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.

⊗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.

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.

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).

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.

Do not idle the elevating motor at the 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.

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.

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 hydraulic system 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

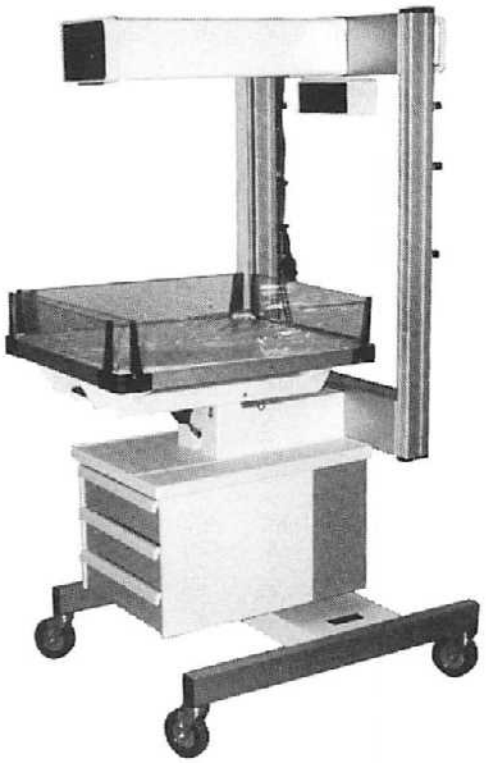

Figure 1-1. Ohmeda 5000 Infant Warmer System

A. POWER SUPPLY BOARD

This is a functional description for the Infant Warmer System Power Supply Board. Refer to Figure 8-1 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 opto-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 component 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 opto-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 solid state relay 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 opto-isolator-driver (U8) to switch on. The opto-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 Figure 8-2 in Section 8 for a detailed circuit diagram.

The control board contains electronic circuitry involved with the measurement, control, computation, memory, logic, and decision making functions of the Infant Warmer 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 solid state relay 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 SOLID STATE RELAY 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 solid state relay test circuitry detects a failed solid state relay. 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 System. 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 SOLID STATE RELAY 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 solid state relay 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 solid state relay 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. SOFTWARE SOLID STATE RELAY 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 solid state relay is not failed open.

5. 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 SOLID STATE RELAY TEST (0E)

This mode can be used to test the hardware solid state relay test circuit. The heat is switched ON all the time to simulate a failed solid state relay. 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 solid state relay 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	Apqar	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 failure
#02	Calibrate high fails	ADC calibration Cal high resistor failure
#03	Calibrate low fails	ADC calibration Cal low resistor failure
#04	Checksum fails	Eprom failure Microprocessor 8031 failure
#05	Ram test fails	Microprocessor 8031 failure
#06	Port 1 lines	I/O expander 8243 failure Microprocessor 8031 failure
#07	ADC not converting	A/D Converter ADC3711 failure Voltage Reference LM10 failure I/O expander 8243 #2 failure
#08	Not used	
#09	Heat not controlled	Heater solid state relay failure Microprocessor 8031 failure VQ1000J Power FET (V1) failure
#10	Line voltage out of range	Line voltage compensation pot on power supply board not calibrated.

C. DISPLAY BOARD

This is a functional description for the Infant Warmer System Display Board Part No. 0631-5031-700. Refer to Figure 8-3 in Section 8 for a detailed circuit diagram.

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 50 microamperes on 100V and 120V units (100 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 solid state relay 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 6600-0053-800).
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 Two 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 System 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

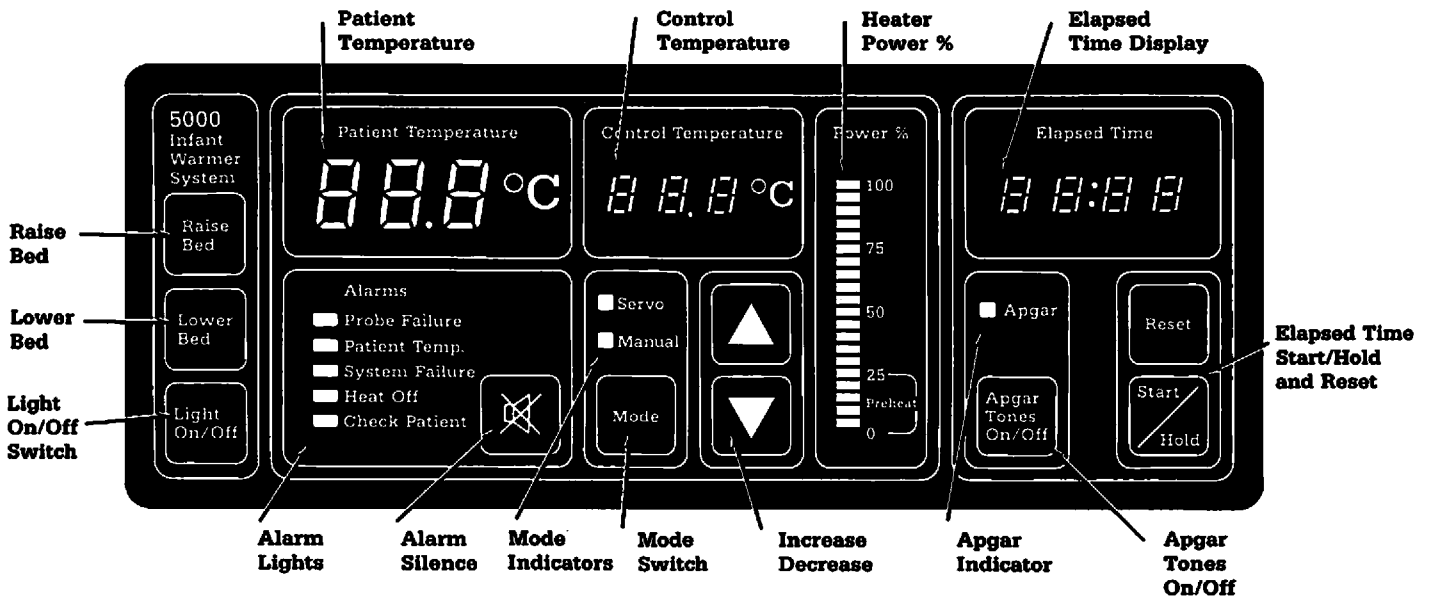

Figure 3-2. Control and Display Panel

1. Connect the Infant Warmer System 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 System. The battery may be recharged by placing the unit in the manual mode at a 0% heat setting. If the battery has failed, 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.

Note: If the battery requires replacement, use a 9 volt style Ni-Cad rechargeable battery (nominal voltage 7.2 volts) to provide voltage for the power failure alarm.

1. Disconnect the patient temperature probe.

2. Place the Infant Warmer System in "servo" mode.

3. Silence the probe failure alarm.

4. Set the control temperature at 37.0 degrees C.

5. Remove the Infant Warmer System 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 System 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 System.

6. Reconnect the Infant Warmer System to the power source. Verify the following:

   a. The Infant Warmer System 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 elevating 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 System 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
5496 ohm +/- 0.1%	(I2)	39.0 +/- 0.1 degrees
7060 ohm +/- 0.1%	(I3)	33.0 +/- 0.1 degrees
5900 ohm +/- 0.1%	(I7)	37.3 +/- 0.1 degrees
6190 ohm +/- 0.1%	(I11)	36.2 +/- 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. Solid State Relay 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 System 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 System 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. Close the cylinder valve and remove the gas cylinder from the yoke.

8. Remove the special fitting and gauge assembly.

9. Reconnect the copper tubing to the regulator outlet.

10. 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 10 microamps on 100v and 120v units (20 microamps on 220v and 240v export units) measured at the metal tip of the patient probe. Replace the patient probe if necessary.

There must be less than 100 microamps on 100v and 120v units (200 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 elevating motor at the 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)

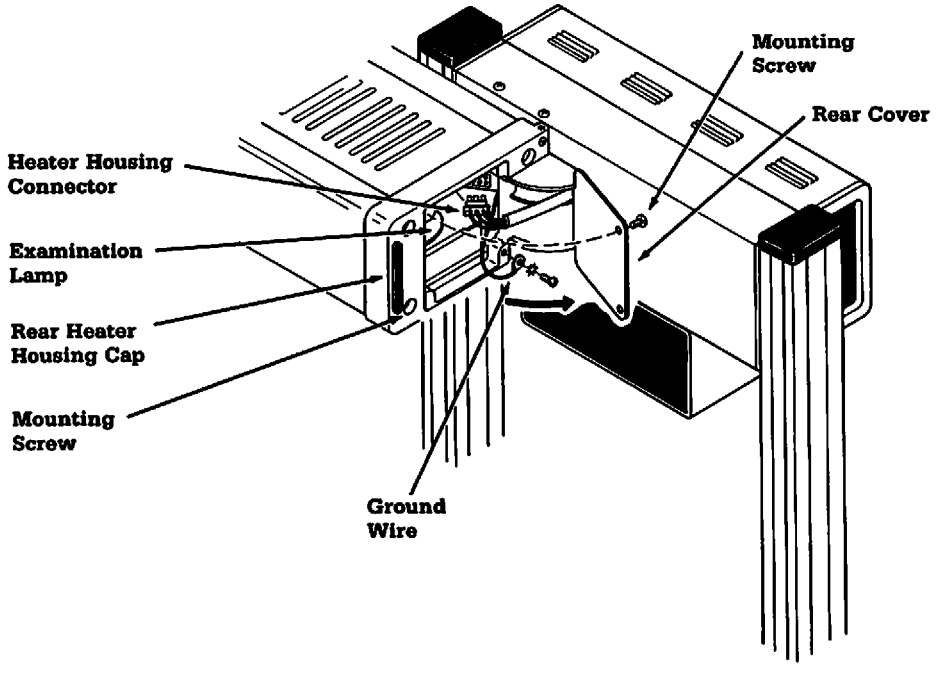

Figure 5-1. Removal of Back Cover from Heater/Lamp Assembly.

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.

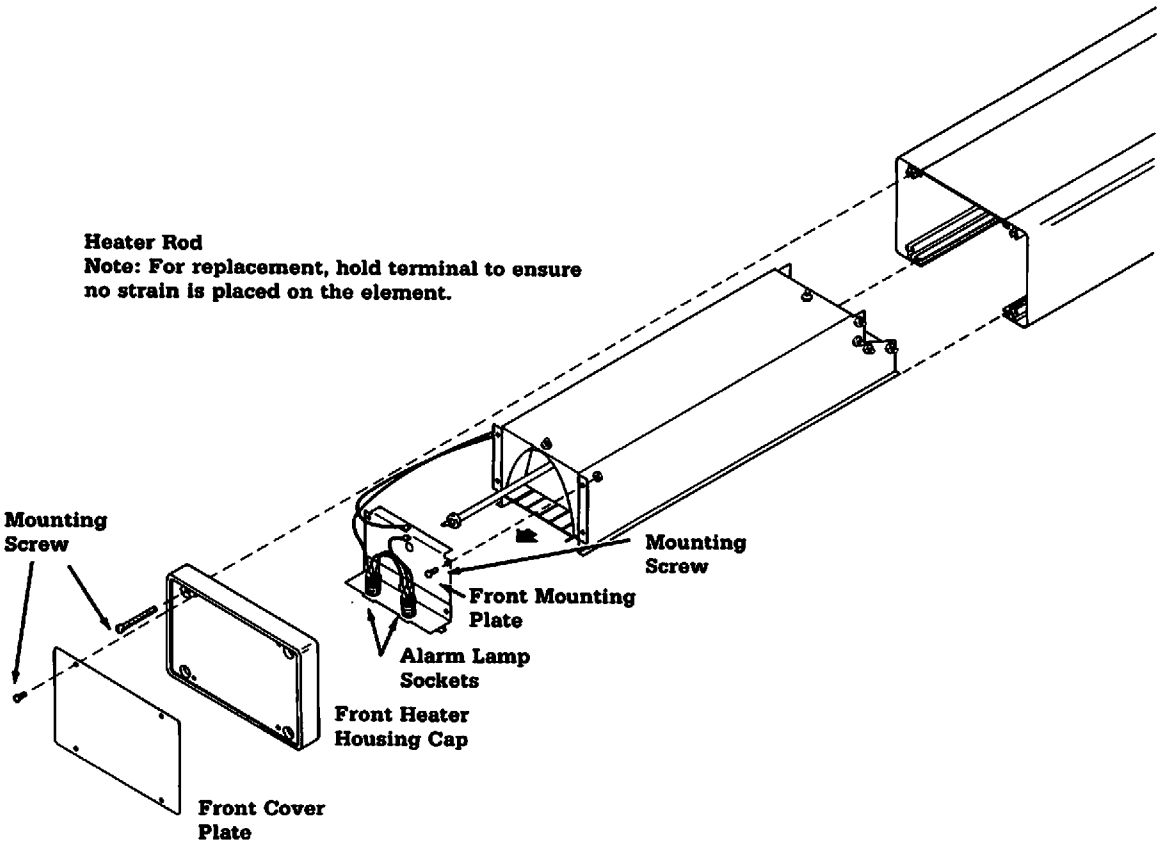

Figure 5-2. Heater/Lamp Housing Assembly

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.

