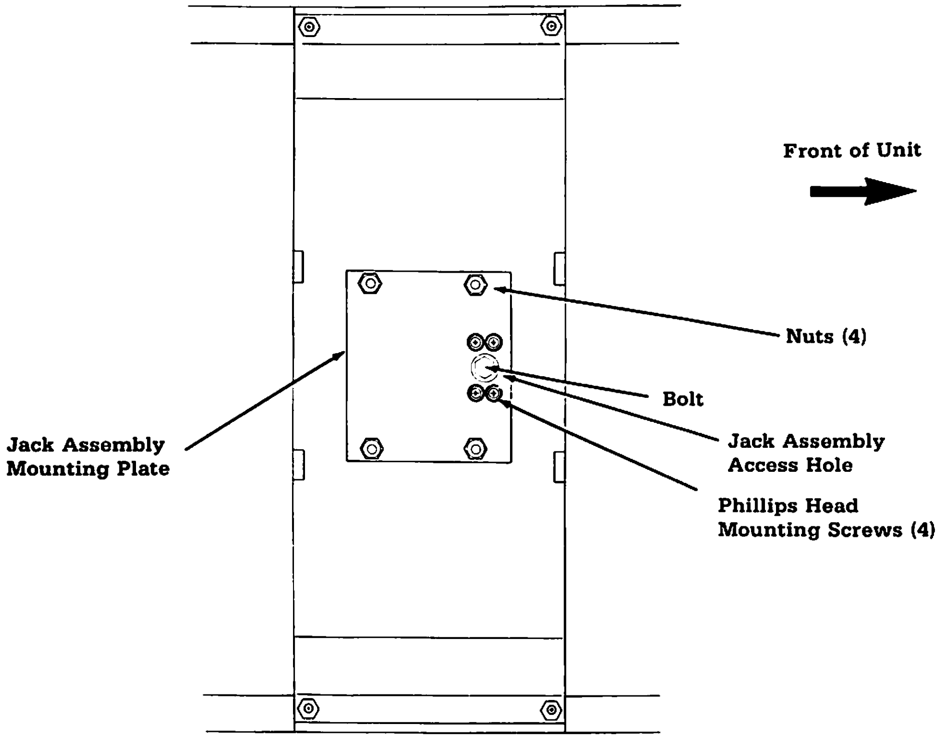


Figure 5-15. Bottom View of 5000 Infant Warmer (laying on its right hand side).

WARNING: Whenever the unit must be laid on its side for a repair procedure, lay it on the right side (as viewed from the front), the lamp-house assembly swings freely to the left and attempting to lay the unit on the left side could cause injury to a repair person or damage to the equipment.

6. Insert a 1/2 inch, socket wrench through the access hole in the bottom mounting plate and remove the lower mounting bolt (5/16-18). See Figure 5-15.

7. Use a 1/2 inch wrench to remove the four(4) 5/16-18 hex nuts and external lock washers from the assembly base plate. DO NOT REMOVE THE FOUR PHILLIPS HEAD SCREWS.

8. Pull the base plate off using care....the ground wires and motor phase capacitor are mounted to this plate. **WARNING: Observe all safety precautions to avoid electrical shock hazard from high voltage.**

9. Using an insulated screwdriver, ground the phase capacitor to the base plate to remove any electrical charge and chance of shock.

10. When the plate is clear of the four studs, swing it to the left and disconnect the lug-screw holding the green ground wires.

11. Disconnect the cable clamp holding the coiled, motor power cable to the plate.

12. Unplug the single pin connector from the power cable common (white) wire.

13. Using a 7/16 inch wrench remove the nut holding the motor housing ground wire (green) to release the power cable.

14. Disconnect the insulated connectors from the phase-change capacitor. The plate should be free for removal.

15. One person at the bottom of the unit must hold the motor/ jack-shaft assembly while a second person at the top loosens the upper motor/jack-shaft mounting bolt with a 1/2 inch wrench. (Access is through the opening in the bed support casting.)

    Note: There is an external lock washer between the head of the bolt and the upper plate. There is also another lock washer, on the same bolt, under the plate between the top of the jack-shaft and the plate. See Figure 5-16.

16. When the upper bolt is loose, the person working the upper bolt should continue to unscrew it while holding it firmly against the plate. The person guiding the motor/jack-shaft assembly from the bottom, should apply gentle pressure outward away from the upper bolt.

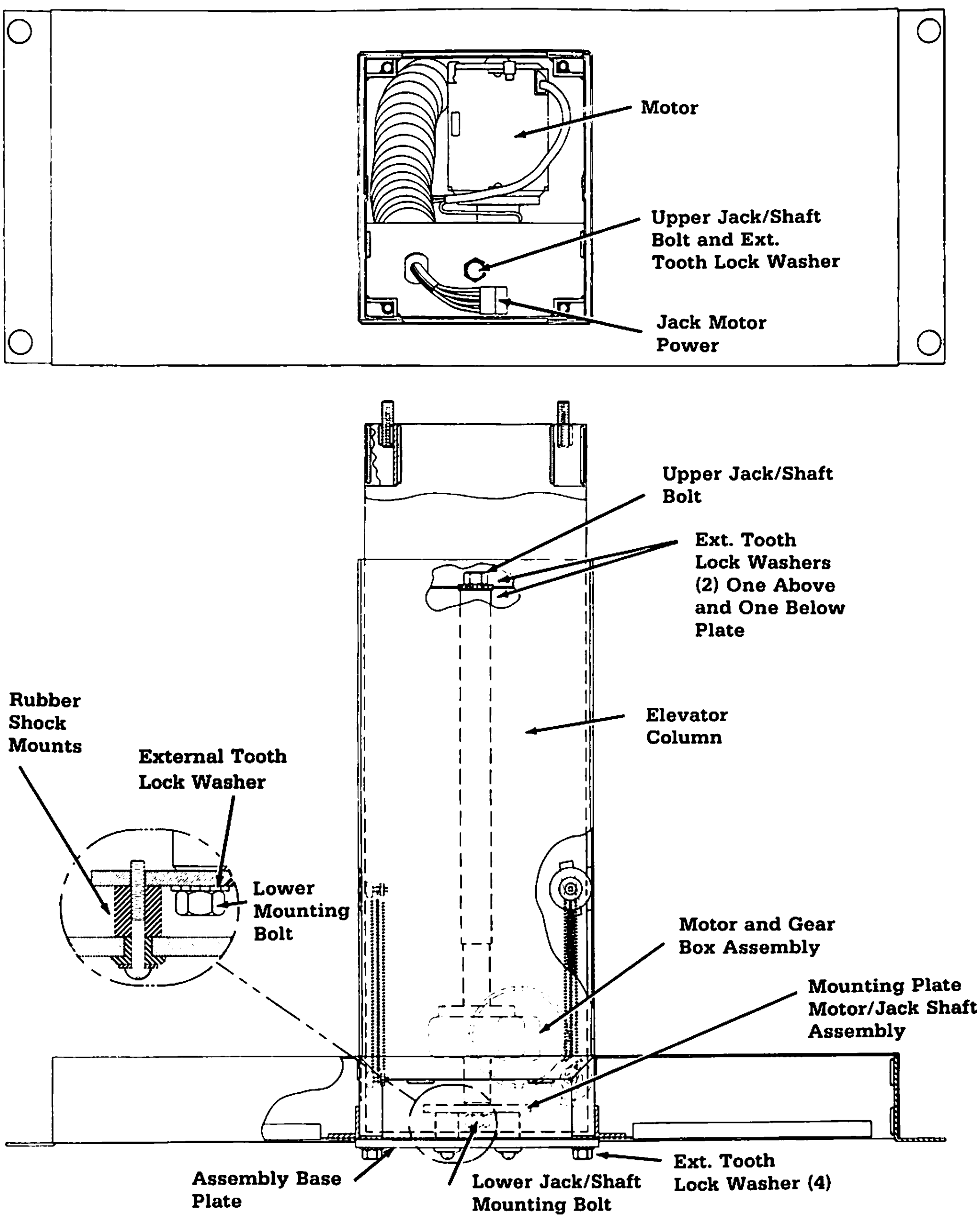


Figure 5-16. Top and Cut-away Internal Side View of Elevating System

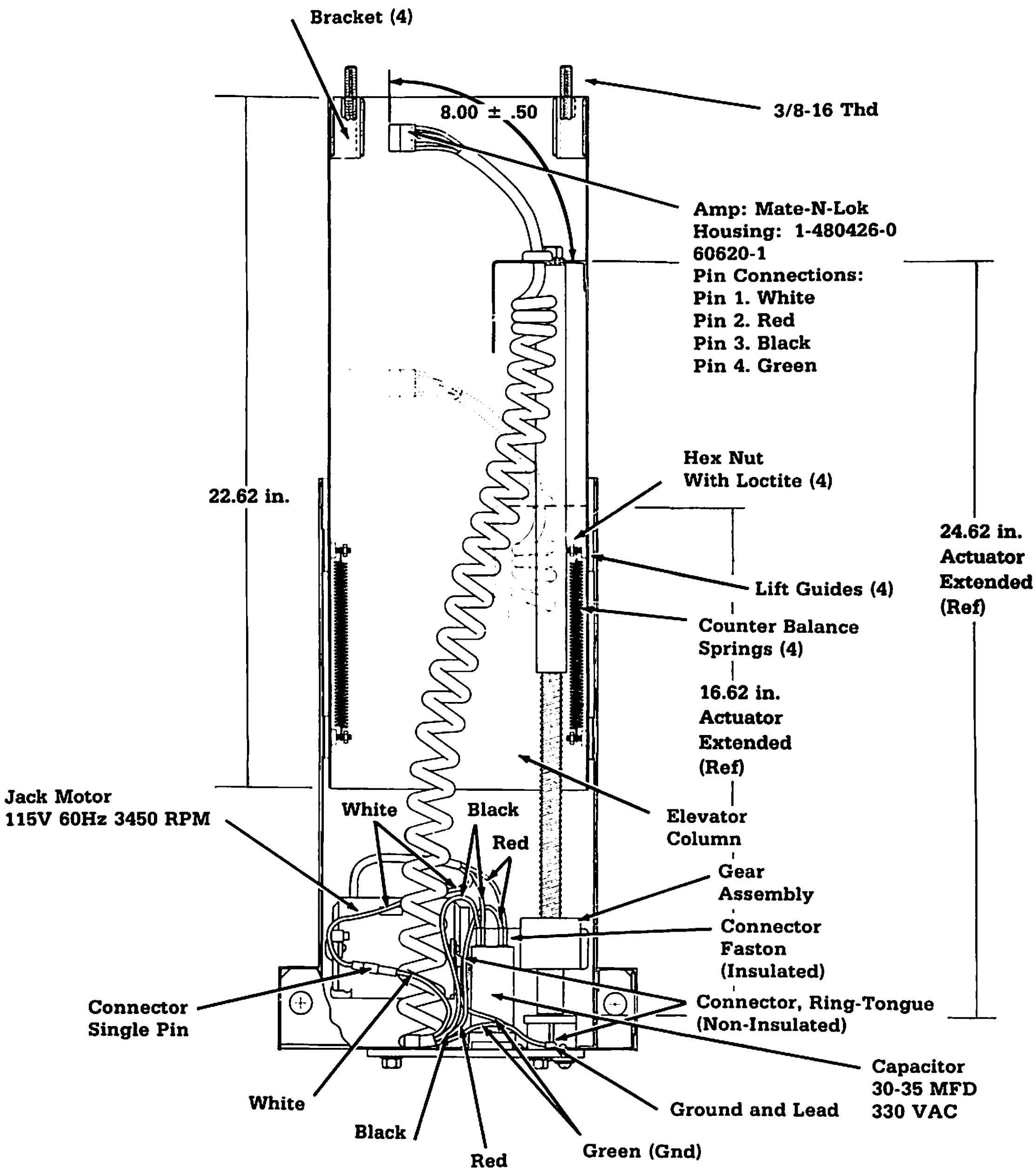


Figure 5-17. Cut-away, Internal Side View; Cable and Wiring Connections

17. When the motor/jack-shaft assembly is loose from the upper bolt, the person holding the bolt should continue to apply pressure, holding it against the plate. This should retain the lock washer between the jack-shaft and plate.