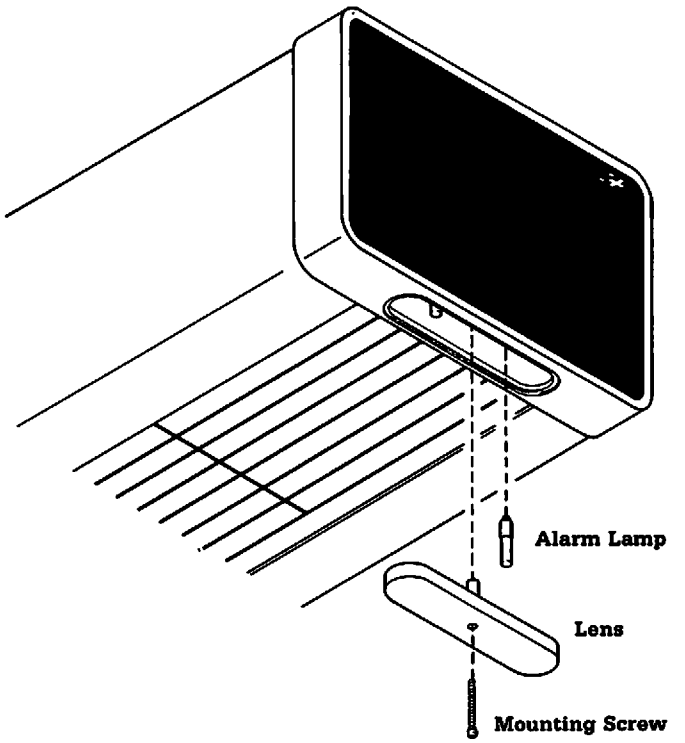

Figure 5-3. Alarm Lamp Replacement.

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.

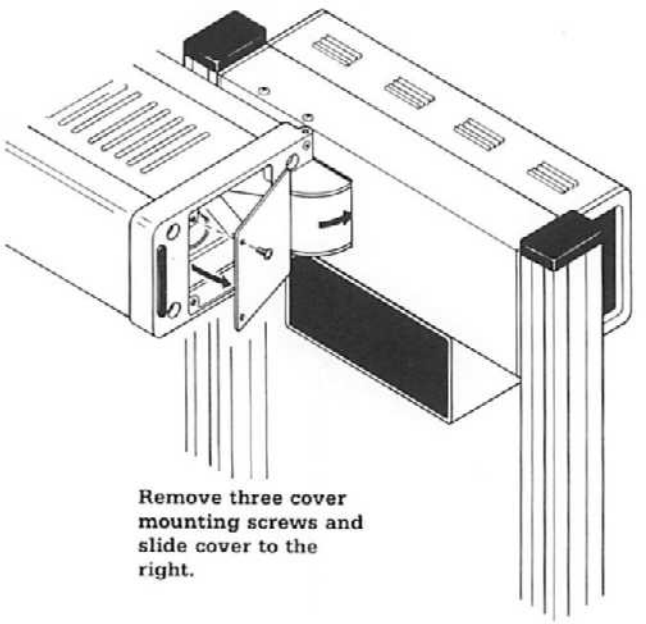

Figure 5-4. Examination Lamp Cover Removal.

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.

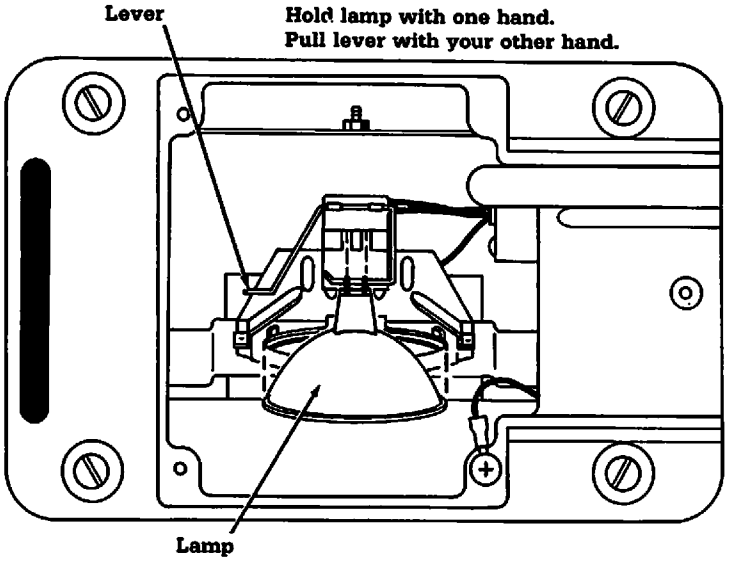

Figure 5-5. Examination Lamp Replacement.

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 (J15, J16 and J17) 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.

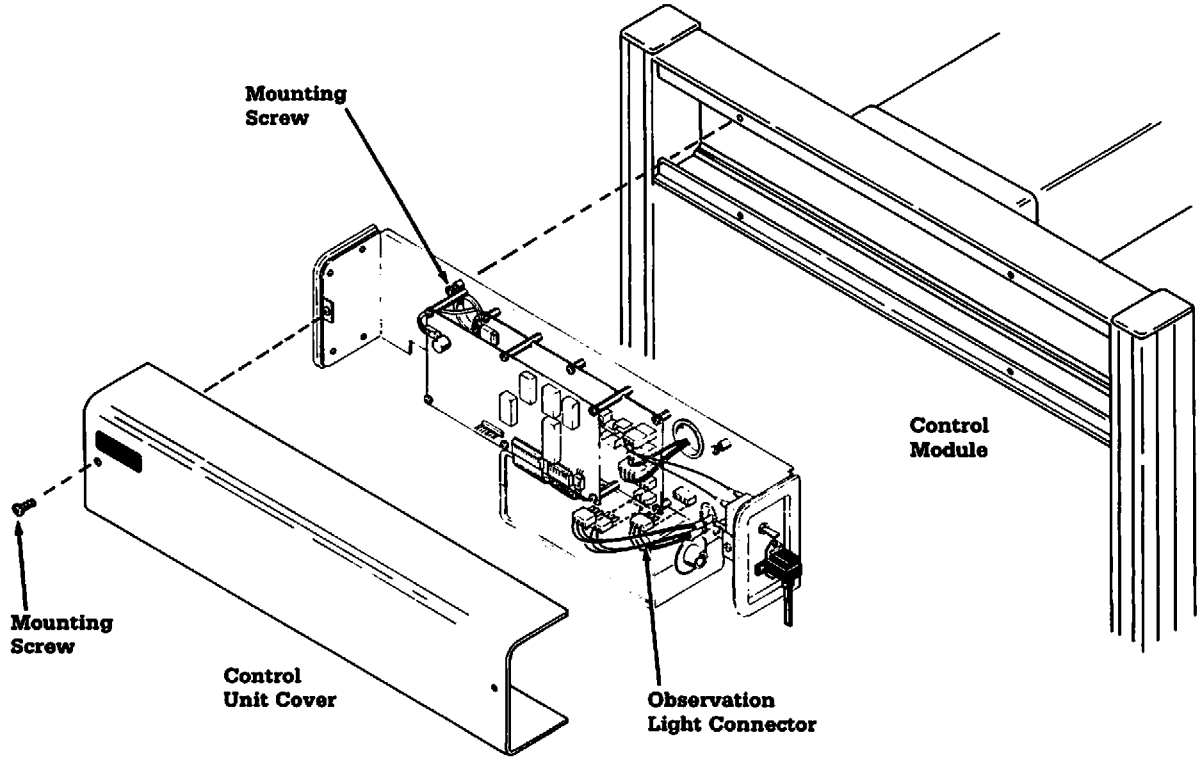

Figure 5-6. Control Module Assembly.

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.

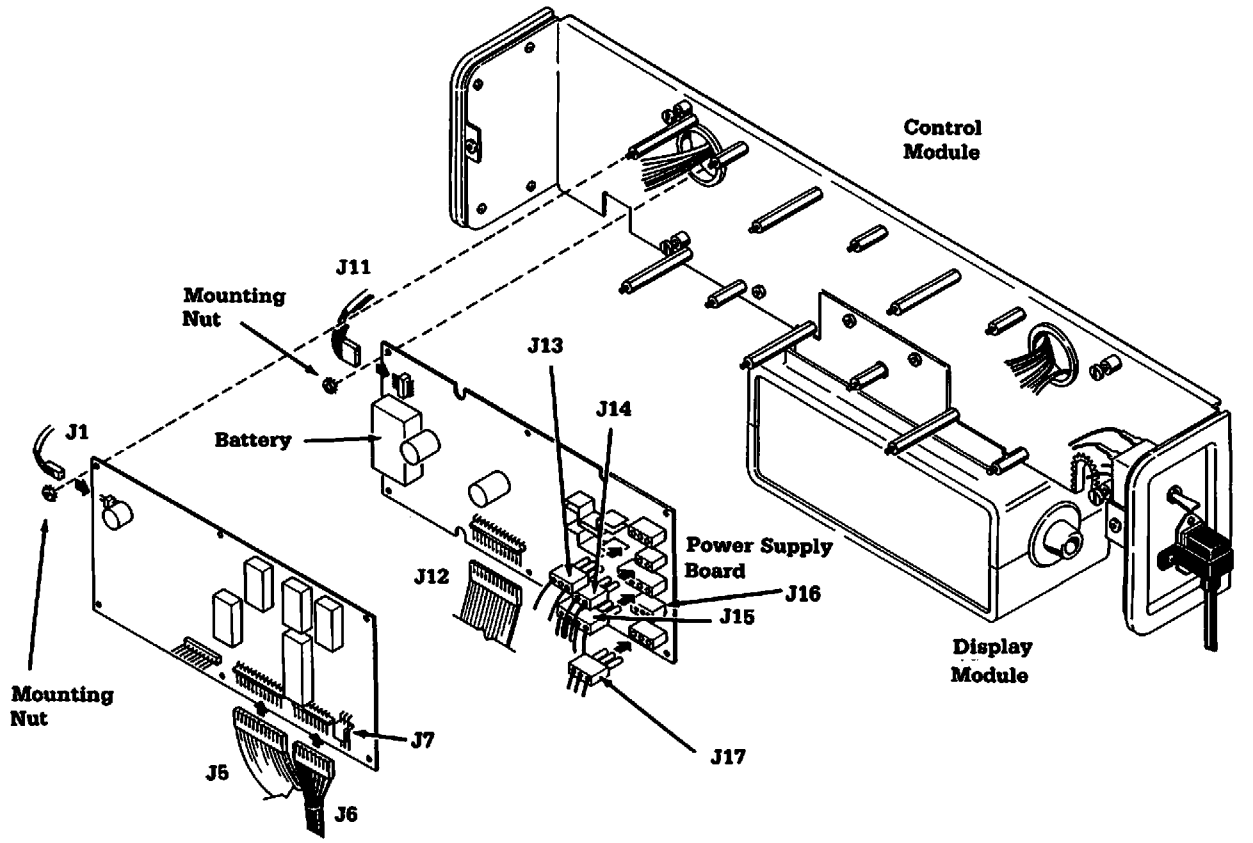

Figure 5-7. Control Board and Power Supply Board Assembly.

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.

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.

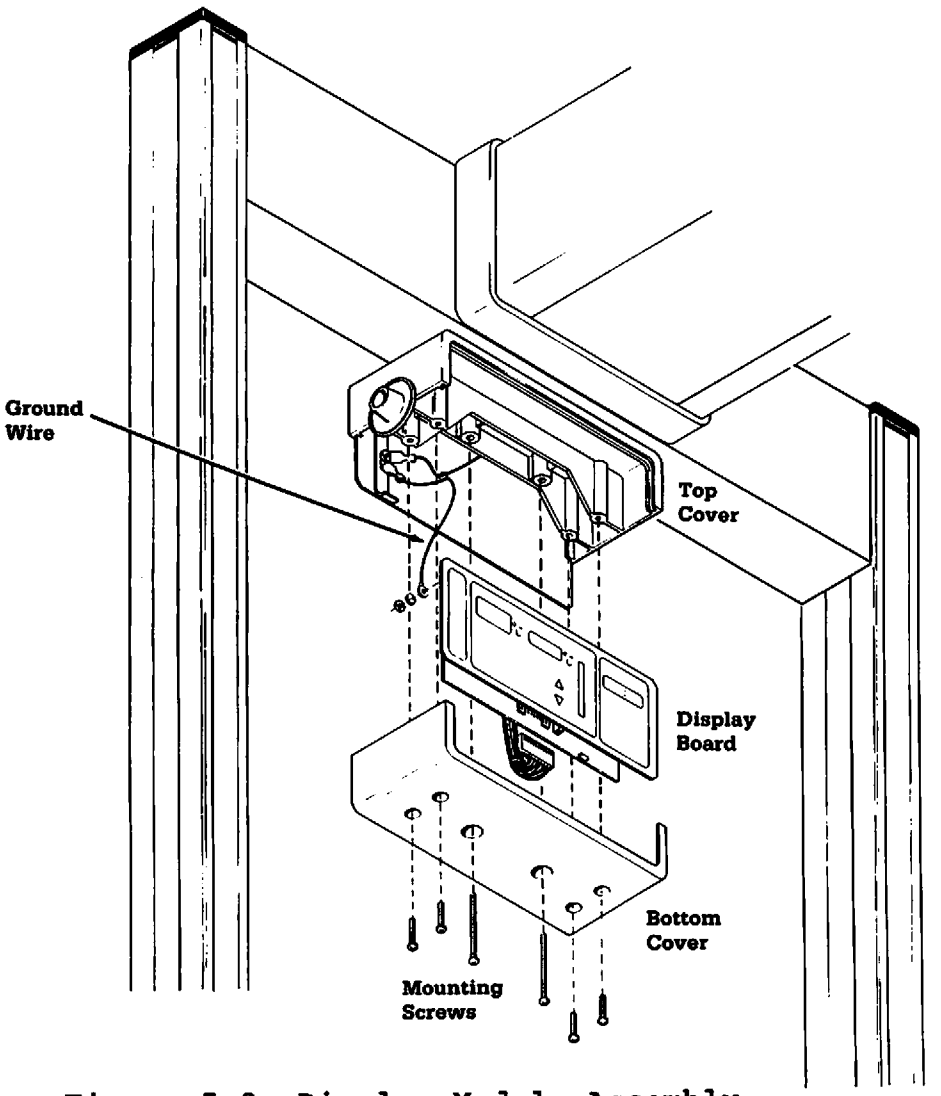

Figure 5-8. Display Module Assembly.

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.

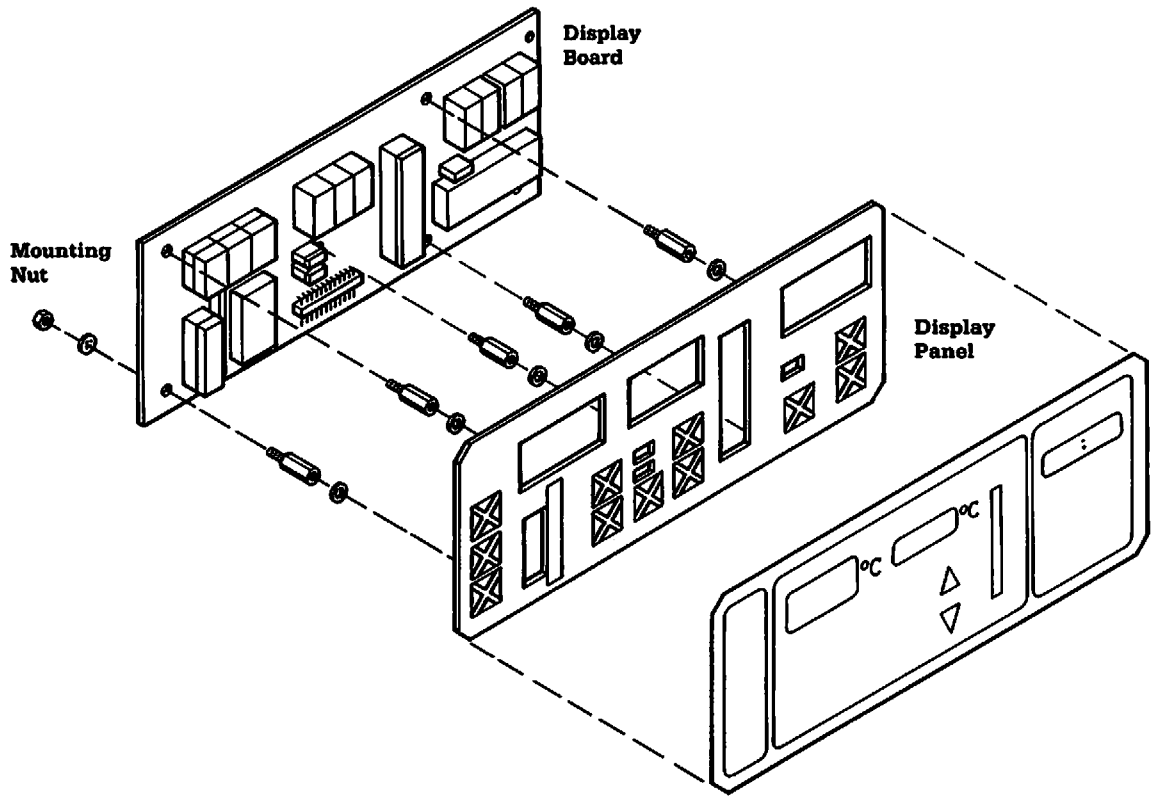

Figure 5-9. Display Board Assembly

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 three connectors (J15, J16, and J17) 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 System 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.

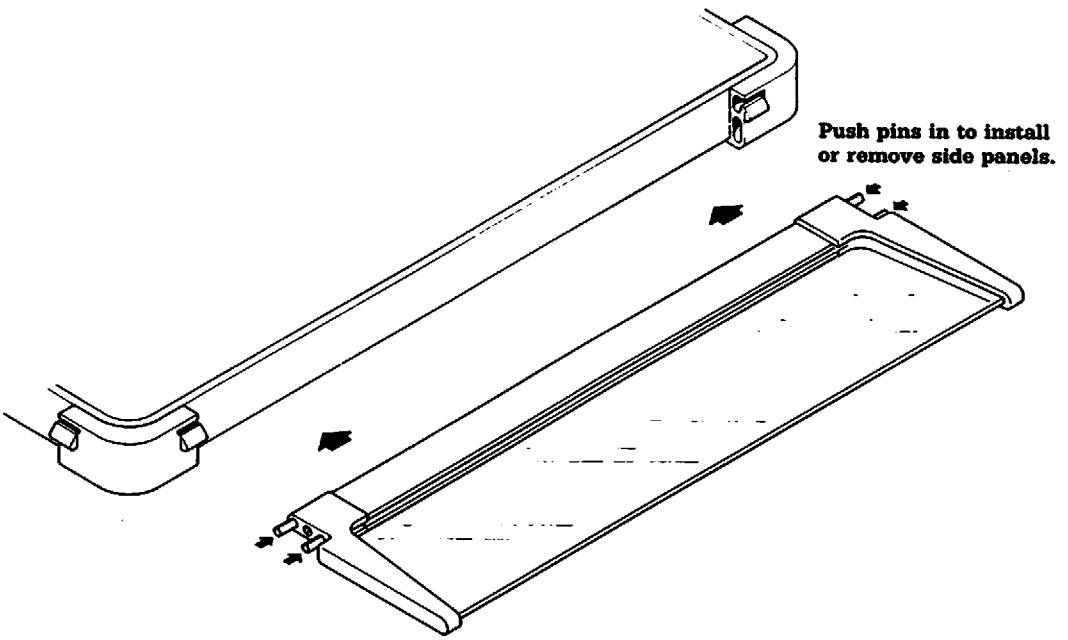

Figure 5-10. Side Panel Operation.

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.