18. The person at the lower end of the unit should remove the motor/jack-shaft assembly from the elevator column.

    Note: The removal of the assembly requires some maneuvering by the person removing it. Gently pull the assembly out and turn it in a clockwise direction until the motor is located in the upper left corner of the access hole. Lifting outward on the bottom of the unit and gently maneuvering back and forth should allow the unit to be pulled out of the elevator column.

19. When the assembly is clear, check the top of the jack-shaft for the upper lock washer which may have stuck to the shaft. If the washer is there, remove it and set aside. If it is not, reach up the elevator column and remove it from the upper mounting bolt and set it aside. Now the upper bolt can be removed and set aside.

20. Remove the Motor/Jack-Shaft assembly to replace the motor, Motor Coupling, Phase Capacitor, Gear box and shaft, or Power Cable.

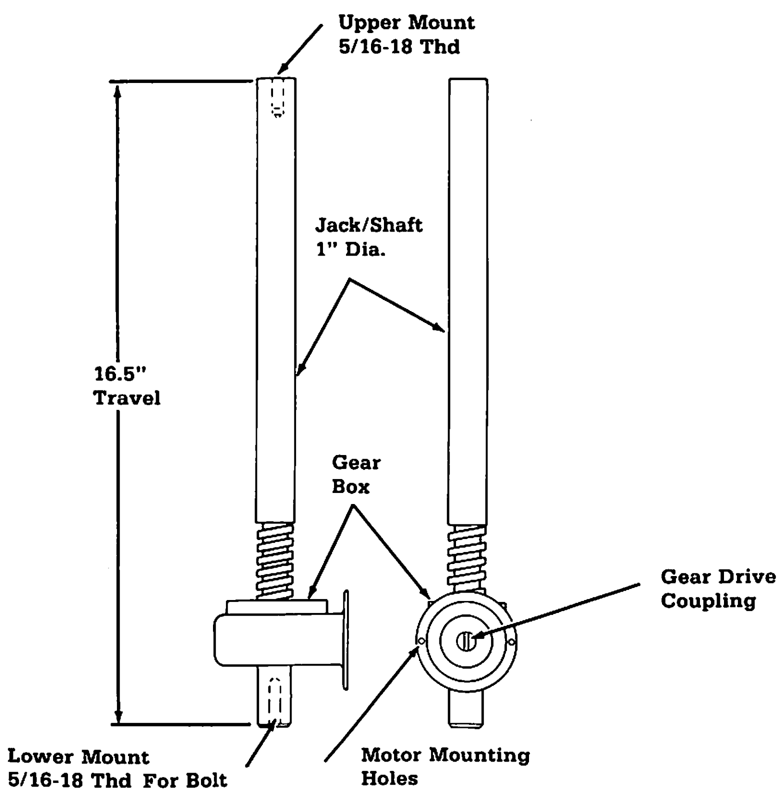


Figure 5-18. Gearbox and Jack-Shaft Assembly.

A. Motor Replacement

Disassembly:

The motor is bidirectional, 115v 60Hz and draws 2.7 amperes. It has thermal overload protection and there are three(3) power connection wires...

White - Common, connects to the power cord
Red - Clockwise Rotation, connects to capacitor
Black - Counter-Clockwise Rotation, connects to capacitor

1. Use a 7/16 inch wrench to remove the two nuts that hold the motor housing to the gear box assembly.

2. One of these nuts held the ground connection from the power cable for the motor housing.

3. Once the two nuts are removed the motor lifts away from the gear box assembly.

4. The motor shaft is coupled to the gear drive with a hard rubber coupling. The coupling is slotted for alignment with a gear drive coupling in the recess of the gear box.

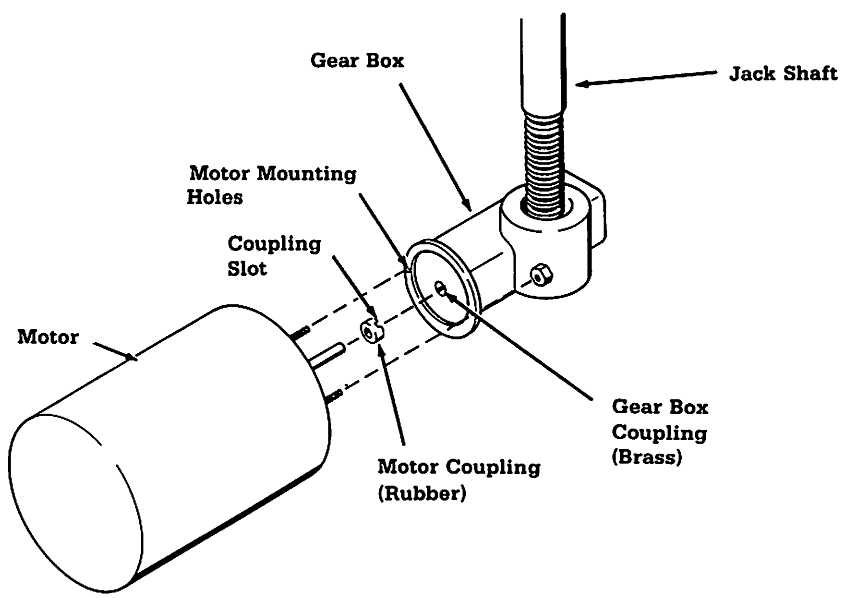


Figure 5-19. Motor and Gearbox Assembly.

Reassembly:

Note: When replacing the motor, there is a need to align the groove in the motor coupling with the raised portion of the drive coupling in the gear box. Ensure that the slot of the motor coupling and the raised portion of the drive coupling are in the same approximate plane. The coupling is such that it will settle itself into final alignment when the jack-shaft is turned.

1. Slip the motor coupling into the gear box assembly and align the studs of the motor housing with the mounting holes on the gear box.

2. Start the 10-32 nut on the right side (viewed from the shaft end of the motor).Do not tighten.

3. Replace the ground wire for the motor housing and start the threads of the 10:32 hex nut. Fit the motor housing against the gear box to ensure proper alignment of the coupling.

4. If the motor does not easily fit flush against the gear box, check the coupling alignment.

5. When the proper fit is accomplished, tighten the motor mounting nuts.

B. Jack Replacement

The gear box/jack-shaft is a single assembly, Part Number 0217-5175-300. The preceding procedures explain disassembly. See Figure 5-18 for gear box/jack-shaft configuration.

C. Capacitor Replacement

1. Disconnect the capacitor as detailed in the General Disassembly procedure, steps 9 and 14. **OBSERVE THE SHOCK HAZARD WARNING.**

2. To remove and replace, simply disconnect the red and black wire connectors lift out the old capacitor from the mounting base and slip in the new one.

3. Reconnect wires. Ensure that connections to the capacitor are power cord red and motor red to the same terminal...power cord black and motor black to the other terminal, see Figure 7-17.

Note: Failure to observe the preceding step will result in the bed movement to be reversed from panel indications.

D. Power Cord Replacement

The power cord is a special coiled, four-conductor, rubber covered cord. It has a four(4) pin Mate-N-Lok connector on the upper end and red, black, white and green wires on the other end. The white wire has a single pin connector which attaches to the white, motor lead with a mating connector. The green (ground) wire is crimped into a ring-tongue, lug which also has a short green wire (with crimp on lug) to provide a motor ground connection.

1. Disconnect all electrical connections.

2. The upper end of the power cord is held in place by a strain relief bushing which must be compressed to remove.

3. The lower end of the power cord is held in place by a cable clamp which is attached to the assembly base plate. The clamp must be removed.

4. The power cord should be free for removal and replacement.

5. In some cases it may be necessary to replace the strain relief bushing with a new one.

E. Column Guide Lubrication:

Anytime that service is required on the components contained in the lift column, or every two years, the surface upon which the column guides ride should be lubricated.

1. The person at the top end of the unit must hold it while the second person at the bottom end pulls the lower part of the unit away from the top. Full lowered position to full raised position is a distance of eight(8) inches.

2. Use a cotton swab, or your finger, to apply a Lubriplate grease (0220-5150-300, 14 oz. can) along each inside corner of the lower column. This is the surface upon which the column guides ride.

Note: The unit movement is eight inches from the fully lowered position to the fully raised position. If you should pull it further apart, the unit will separate and you must use the following procedure to rejoin the upper and lower columns.

1. Remove the lower end of the four(4) counter-balance springs by removing the hex nuts with a 3/8 inch wrench. See Figure 5-17.

2. Using a long-nose pliers, or a spring hook, to remove the lower loop of the counter balance springs.

   CAUTION: Depending on the position of the upper column in relation to the lower column, the springs could be heavily or lightly tension loaded. Use care when releasing the springs.

3. Push the column guides toward the bottom of the column. The slotted mounting holes will position the guide so the bottom section of the column will slide over the upper section.

4. Slide the two sections together using care to ensure that they are properly aligned. It may take a couple of attempts to slip the lower column section over the top while clearing the guides.

5. When the two units are rejoined, ensure that they slide without binding.

6. Replace each counter balance spring by reconnecting the end-loop to the stud on each guide.

7. Replace the four(4) hex nuts and apply a small amount of medium strength Loc-Tite.

5.5 CASTER REPLACEMENT

Casters can be replaced with the unit upright or the unit may be carefully placed on it's right side (as viewed from the front of the unit).

WARNING: Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

CAUTION: When lowering or lifting the Infant Warmer System to and from the floor for inspection or repair, use two people for safety. Always ensure that you lay the unit on its right side (as viewed from the front) when laying the unit down. The heater/lamp housing does not lock and pivots to the left for access.

1. Lock or block all remaining casters to keep the unit from rolling around (unless the unit has been laid on it's side).

2. Use blocks to raise the frame higher near the caster you are replacing.

3. Remove the plastic end plate from the stand assembly.

4. Use a 7/8 " socket and ratchet to remove the caster mounting nut.

   Note: There is another nut underneath the caster. You may have to hold this nut while removing or tightening the caster mounting nut.

5. Tilt the unit; remove the old caster and install the new caster (unless the unit has been laid on it's side).

6. Replace the mounting nut and tighten securely.

   Note: There is another nut underneath the caster. You may have to hold this nut while removing or tightening the caster mounting nut.

7. Replace the plastic end cap.

5.6 YOKE MANIFOLD REPAIRS

WARNING: Never oil or grease oxygen equipment unless a lubricant that is made and approved for this type of service is used. Oils and grease oxidize readily, and in the presence of oxygen, will burn violently. Vac Kote* is the oxygen service lubricant recommended (Order No. 0220-0091-300).

WARNING: Before any disassembly or repair disconnect the electrical supply, gas pipeline supply connections and remove any gas cylinders.

A. General (Figures 5-20 and 5-21)

Periodically lubricate the Tee handle screws with a small amount of oxygen service lubricant. This will prolong their life and make sealing of the yoke gaskets easier.

Periodically replace the yoke check valve strainer nipples before they become clogged with lint or dust. Momentarily open and then close the cylinder valve before installing cylinders to blow any foreign material from the valve.

When installing fresh cylinders, remove the old gasket and use a clean new gasket (gasket seal, stock no. 0210-5040-100) in its place. Open cylinder valves S-L-O-W-L-Y to avoid straining high pressure gauges and developing excessive heat of recompression.

*Vac Kote is a trademark of Ball Brothers Research Corporation.

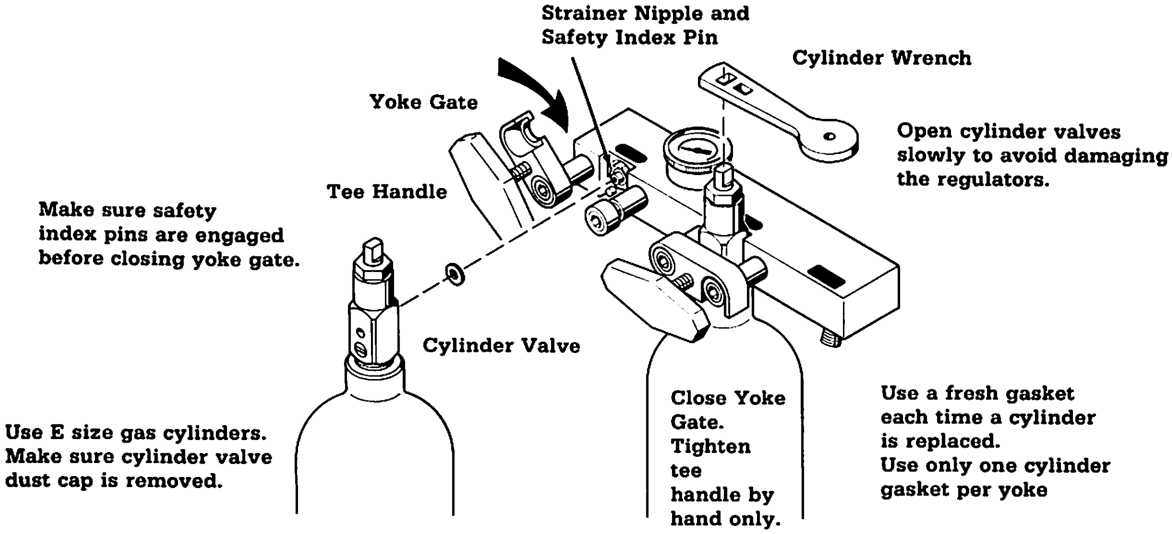


Figure 5-20. Gas Manifold Maintenance.

B. Gauge Replacement (0205-8350-300, O2 0205-8355-300, Air)

WARNING: When replacing gauges, be sure to use identical pressure ranges.

1. Turn off oxygen supply.
2. Use a 7/16 inch open end wrench and turn the gauge counterclockwise to remove it.
3. Apply Teflon tape around the threads of the new gauge.
4. Install the new gauge by turning it in clockwise. Do not over-tighten.

C. Gauge Lens Replacement (0212-0900-300)

1. Turn the lens cover counterclockwise to remove it.

2. Clean both sides of the replacement lens.

3. Place the lens cover in position over the gauge face and turn the lens clockwise. Do not over-tighten.

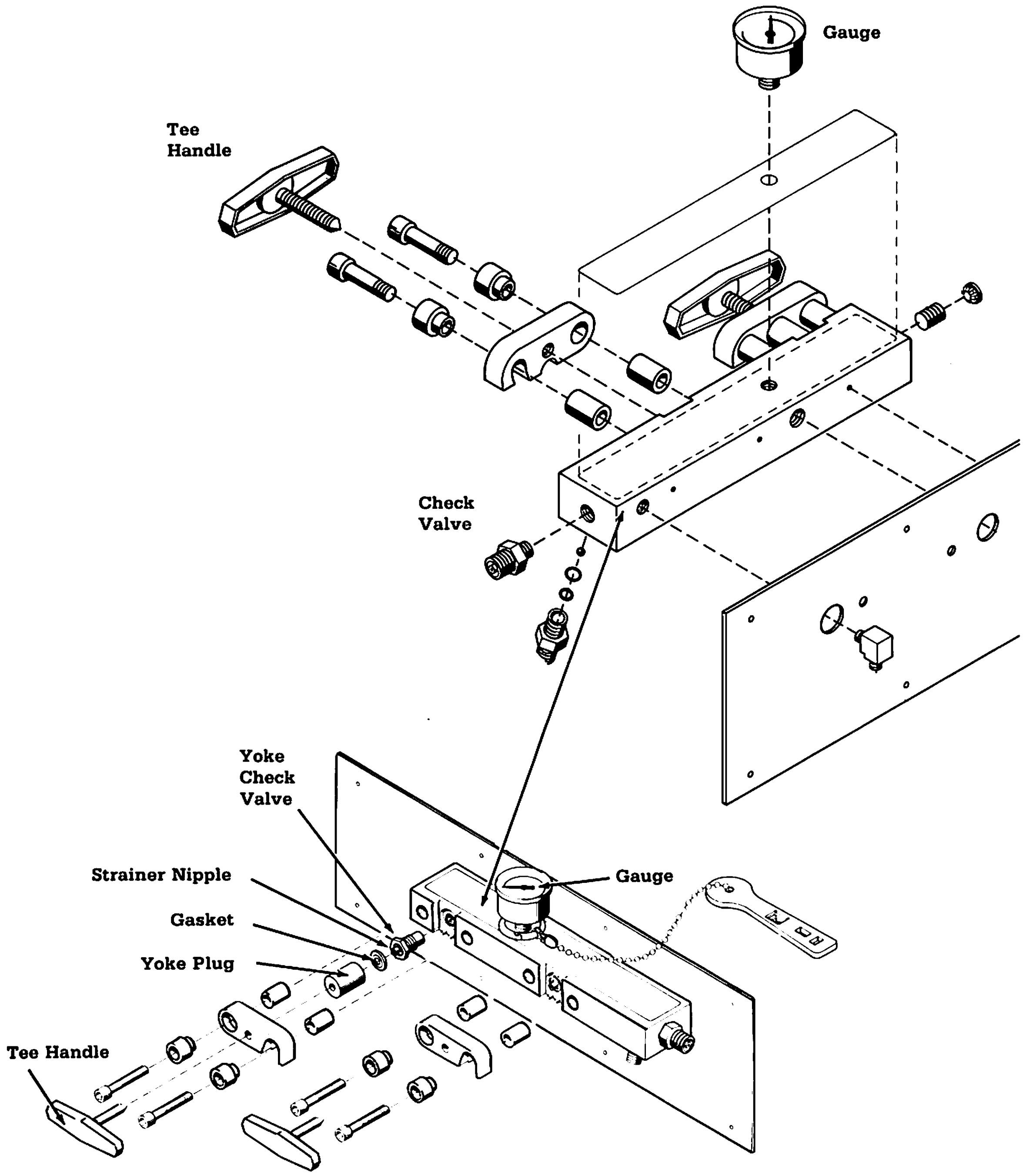


Figure 5-21. Manifold Assembly

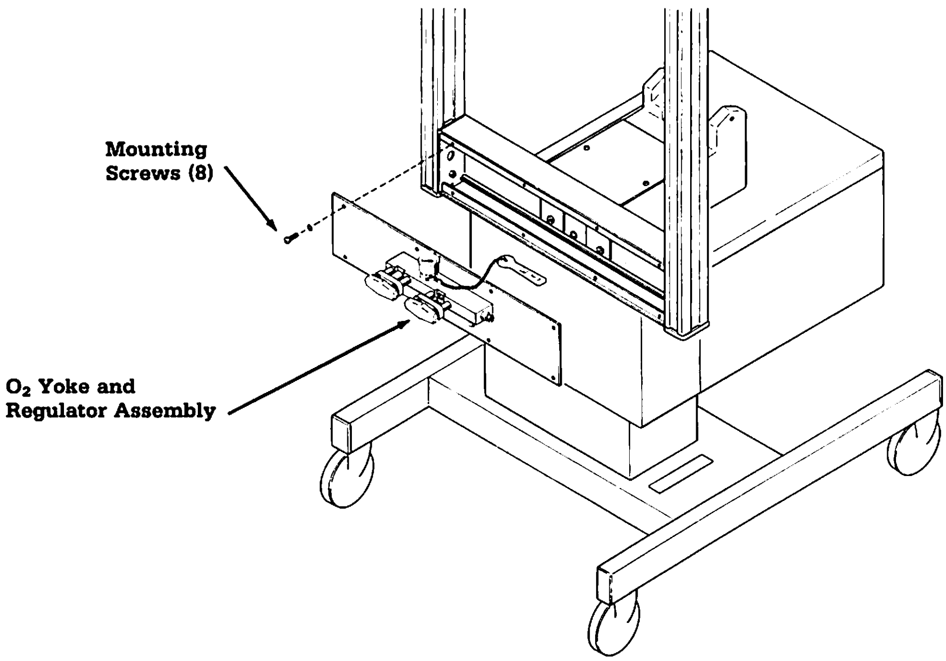


Figure 5-22. Manifold Assembly Removal.

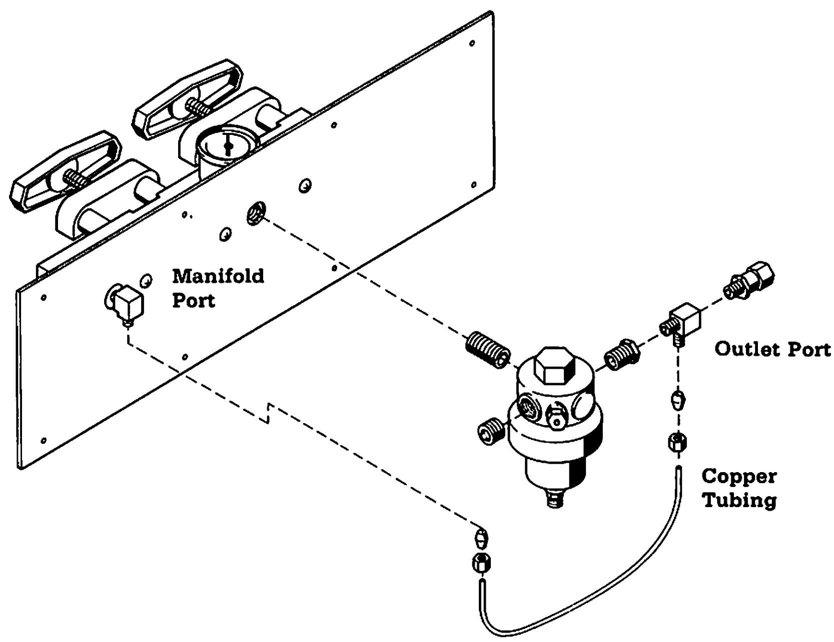


Figure 5-23. High Pressure Regulator.