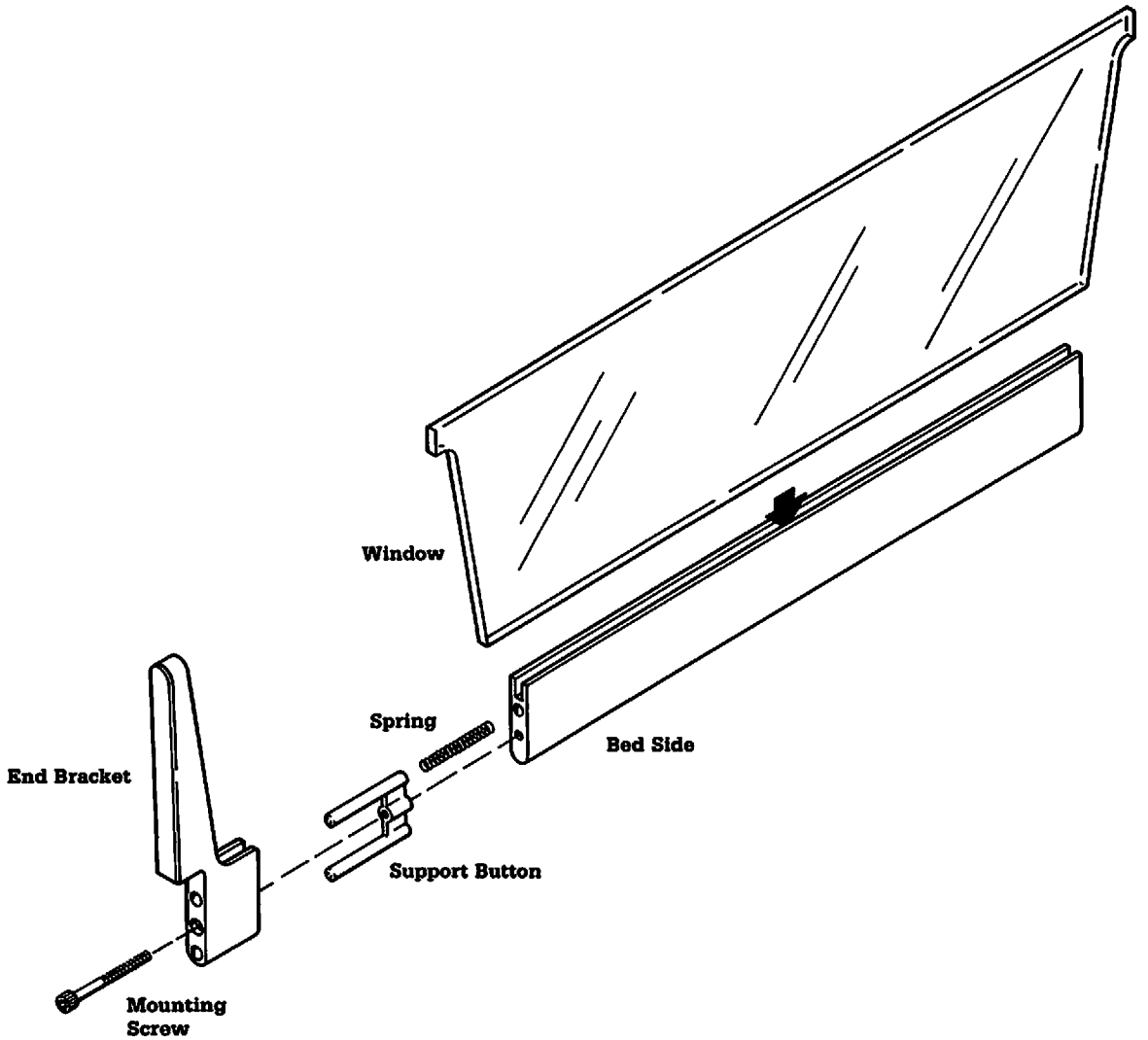

Figure 5-11. Side Panel Assembly.

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.

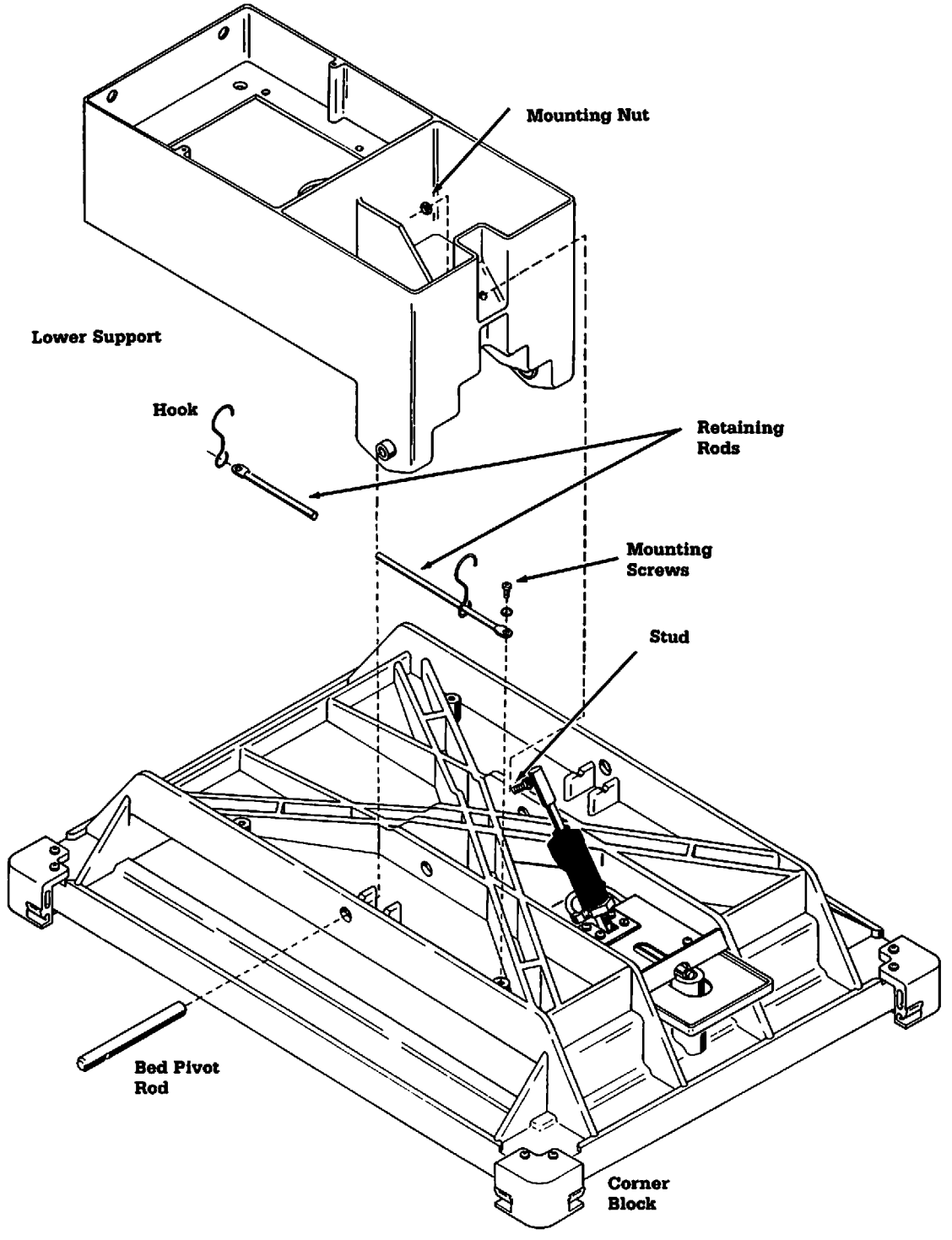

Figure 5-12. Bed Platform Assembly

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 hydraulic system 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.

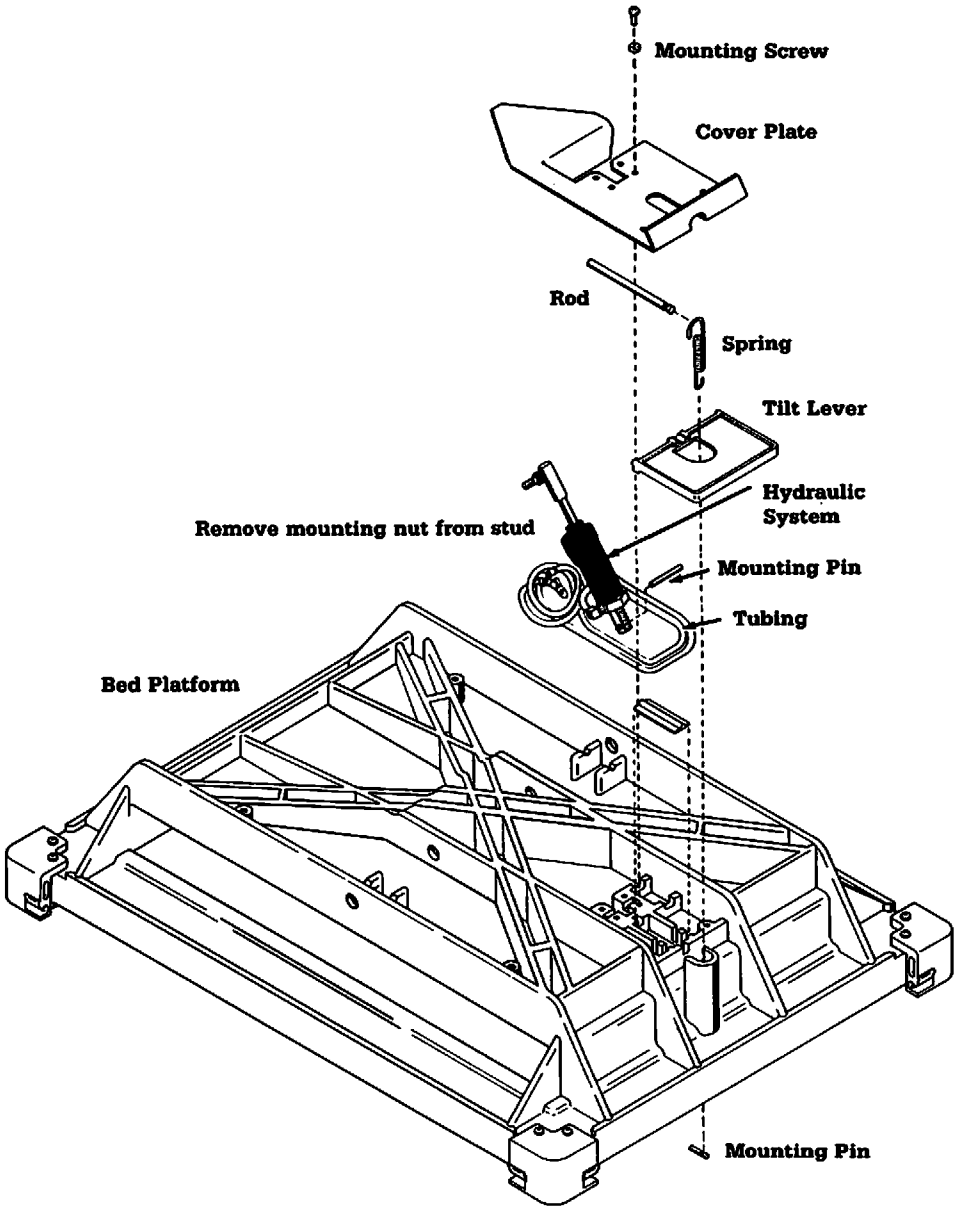

Figure 5-13. Hydraulic System Assembly.

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.

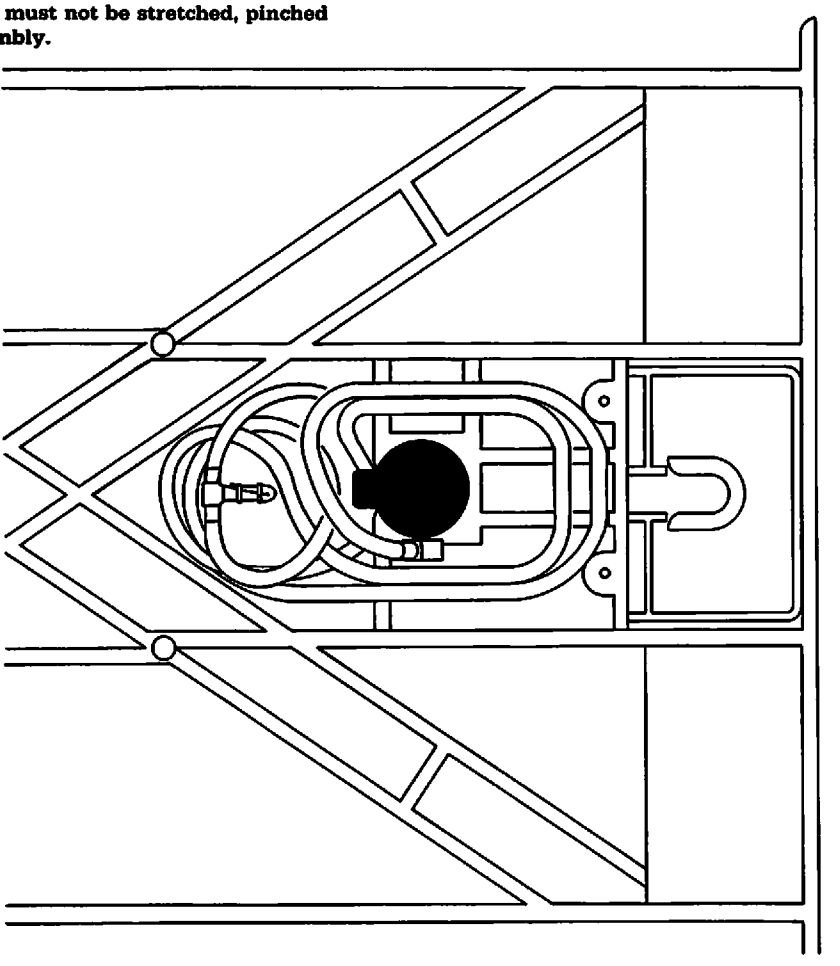

Figure 5-14. Hydraulic Tubing Installation.