D. Strainer Replacement

Periodically (at least once a year) replace the strainer nipples before they become clogged with lint or dust.

The strainers are located in the cylinder yokes of the gas supply modules. Close the cylinder valve and remove the gas cylinder, if present. With the yoke gate swung out of the way, use a flat-tip screwdriver to unscrew the strainer. Screw the replacement strainer (Stock No. 0206-2806-725) snugly into place.

Install yoke plugs (Stock No. 0206-7129-525) and gaskets (Stock No. 0210-5023-300) on unused yokes to prevent dust and lint from accumulating in the strainers or leakage occurring between the check valves.

The tee handle screw can be unscrewed from the yoke gate and replaced if necessary. Order Stock No. 0219-3372-600.

E. Check Valve Replacement

Replace the check valves in the gas manifold when required. The check valves are located in the cylinder yokes of the gas supply modules.

1. Close the cylinder valve and remove the gas cylinder, if present. With the yoke gate swung out of the way, use the special tool (part number 0175-0420-000) to remove the check valve from the manifold block. Replace parts as necessary.

a. Check valve complete 0207-8081-800
b. Strainer 0206-2805-725
c. Plug 0206-7125-325
d. Cap 0206-2314-525
e. Seat 0206-2317-540

Screw the replacement strainer (Stock No. 0206-2805-725) snugly into place.

F. High Pressure Regulator Repair (Figure 5-22 and 5-23)

Regulator Part No. 6600-0003-700.

WARNING: Do not use oil or oil bearing materials on or near the regulator. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. All metallic

parts of the regulator must be discarded if contaminated with oil or grease.

1. Disconnect the gas pipeline connection, close the cylinder valves and remove the gas cylinders.

2. Remove the eight mounting screws for the Yoke and Regulator Assembly and then remove the assembly.

3. Disconnect the copper tubing from the outlet port of the regulator and the elbow of the manifold port.

4. Remove the regulator from the manifold block by turning it counterclockwise.

5. Place the regulator in a vise with the spring case up.

6. Turn the adjustment screw counterclockwise until the screw no longer exerts pressure on the internal parts of the regulator.

7. Use a 1 1/2 inch wrench on the hexagon of the spring case, and unscrew it by turning it counterclockwise.

8. Remove the spring case, spring button, spring, diaphragm plate, diaphragm and thrust plate.

9. Using a wrench, remove the seat retainer, O-ring, pin, seat, valve assembly, and marginal spring.

10. Replace new pin, O-ring, seat and marginal spring with parts from repair kit No. 0306-9950-870.

11. Use a wrench to tighten the seat retainer into the regulator body to a torque of approximately 119 inch pounds.

12. Replace thrust plate diaphragm, diaphragm plate, spring, spring button and spring case.

13. Use a wrench across the hexagon on the spring case, turn the case clockwise to replace it. Do not over-tighten.

14. Reattach the regulator to the manifold block. Use Teflon tape to seal the thread connection.

    Note: The regulator must be reset to 52 +/- 2 psig with a 500 cc flow passing through it.

15. Attach the special fitting and gauge assembly (Tool Number 0175-0543-000) to the regulator outlet. This special tool has a (0.025 in.) orifice to maintain a 500 cc flow for proper regulator adjustment.

16. Adjust the regulator adjustment screw until the pressure gauge reads 52 +/- 2 psig.

17. Tighten the adjustment screw lock nut.

18. Remove the special fitting and gauge assembly.

19. Reconnect the copper tubing to the regulator outlet.

20. Place the assembly in position and replace the eight mounting screws.

G. Pneumatic Troubleshooting

This troubleshooting information provides a list of some problem conditions, possible causes and solutions. If any of the symptoms listed below occur, shut off the gas cylinder valve.

Condition	Possible Cause	Solution
Gas leakage at the regulator outlet when the adjustment screw is completely released.	Leak across the regulator seat.	Replace seat and corresponding parts.
Outlet pressure increases steadily above set pressure (no flow through system).	Leak across the regulator seat.	Replace seat and corresponding parts.
Gas leakage from the spring case.	Loose spring case or damaged diaphragm.	Check seating of spring case. Replace diaphragm if damaged.
Excessive drop in working pressure.	Worn or sticking internal parts. Internal flow obstructed. Dirty filter. Cylinder valve not fully open. Dirty yoke check valve and strainer nipple.	Replace worn or sticking parts. Check for flow obstructions. Replace filter. Open cylinder valve. Clean yoke check valve and strainer nipple.
Gas leakage from relief valve.	Dirty valve seat Leak across the regulator seat.	Replace seat and corresponding parts.

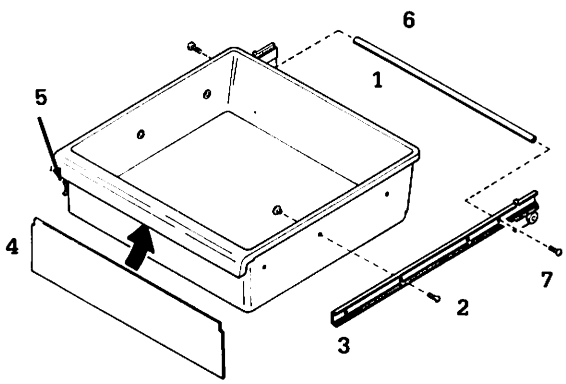
6/ CONTROL UNIT TROUBLESHOOTING GUIDE

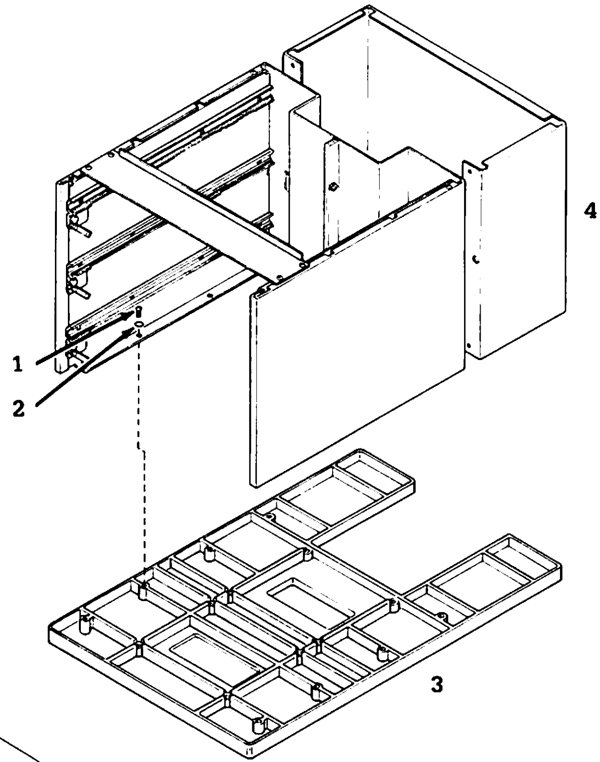
The error code is displayed in the Elapsed Time display.

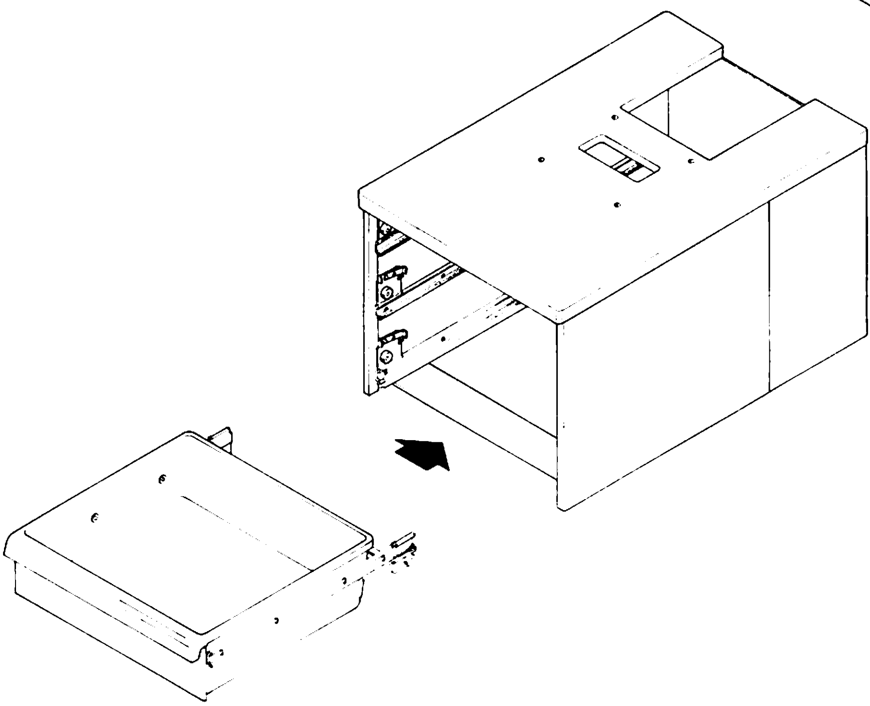
ERROR	DESCRIPTION	POSSIBLE CAUSE
#01	Instruction test fails	Microprocessor 8031 defective
#02	Calibrate high fails	ADC calibration Cal high resistor defective
#03	Calibrate low fails	ADC calibration Cal low resistor defective
#04	Checksum fails	Eprom defective Microprocessor 8031 defective
#05	Ram test fails	Microprocessor 8031 defective
#06	Port 1 lines	I/O expander 8243 defective Microprocessor 8031 defective
#07	ADC not converting	A/D Converter ADC3711 defective Voltage Reference LM10 defective I/O expander 8243 #2 defective
#08	Hardware triac timer	Logic gate 4020B defective IC in triac test area defective
#09	Heat not controlled	Heater triac defective Microprocessor 8031 defective Heater opto-isolator or driver defective
#10	Line voltage out of range.	Line voltage compensation pot. on power supply board not calibrated.