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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 System 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 System on its right-hand side, as viewed from the front.

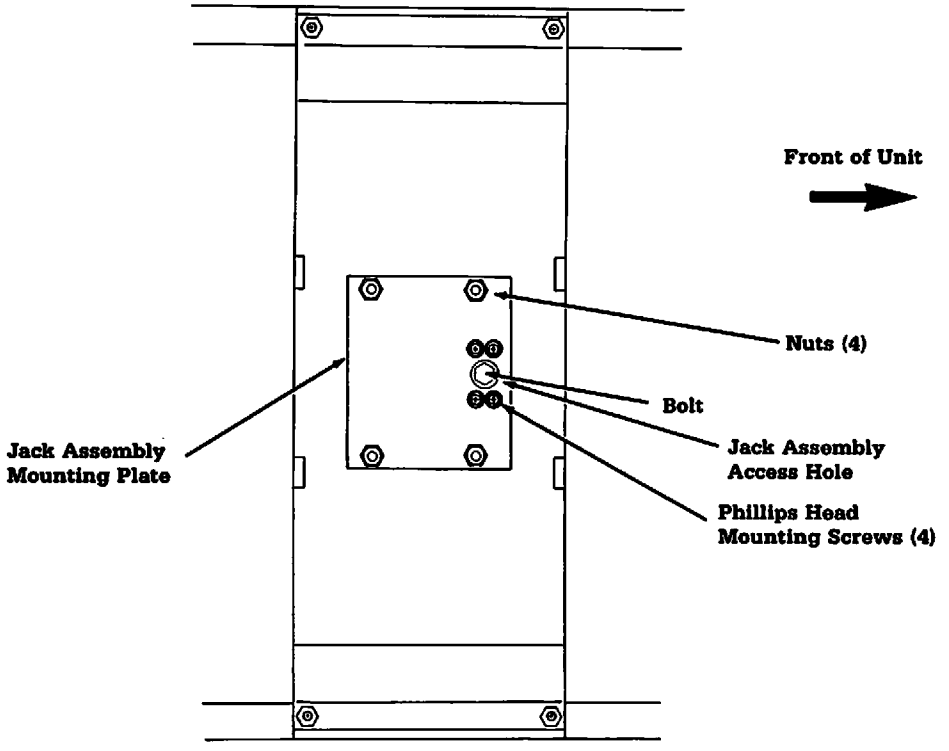


Figure 5-15. Bottom View of 5000 Infant Warmer System (laying on its right hand side).

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.

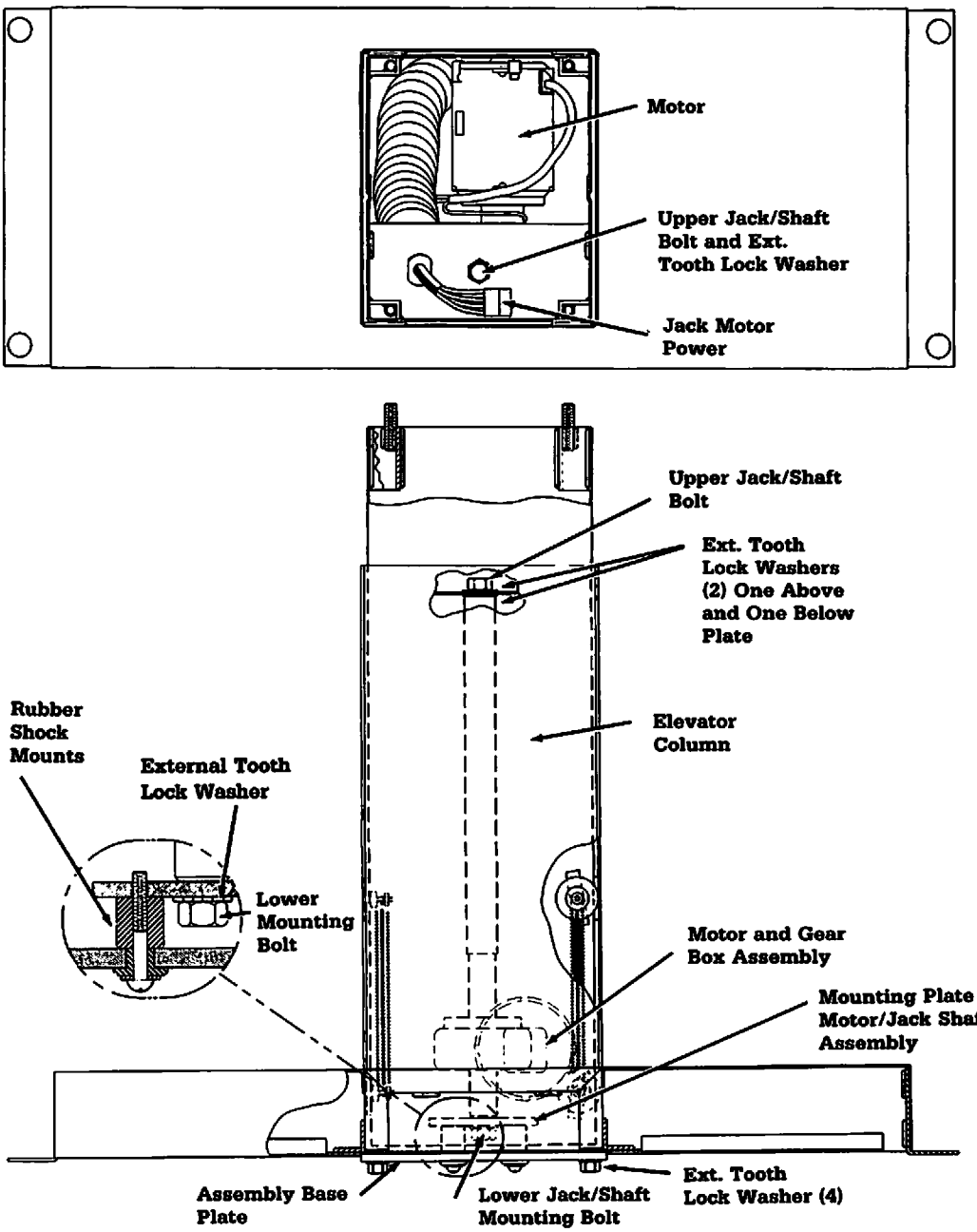


Figure 5-16. Top and Cut-away Internal Side View of Elevating System

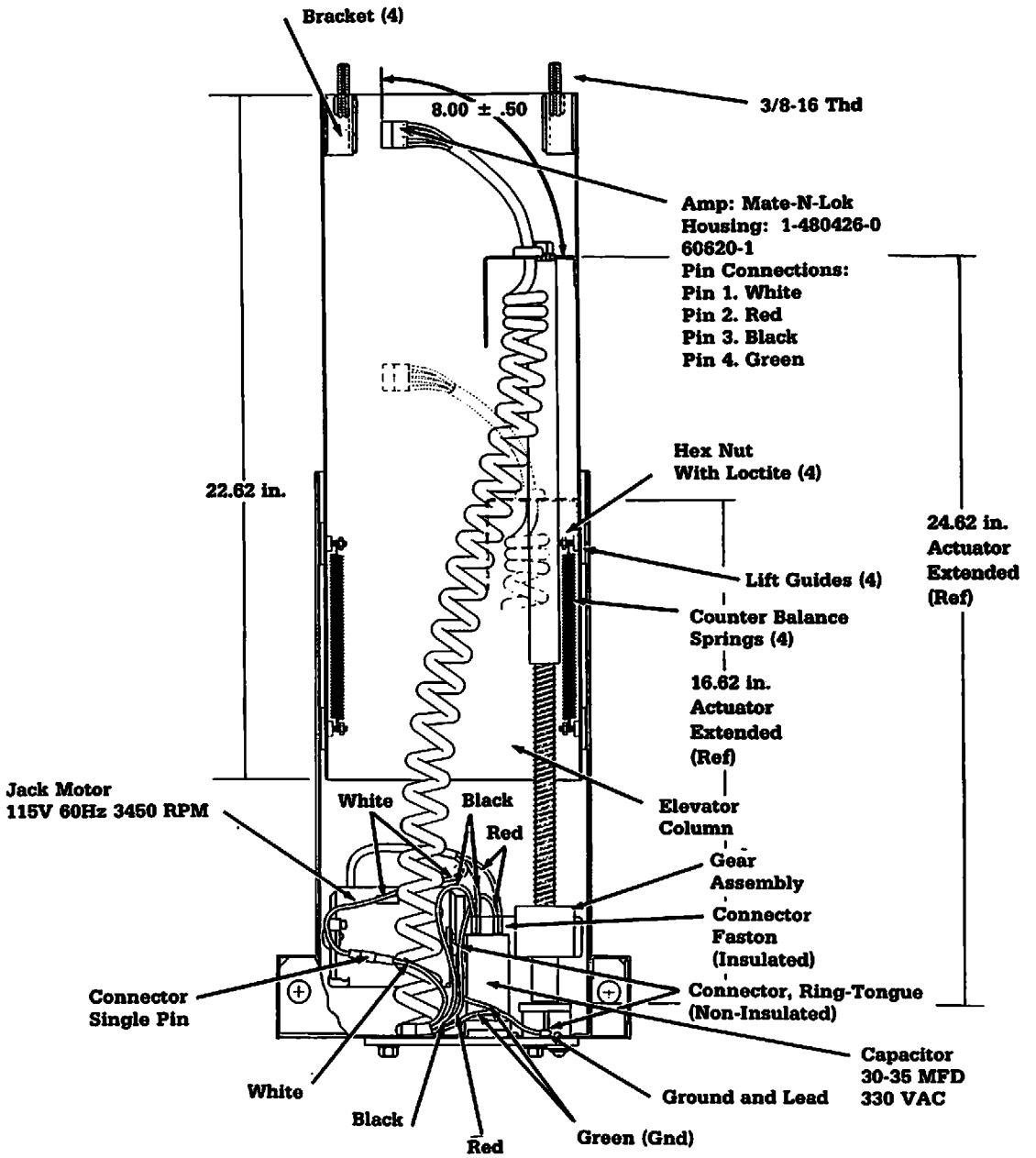


Figure 5-17. Cut-away, Internal Side View; Cable and Wiring Connections

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.

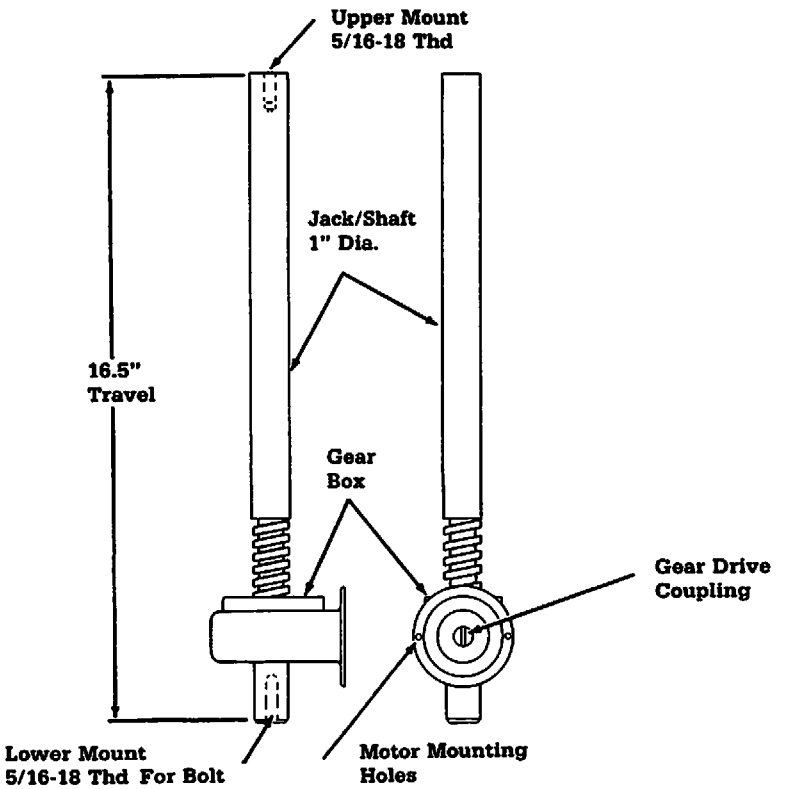


Figure 5-18. Gearbox and Jack-Shaft Assembly.

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.

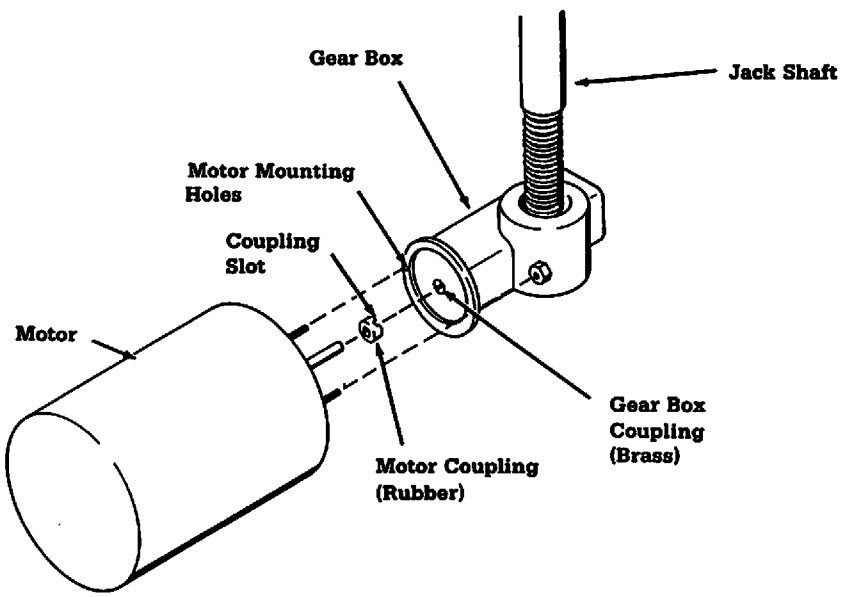


Figure 5-19. Motor and Gearbox Assembly.

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: For safety have at least 2 people available to replace a caster.

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. 0210-5022-300) 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.

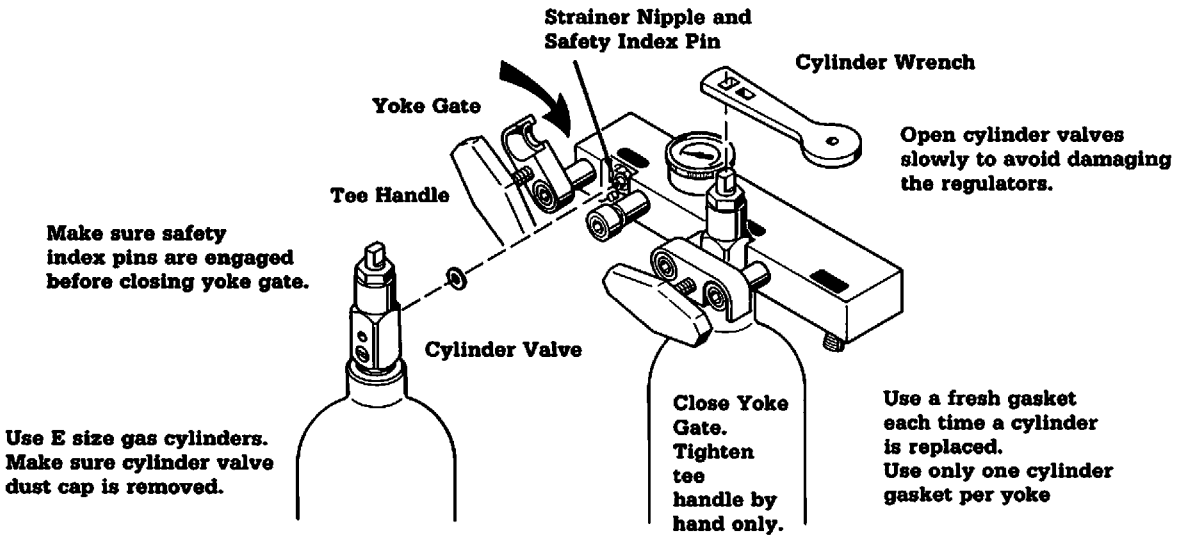


Figure 5-20. Gas Manifold Maintenance.

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.

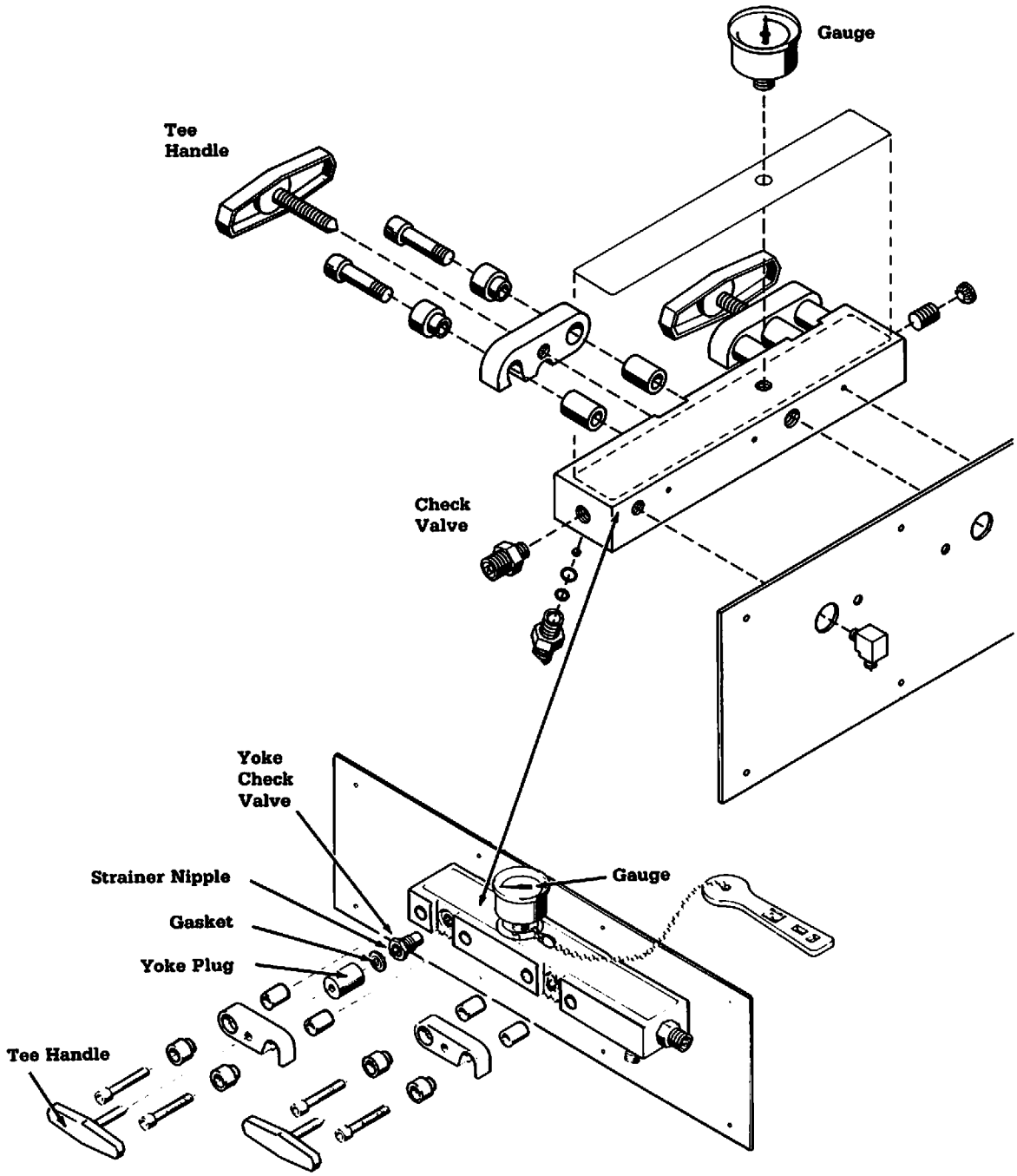


Figure 5-21. Manifold Assembly

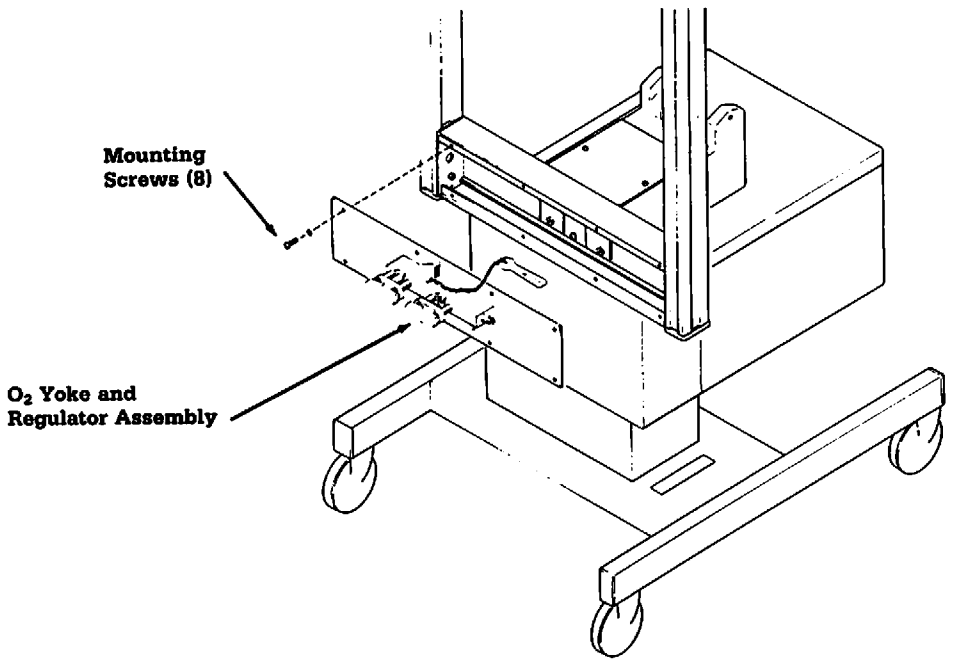


Figure 5-22. Manifold Assembly Removal.