7/Illustrated Parts and Parts List

Description	Part Number
IWS Acessories	
Tape Teflon	0220-5050-300
Lubriplate	0616-0203-300
1. Plastic Drawer	0217-5220-400
2. Post Screw ¼ in	0203-5611-300
3. Right Slide Track	0203-2507-400
4. Drawer Front	0214-1576-510
5. Left Slide Track	0203-2508-400
6. Stabilizer Bar	6600-0045-500
7. Screw #6-32 × 5/16	0140-6724-105

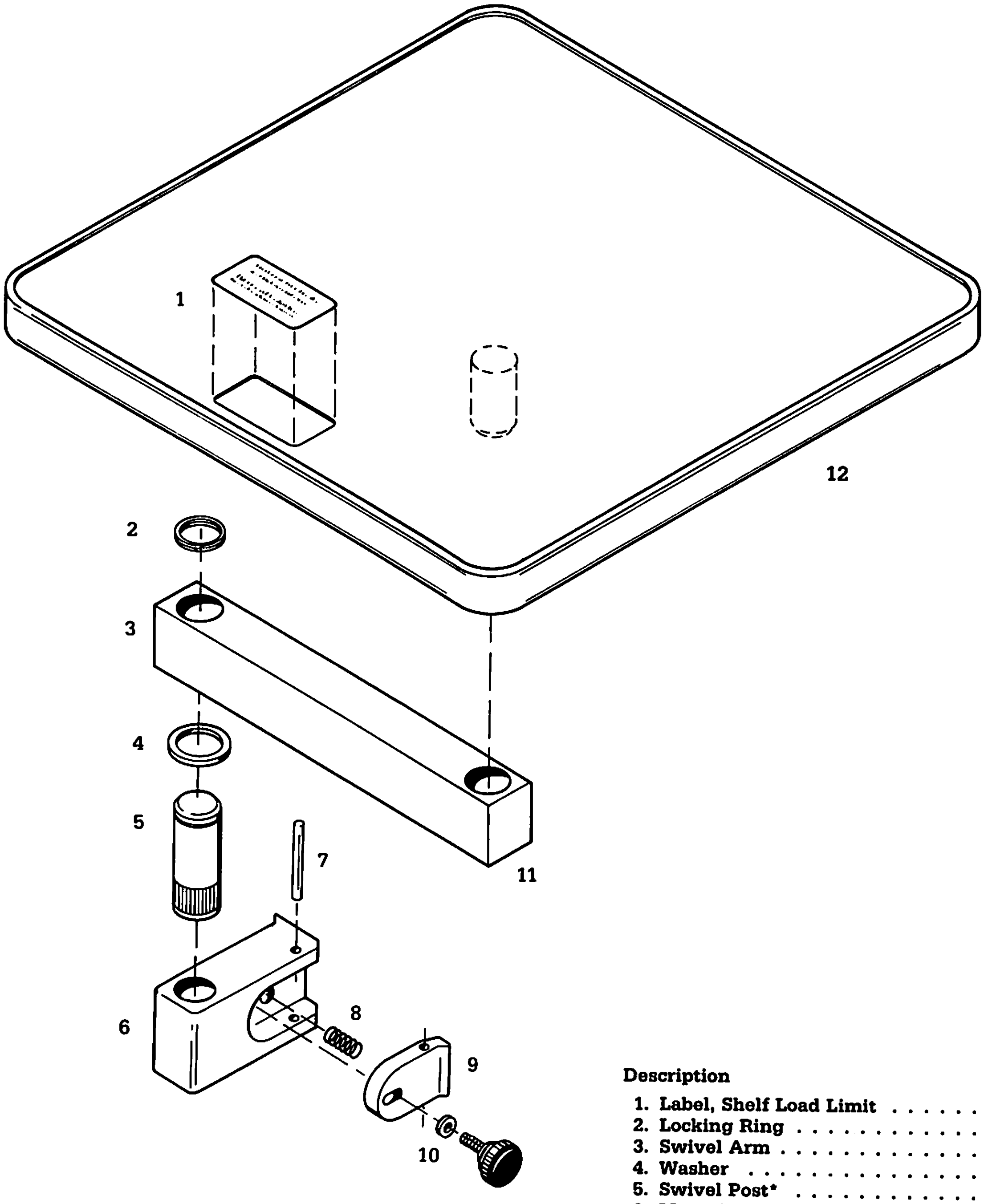






Description	Part Number
1. Screw, #10 × ½	0140-6530-106
2. Internal Lock Washer #10	0144-1110-131
3. Drawer Cabinet Top	6600-0026-500
4. Rear Shroud	6600-0033-500

Figure 7-19
Drawer Assembly 2

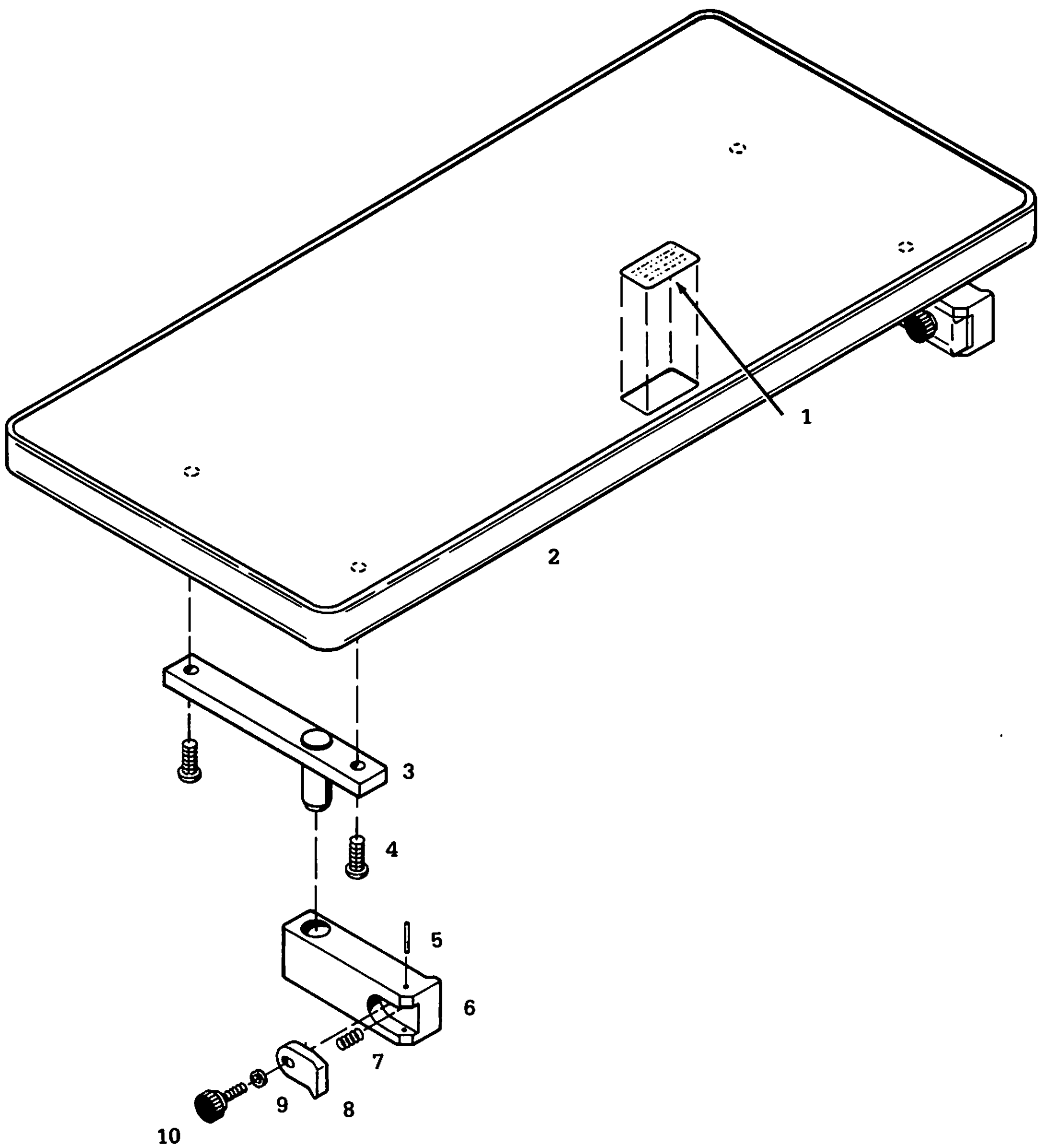


Description	Part Number
1. Label, Shelf Load Limit	0205-4955-300
2. Locking Ring	0203-5186-300
3. Swivel Arm	0217-5337-552
4. Washer	0202-0096-300
5. Swivel Post*	0217-5244-500
6. Mounting Block*	0217-5330-552
7. Groove Pin	6600-0020-400
8. Spring	0203-3186-300
9. Pawl	0217-5300-552
10. Washer	0202-0095-300
11. Knob**	0217-5335-300
12. Swivel Shelf, 12 × 12	0217-5347-600

* These parts must be separated and then pressed together using a hydraulic press or a large bench vise.

** Apply Lubriplate to the knob threads.

Figure 7-20
Instrument Shelf Assembly (0217-5365-800)

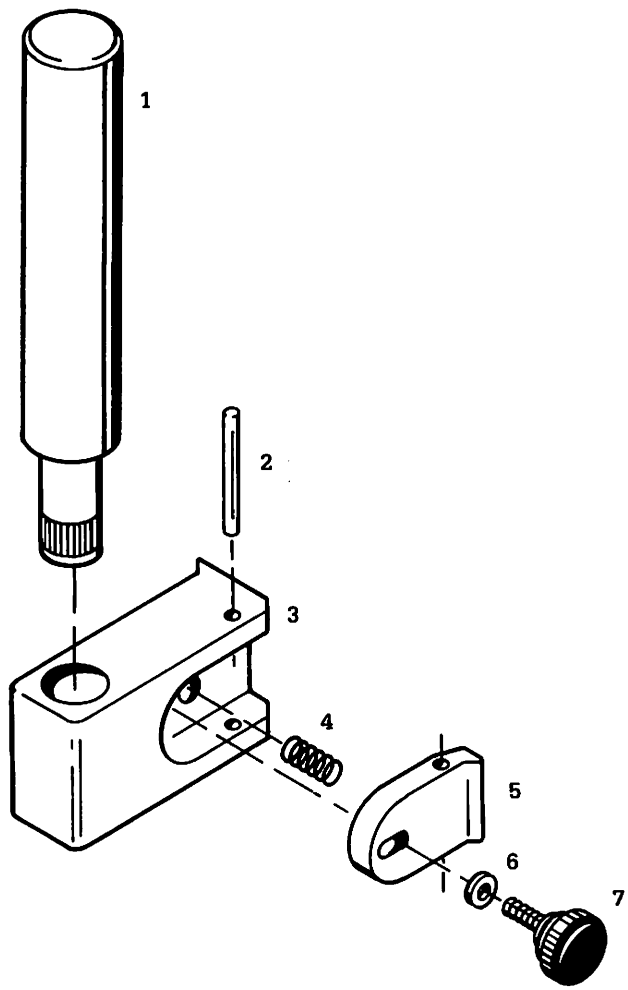


Description	Part Number
1. Label, Shelf Load Limit	0205-4956-300
2. Monitor Shelf 12 × 30.5	0217-5349-100
3. Shelf Support	0217-5346-710
4. Screw ¼-20 × ⅝*	0140-6136-110
5. Groove Pin	6600-0020-400
6. Post Block	0217-5329-552
7. Spring	0203-3186-300
8. Pawl	0217-5300-552
9. Washer	0202-0095-300
10. Knob**	0217-5335-300

* Use Loctite 242 on threads, tighten, then loosen ½ turn.

** Apply Lubriplate to the knob threads.

Figure 7-21
Monitor Shelf Assembly (6600-0010-800)

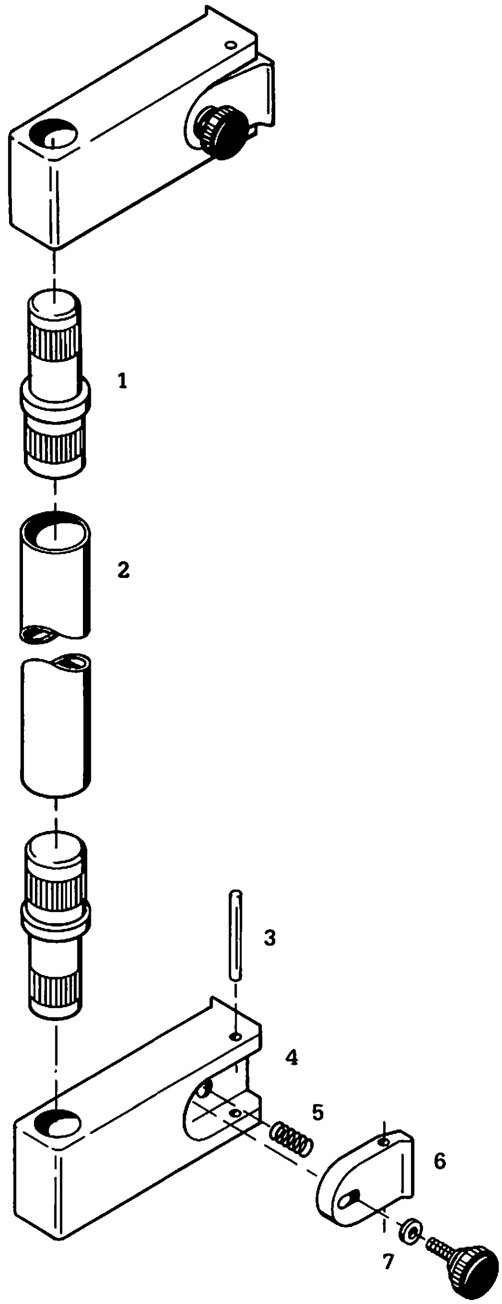


Description	Part Number
1. Mounting Post*	0217-5328-500
2. Groove Pin	6600-0020-400
3. Mounting Block	0217-5330-552
4. Spring	0203-3186-300
5. Pawl	0217-5300-552
6. Washer	0202-0095-300
7. Knob**	0217-5335-300

* This part must be separated and then pressed together using a hydraulic press or a large bench vise.

** Apply Lubriplate to the knob threads.

Figure 7-22
3.5 Inch Utility Post Assembly (0217-5374-800)

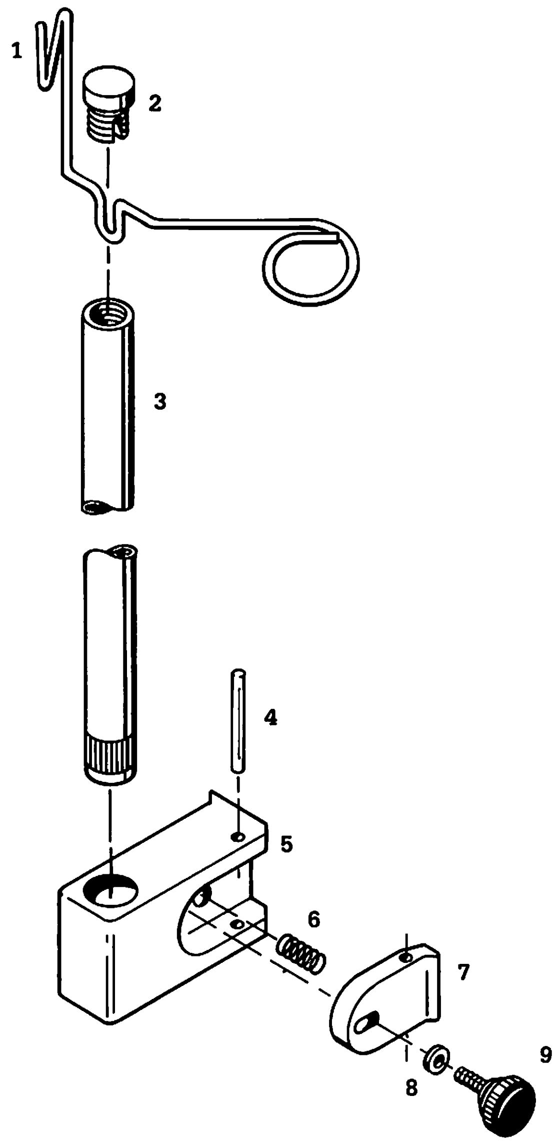


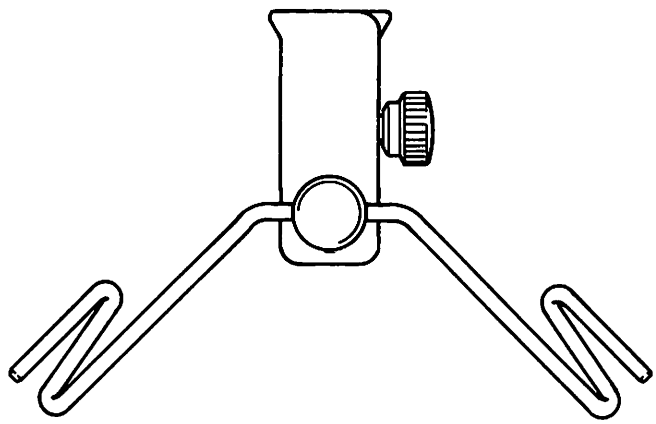
Description	Part Number
1. Double Adapter*	0217-5332-500
2. Post, 20 inch	0217-5333-500
3. Groove Pin	6600-0020-400
4. Post Block	0217-5329-552
5. Spring	0203-3186-300
6. Pawl	0217-5300-552
7. Washer	0202-0095-300
8. Knob**	0217-5335-300

*** This part must be separated and then pressed together using a hydraulic press or a large bench vise. Be sure to align upper and lower blocks before assembly.**

**** Apply Lubriplate to the knob threads.**

Figure 7-23
20 Inch Utility Post Assembly (0217-5376-800)





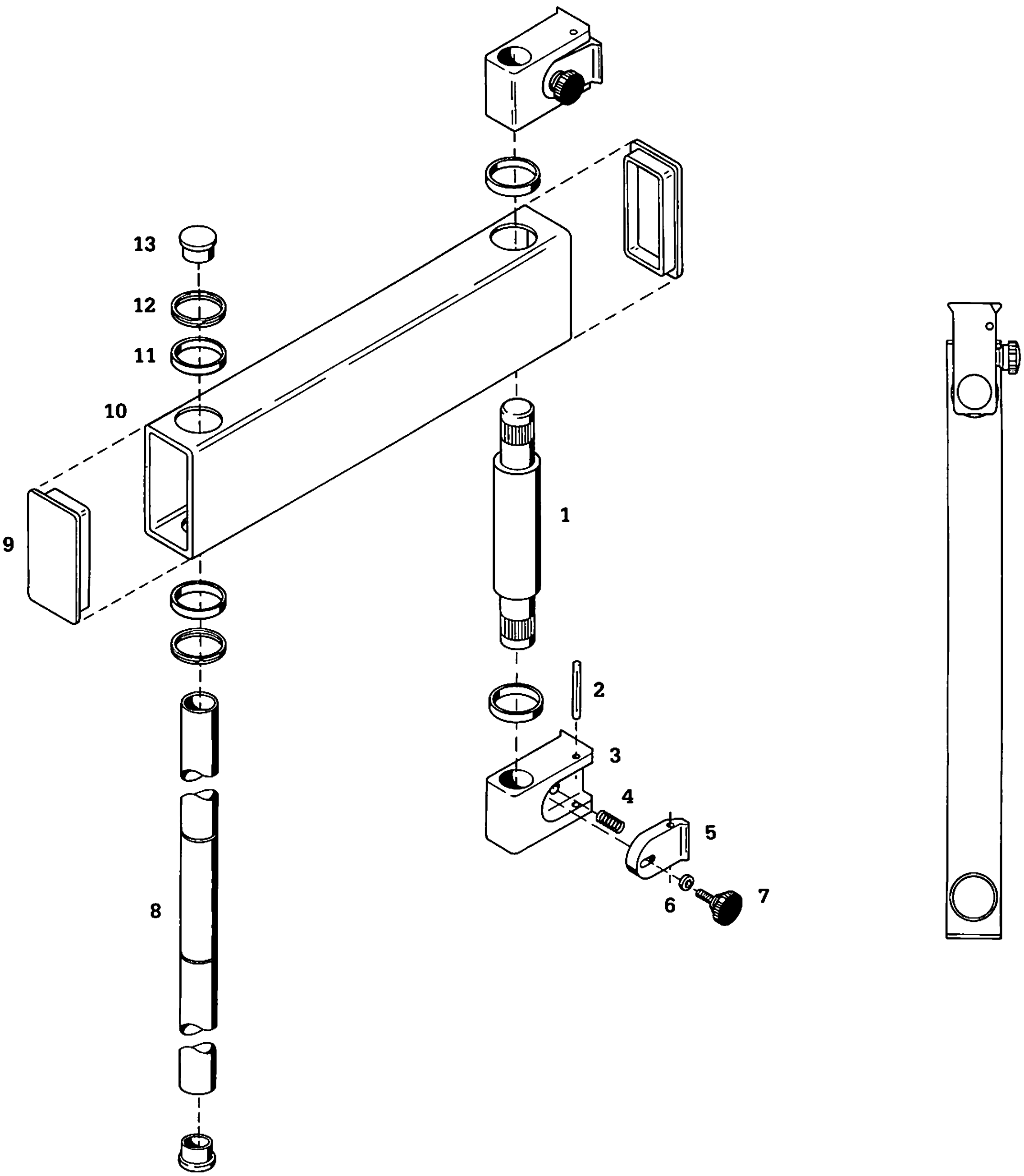
Description	Part Number
1. Hanger	0217-5091-300
2. Cap+	0217-5092-535
3. Rod*	0217-5345-549
4. Groove Pin	6600-0020-400
5. Post Block	0217-5330-552
6. Spring	0203-3186-300
7. Pawl	0217-5300-552
8. Washer	0202-0095-300
9. Knob**	0217-5335-300

+ Apply Loctite 277 before assembly.

* This part must be separated and then pressed together using a hydraulic press or a large bench vise.

** Apply Lubriplate to the knob threads.

Figure 7-24
I.V. Pole Assembly (0217-5378-800)