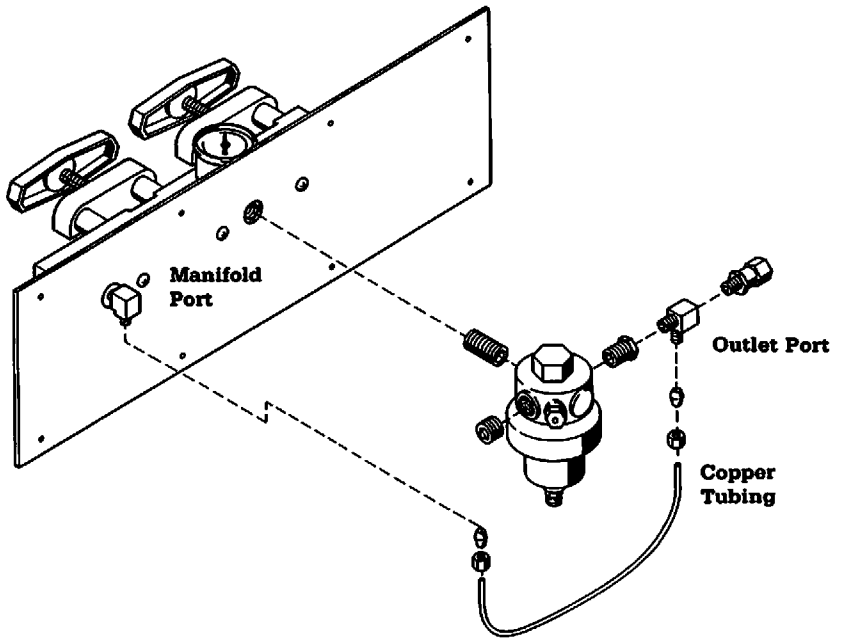


Figure 5-23. High Pressure Regulator.

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. 0210-5022-300) 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.

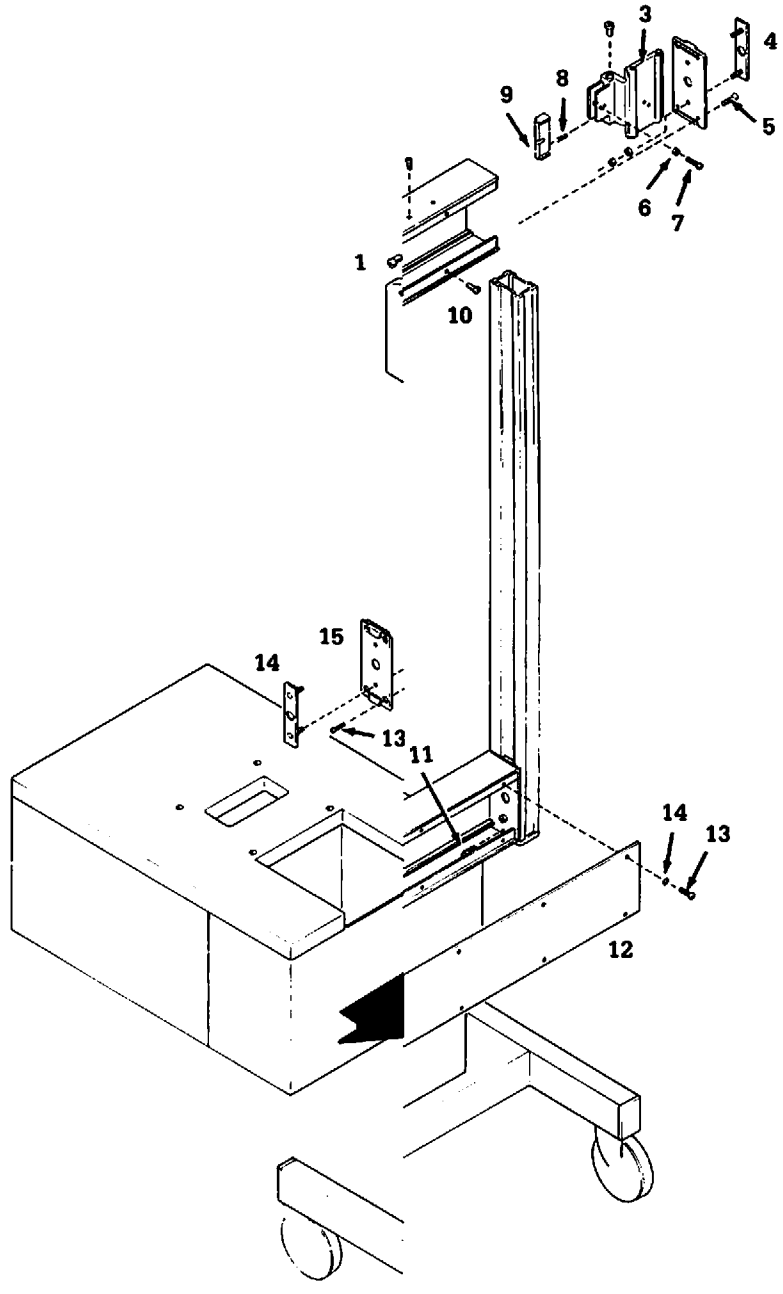
Condition	Possible Cause	Solution
Gas leakage at the regulator outlet when the adjustment screw is completely released.	Leak across the regulator seat.	Replace seat and corresponding parts.
Outlet pressure increases steadily above set pressure (no flow through system).	Leak across the regulator seat.	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.

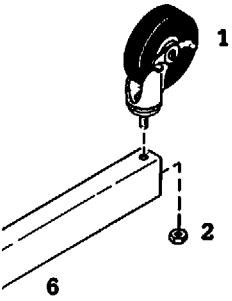
ERROR	DESCRIPTION	POSSIBLE CAUSE
#01	Instruction test fails	Microprocessor 8031 failure
#02	Calibrate high fails	ADC calibration Cal high resistor failure
#03	Calibrate low fails	ADC calibration Cal low resistor failure
#04	Checksum fails	Eprom failure Microprocessor 8031 failure
#05	Ram test fails	Microprocessor 8031 failure
#06	Port 1 lines	I/O expander 8243 failure Microprocessor 8031 failure
#07	ADC not converting	A/D Converter ADC3711 failure Voltage Reference LM10 failure I/O expander 8243 #2 failure
#08	Not used	
#09	Heat not controlled	Heater solid state relay failure Microprocessor 8031 failure VQ1000J Power FET (V1) failure
#10	Line voltage out of range.	Line voltage compensation pot. on power supply board not calibrated.

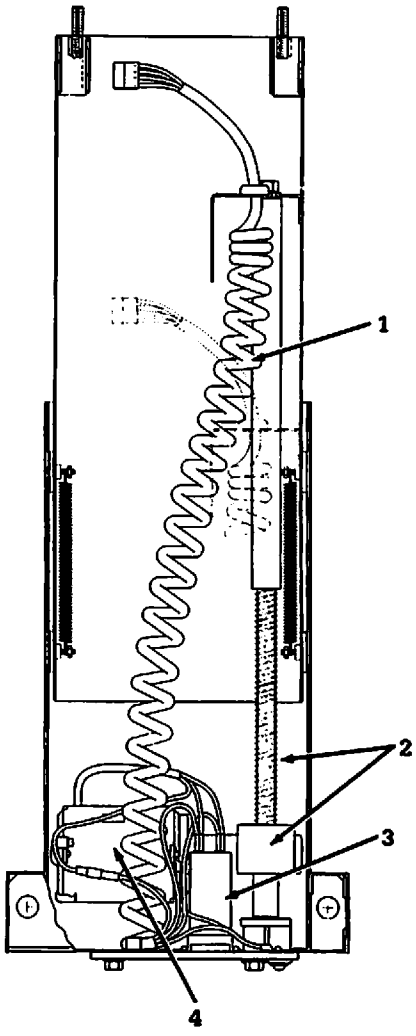
SERVICE NOTES



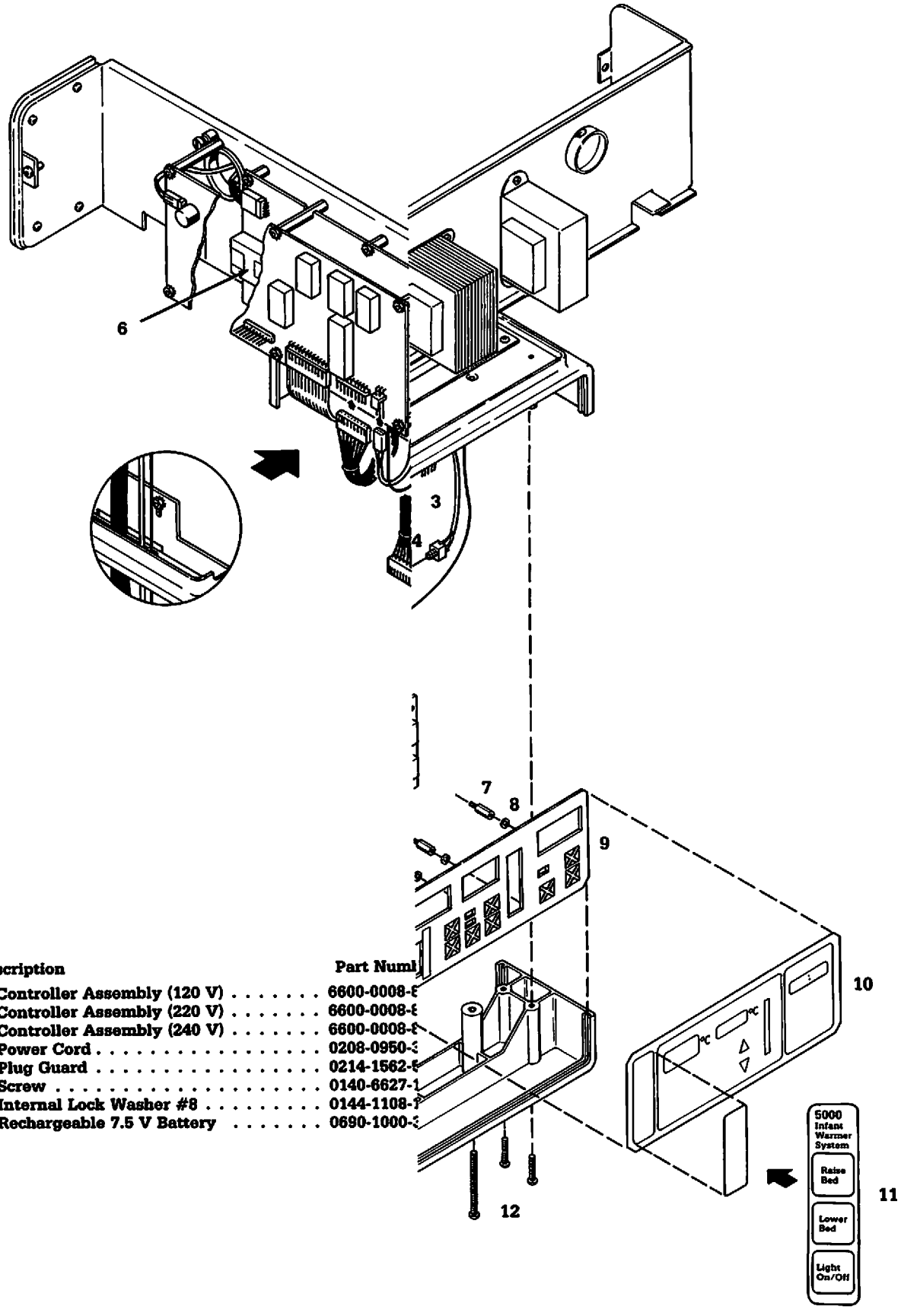
Description	Part Numl
1. Bearing	0209-0079-3
2. Screw 10-24 × 5/16	0140-6530-1
3. Bed Support Cover	0214-1559-8r
4. Screw, 3/8-16 × 7/8	0144-2245-40
5. Bed Support	0217-5310-20
6. Lower Cross Support	0217-5180-30
7. Nut, Elastic 3/8-16	0202-1022-30
Lockwasher	0202-3415-36
8. Upright w/Dovetails	0217-5178-33
9. End Cap	0217-5286-18
10. Screw	0140-6627-10
11. Hex Nut 5/16-18	0144-3140-10
12. Lockwasher 5/16 int	0202-3418-22
13. Screw, 1/4 × 1	0142-4247-10
14. Double Locking Lug	6600-0029-29
15. Upright Casting	0217-5285-16
16. Support Plate	0214-1558-11