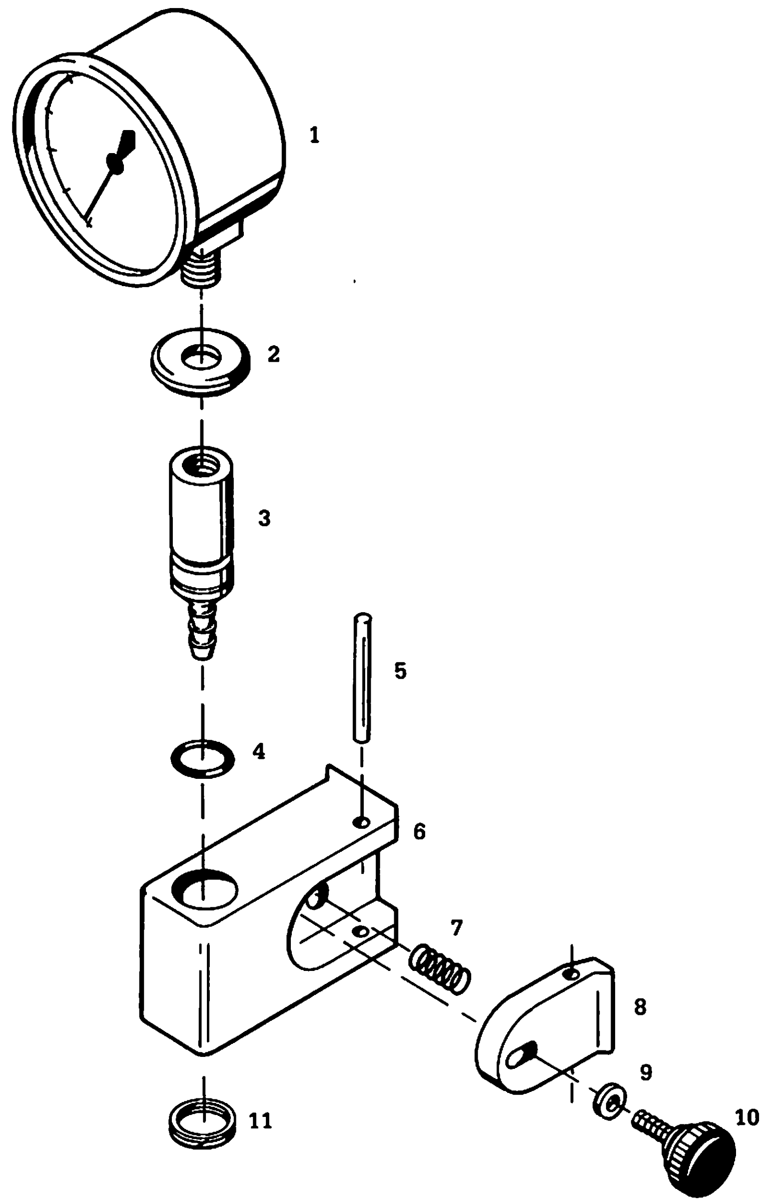


Description	Part Number
1. Ventilator Pivot Post*	0217-5289-500
2. Groove Pin	6600-0020-400
3. Manifold Accessory Block	0217-5331-552
4. Spring	0203-3186-300
5. Pawl Accessory Block	0217-5300-552
6. Washer	0202-0095-300
7. Knob**	0217-5335-300
8. Ventilator Mounting Post Tube	0217-5288-500
9. End Rail Cap	0211-1546-300
10. Ventilator Mounting Post Arm	0217-5287-300
11. Black Delrin Washer	0202-0097-500
12. Spiral Ring Lock	0203-5188-300
13. Black Butyrate Cap	0211-1542-300

*** This part must be separated and then pressed together using a hydraulic press or a large bench vise. Be sure to align upper and lower blocks before assembly.**

**** Apply Lubriplate to the knob threads.**

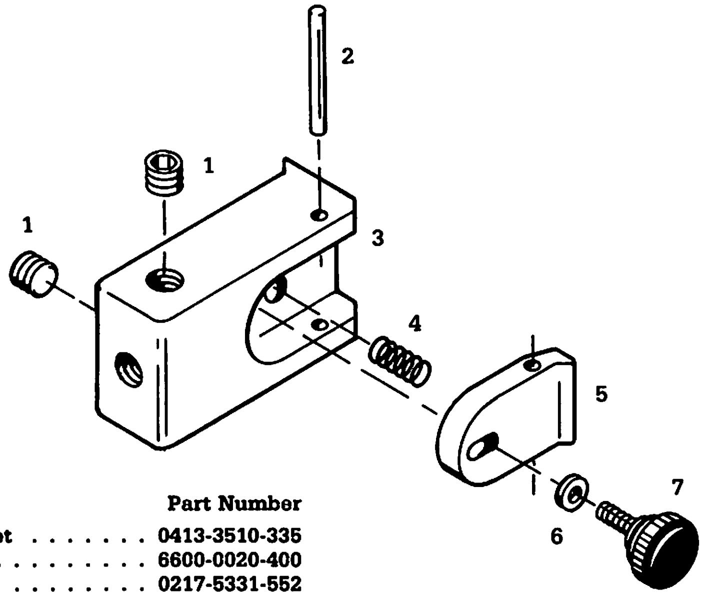
Figure 7-25
Ventilator Mounting Post Assembly (0217-5357-800)



Description	Part Number
1. Gauge -20 to $+100cmH_2O$ (-2 to $+10$kpa)	0205-8156-300
2. Washer	0402-0221-500
3. Coupler	0217-5344-542
4. O-ring	0210-0543-300
5. Groove Pin	6600-0020-400
6. Post Block	0217-5330-552
7. Spring	0203-3186-300
8. Pawl	0217-5300-552
9. Washer	0202-0095-300
10. Knob*	0217-5335-300
11. Locking Ring	0203-5186-300

*** Apply Lubriplate to the knob threads. Note: Seal pipe threads with Loctite # 79 or Teflon tape.**

Figure 7-26
Manometer Assembly (0217-5377-800)

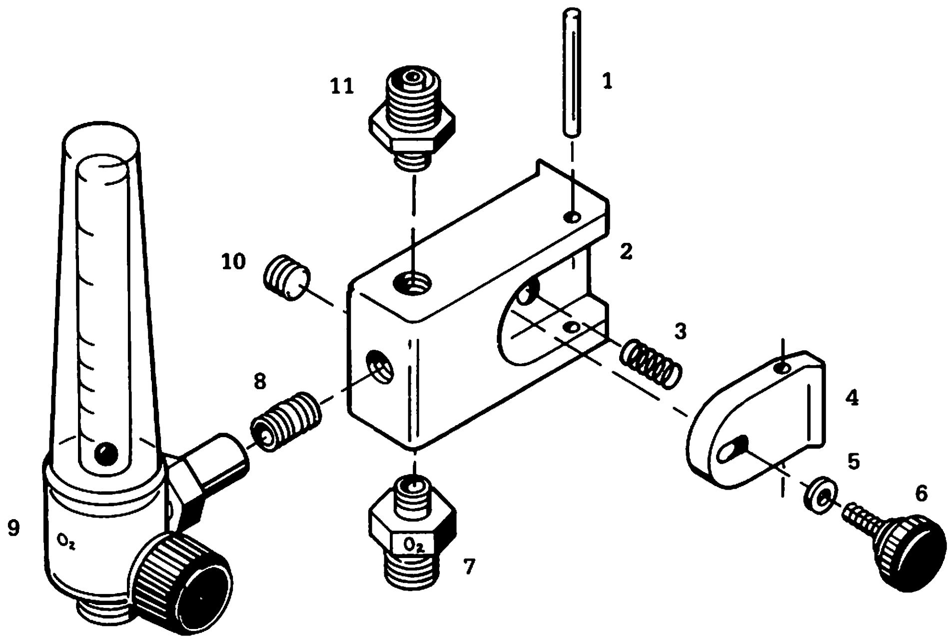


Description	Part Number
1. Plug 1/8 nptm w/Hex Socket	0413-3510-335
2. Groove Pin	6600-0020-400
3. Manifold Accessory Block	0217-5331-552
4. Spring	0203-3186-300
5. Pawl Accessory Block	0217-5300-552
6. Washer	0202-0095-300
7. Knob*	0217-5335-300

* Apply Lubriplate to the knob threads.

Note: Seal pipe threads with Loctite # 79 or Teflon tape. Pawl must operate freely.

Figure 7-27
Manifold Assembly (0217-5359-800)

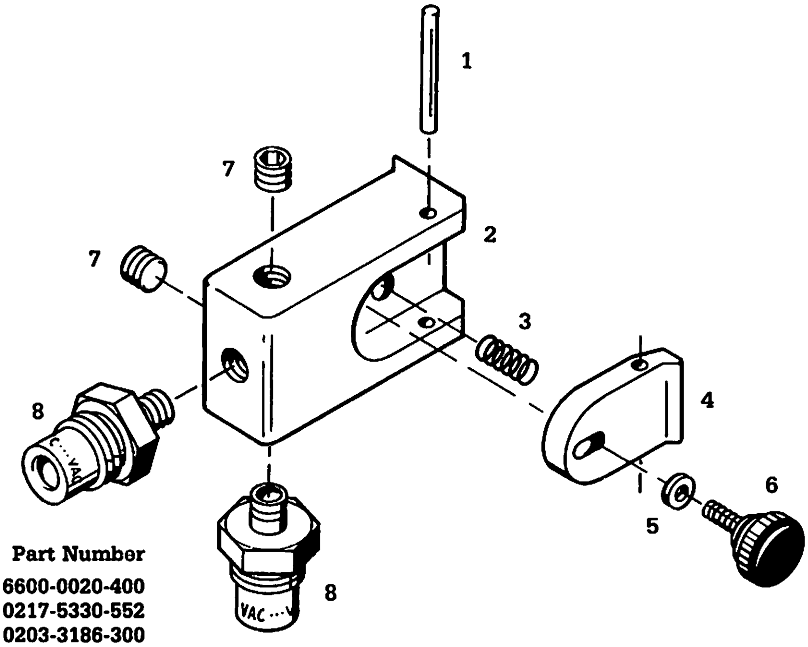


Description	Part Number
1. Groove Pin	6600-0020-400
2. Mounting Block	0217-5330-552
3. Spring	0203-3186-300
4. Pawl	0217-5300-552
5. Washer	0202-0095-300
6. Knob*	0217-5335-300
7. O_2 DISS Adapter 1/8 npt	0204-0490-535
8. Close Nipple 1/8 nptm	0413-1000-335
9. O_2 Flowmeter	0304-5500-805
10. Hex Socket Plug 1/8 nptm	0413-3510-335
11. O_2 DISS Outlet 1/8 npt	0205-0540-800

* Apply Lubriplate to the knob threads.

Note: Seal pipe threads with Loctite # 79 or Teflon tape. Pawl must operate freely.

Figure 7-28
Flowmeter Assembly (0217-5370-800)

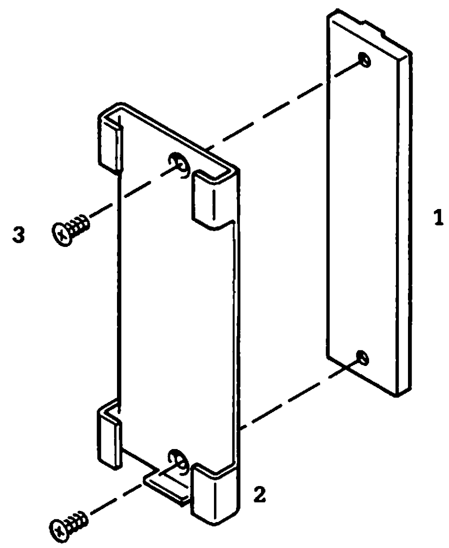


Description	Part Number
1. Groove Pin	6600-0020-400
2. Mounting Block	0217-5330-552
3. Spring	0203-3186-300
4. Pawl	0217-5300-552
5. Washer	0202-0095-300
6. Knob*	0217-5335-300
7. Hex Socket Plug ⅛ nptm	0413-3510-335
8. DISS Vacuum Adapter ⅛ npt	0204-7989-535

Note: Seal pipe threads with Loctite # 79 or Teflon tape.

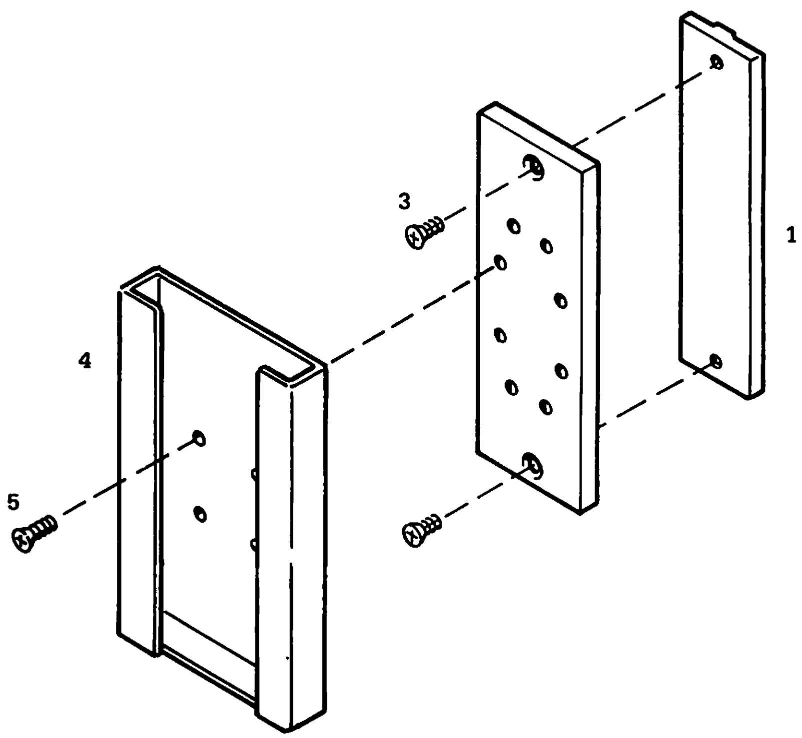
*** Apply Lubriplate to the knob threads.**

Figure 7-29
Vacuum Manifold Assembly (0217-5369-800)



Description	Part Number
1. Vacuum Slide Locking Lug	0217-5243-551
2. Vacuum Slide Bottle Mount	0221-2343-500
3. Screw 6-32 × .238	0400-3145-300

Figure 7-30
Slide Assembly (0217-5367-800)



Description	Part Number
1. Locking Lug	0217-5243-551
2. Adapter Plate	0217-5217-549
3. Screw	0400-3103-300
4. Bracket, Bird Blender	6600-0031-900
5. Screws (4)	

Figure 7-31
Bird Dovetail Adapter Assembly (0217-5363-800)

APPENDIX

A. TEST EQUIPMENT AND SPECIAL TOOLS

Description	Part Number
Digital Multimeter, Fluke Model 8062A	0175-2379-000
Oscilloscope, B&K Model No. 1477, 15MHz Dual Trace Scope or equivalent	0175-2302-000
Leakage Current Tester, with AAMI test load or equivalent	0175-2284-000
Static Control Work Station, 3M Model 8005	0175-2311-000
Temperature Simulator (not required equipment)	0217-2788-800
Patient Probe Test Lead (For connecting calibrated resistors to the patient probe input.)	
IC Extraction & Insertion Tools,	

B. TEMPERATURE CONVERSION CHART

Temperature Conversion Chart

°C	°F	°C	°F	°C	°F
20.0	68.0	34.5	94.1	37.6	99.7
21.5	70.7	35.0	95.0	37.7	99.9
22.0	71.6	35.1	95.2	37.8	100.0
22.5	72.5	35.2	95.4	37.9	100.2
23.0	73.4	35.3	95.4	38.0	100.4
23.5	74.3	35.4	95.7	38.1	100.6
24.0	75.2	35.5	95.9	38.2	100.8
24.5	76.1	35.6	96.1	38.3	100.9
25.0	77.0	35.7	96.3	38.4	101.1
25.5	77.9	35.8	96.4	38.5	101.3
26.0	78.8	35.9	96.6	38.6	101.5
26.5	79.7	36.0	96.8	38.7	101.7
27.0	80.6	36.1	97.0	38.8	101.8
27.5	81.5	36.2	97.2	38.9	102.0
28.0	82.4	36.3	97.3	39.0	102.2
28.5	83.3	36.4	97.5	39.5	103.1
29.0	84.2	36.5	97.7	40.0	104.0
29.5	85.1	36.6	97.9	40.5	104.9
30.0	86.0	36.7	98.1	41.0	105.8
30.5	86.9	36.8	98.2	41.5	106.7
31.0	87.8	36.9	98.4	42.0	107.6
31.5	88.7	37.0	98.6	42.5	108.5
32.0	89.6	37.1	98.8	43.0	109.4
32.5	90.5	37.2	99.0	43.5	110.3
33.0	91.4	37.3	99.1	44.0	111.2
33.5	92.3	37.4	99.3	44.5	112.1
34.0	93.2	37.5	99.5	45.0	113.0

C. TEMPERATURE PROBE CHARACTERISTICS

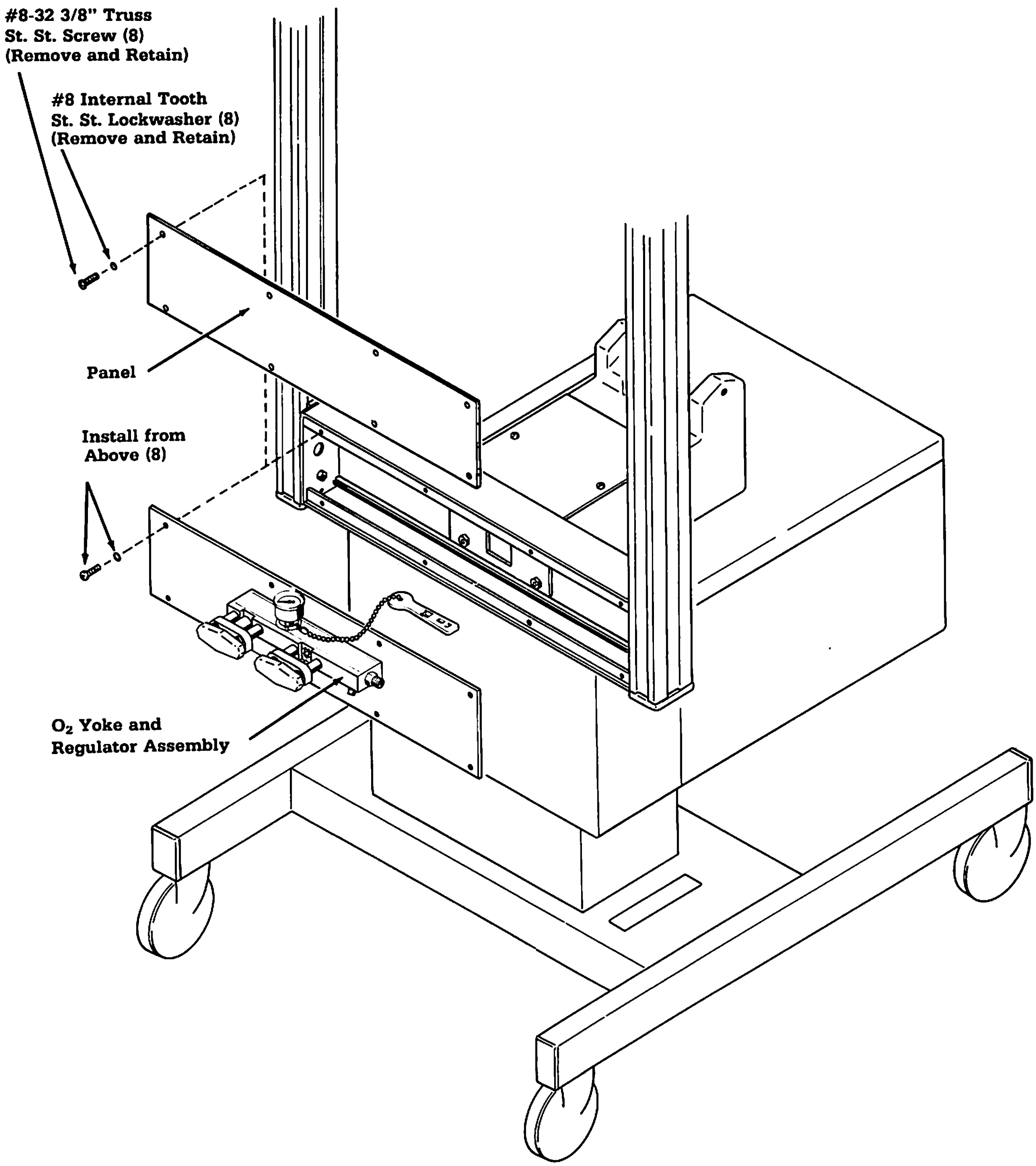
Patient Probe Characteristics

Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms	Temp °C	Res. Ohms
29.9	8049.1	34.0	6778.1	38.0	5731.3	42.0	4845.3
30.0	8015.4	.1	6749.8	.1	5707.3	.1	4825.0
.1	7981.9	.2	6721.5	.2	5683.5	.2	4804.8
.2	7948.5	.3	6693.4	.3	5659.7	.3	4784.6
.3	7915.2	.4	6665.4	.4	5636.0	.4	4764.6
.4	7882.1	.5	6637.5	.5	5612.4	.5	4744.6
.5	7849.2	.6	6609.8	.6	5588.9	.6	4724.7
.6	7816.3	.7	6582.1	.7	5565.4	.7	4704.9
.7	7783.7	.8	6554.6	.8	5542.1	.8	4685.1
.8	7751.1	.9	6527.1	.9	5518.9	.9	4665.5
.9	7718.7	35.0	6499.8	39.0	5495.8	43.0	4645.9
31.0	7686.4	.1	6472.6	.1	5472.8	.1	4626.4
.1	7654.3	.2	6445.6	.2	5449.9	.2	4607.0
.2	7622.2	.3	6418.6	.3	5427.1	.3	4587.7
.3	7590.4	.4	6391.7	.4	5404.3	.4	4568.5
.4	7558.6	.5	6365.0	.5	5381.7	.5	4549.3
.5	7527.0	.6	6338.3	.6	5359.1	.6	4530.2
.6	7495.5	.7	6311.8	.7	5336.7	.7	4511.2
.7	7464.2	.8	6285.4	.8	5314.3	.8	4492.3
.8	7432.9	.9	6259.1	.9	5292.1	.9	4473.4
.9	7401.9	36.0	6232.9	40.0	5269.9	44.0	4454.6
32.0	7370.9	.1	6206.8	.1	5247.8	.1	4436.0
.1	7340.1	.2	6180.9	.2	5225.8	.2	4417.3
.2	7309.4	.3	6155.0	.3	203.9	.3	4398.8
.3	7278.8	.4	6129.2	.4	5182.1	.4	4380.3
.4	7248.3	.5	6103.6	.5	5160.4	.5	4361.9
.5	7218.0	.6	6078.0	.6	5138.8	.6	4343.6
.6	7187.8	.7	6052.6	.7	5117.3	.7	4325.4
.7	7157.8	.8	6027.3	.8	5095.8	.8	4307.3
.8	7127.8	.9	6002.0	.9	5074.5	.9	4289.2
.9	7098.0	37.0	5976.9	41.0	5053.2	45.0	4271.2
33.0	7068.3	.1	5951.9	.1	5032.0		
.1	7038.8	.2	5927.0	.2	5010.9		
.2	7009.3	.3	5902.2	.3	4989.9		
.3	6980.0	.4	5877.4	.4	4969.0		
.4	6950.8	.5	5852.8	.5	4948.2		
.5	6921.7	.6	5828.3	.6	4927.4		
.6	6892.8	.7	5803.9	.7	4906.8		
.7	6863.9	.8	5779.6	.8	4886.2		
.8	6835.2	.9	5755.4	.9	4865.7		
.9	6806.6						

D. OXYGEN AND OXYGEN/AIR YOKES AND REGULATOR ASSEMBLY KIT.

Oxygen Yoke and Regulator Assembly Kit
Part Number 6600-0011-800

Air/Oxygen Yoke and Regulator Assembly
Kit Part Number 6600-0023-800



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