Figure 7-1
Infant Warmer Frame Assembly (Model 5000)



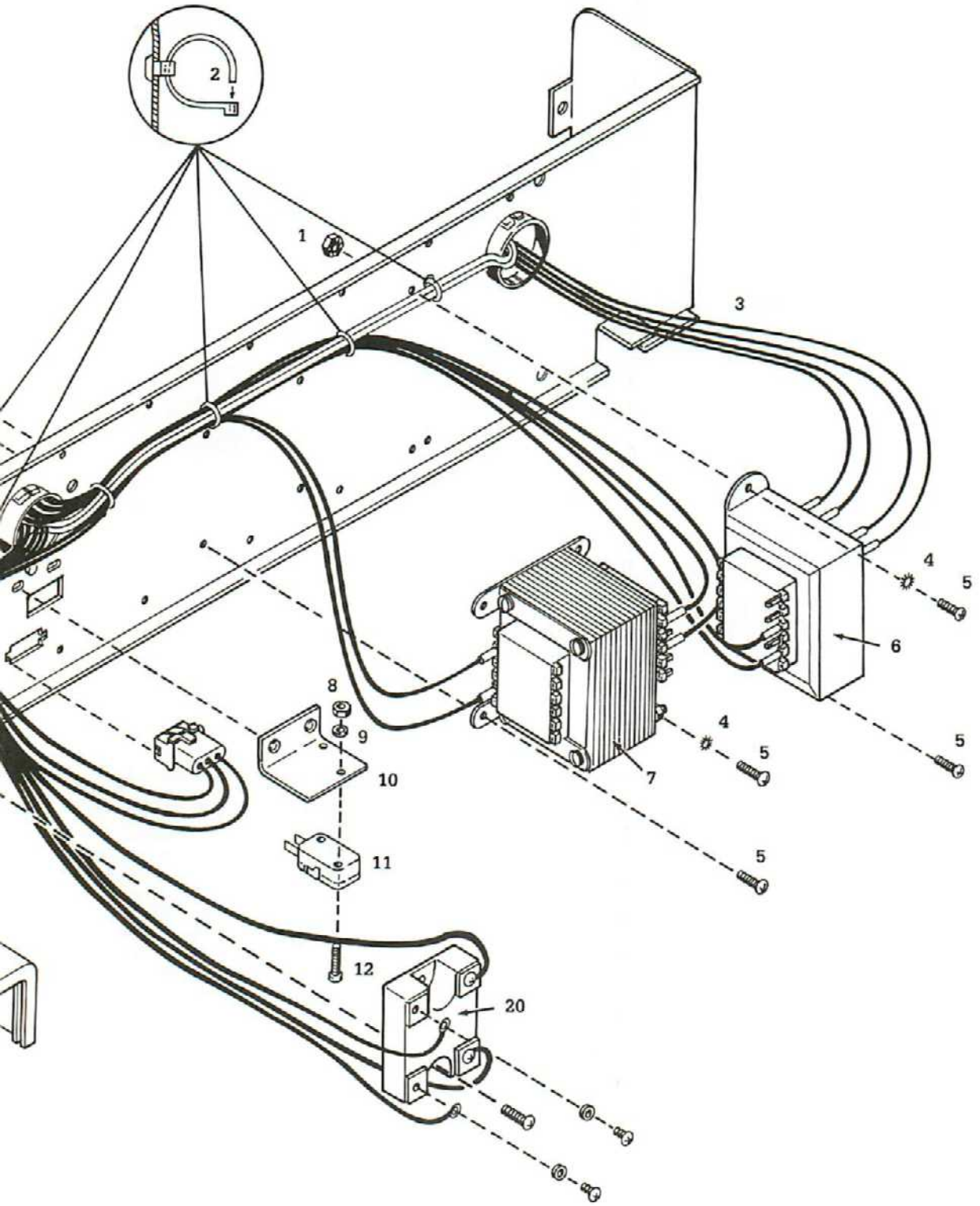


Description	Part Number
1. Flexible Power Cord	6600-0033-700
2. Gear/Jackshaft Assembly	0217-5175-300
3. Condenser 120 Volt	0682-7045-300
Condenser 220/240 Volt	6600-0036-600
4. Motor 120 Volt	0208-2506-300
Motor 220/240 Volt	6600-0037-600



Description	Part Numl
1. Controller Assembly (120 V)	6600-0008-[illegible]
Controller Assembly (220 V)	6600-0008-[illegible]
Controller Assembly (240 V)	6600-0008-[illegible]
2. Power Cord	0208-0950-[illegible]
3. Plug Guard	0214-1562-[illegible]
4. Screw	0140-6627-[illegible]
5. Internal Lock Washer #8	0144-1108-[illegible]
6. Rechargeable 7.5 V Battery	0690-1000-[illegible]

Figure 7-4
Infant Warmer Controller Assembly 1 (Model 5000


1
2
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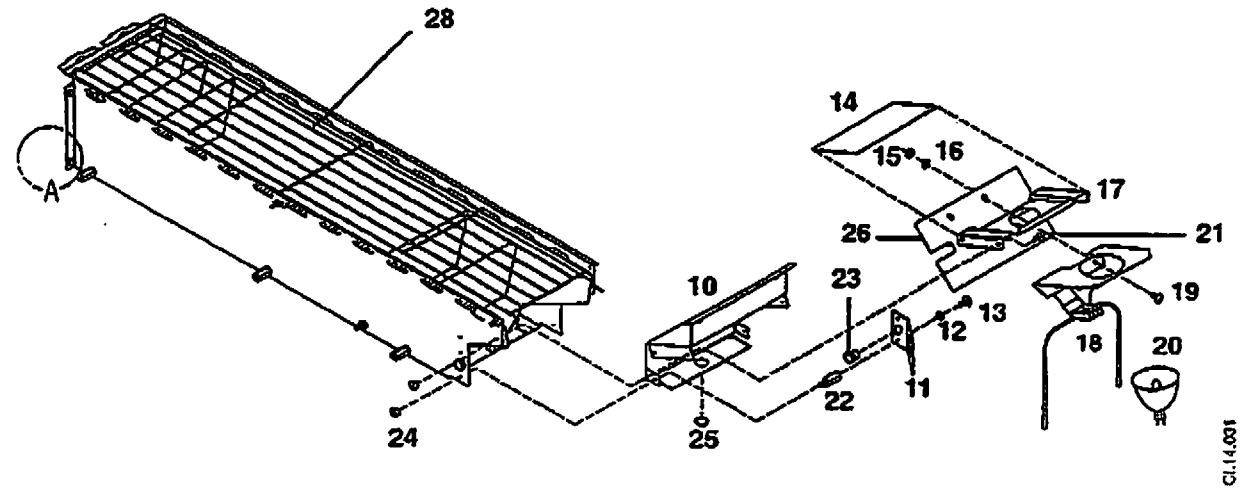
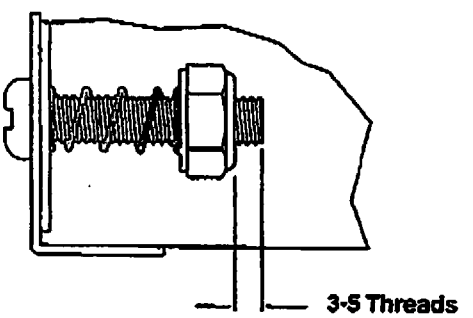
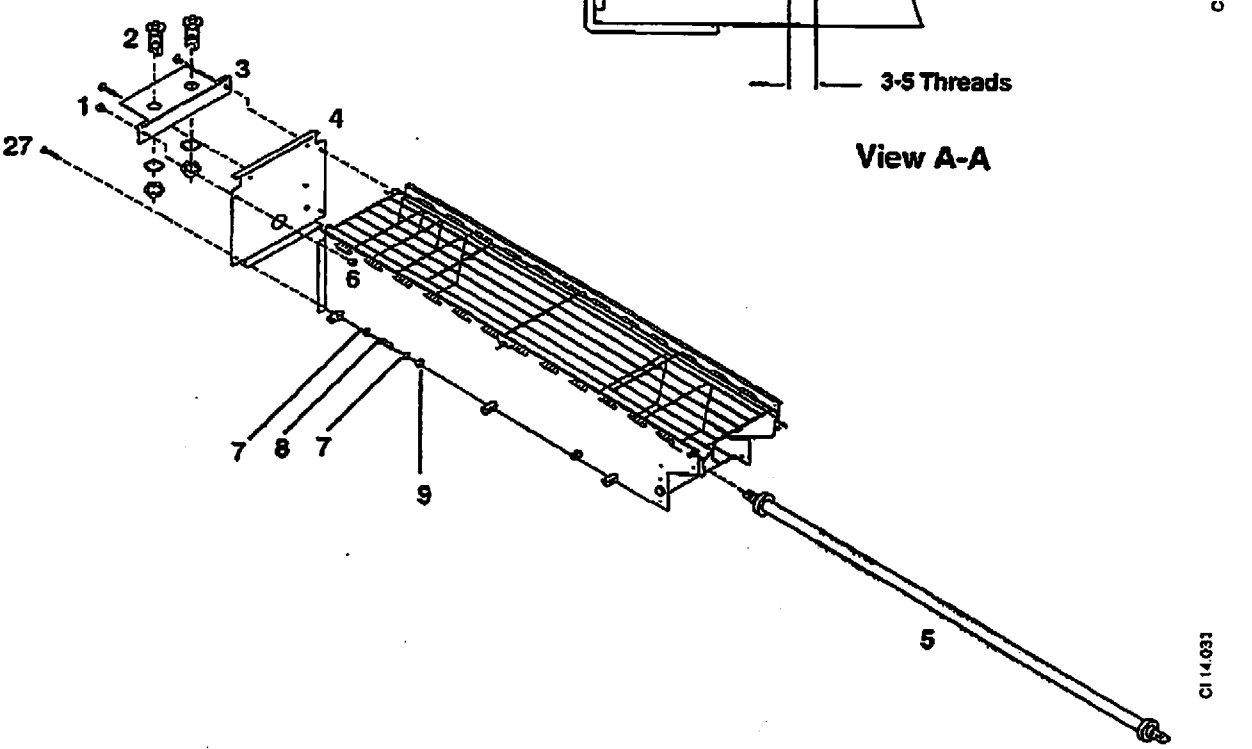
7/Illustrated Parts



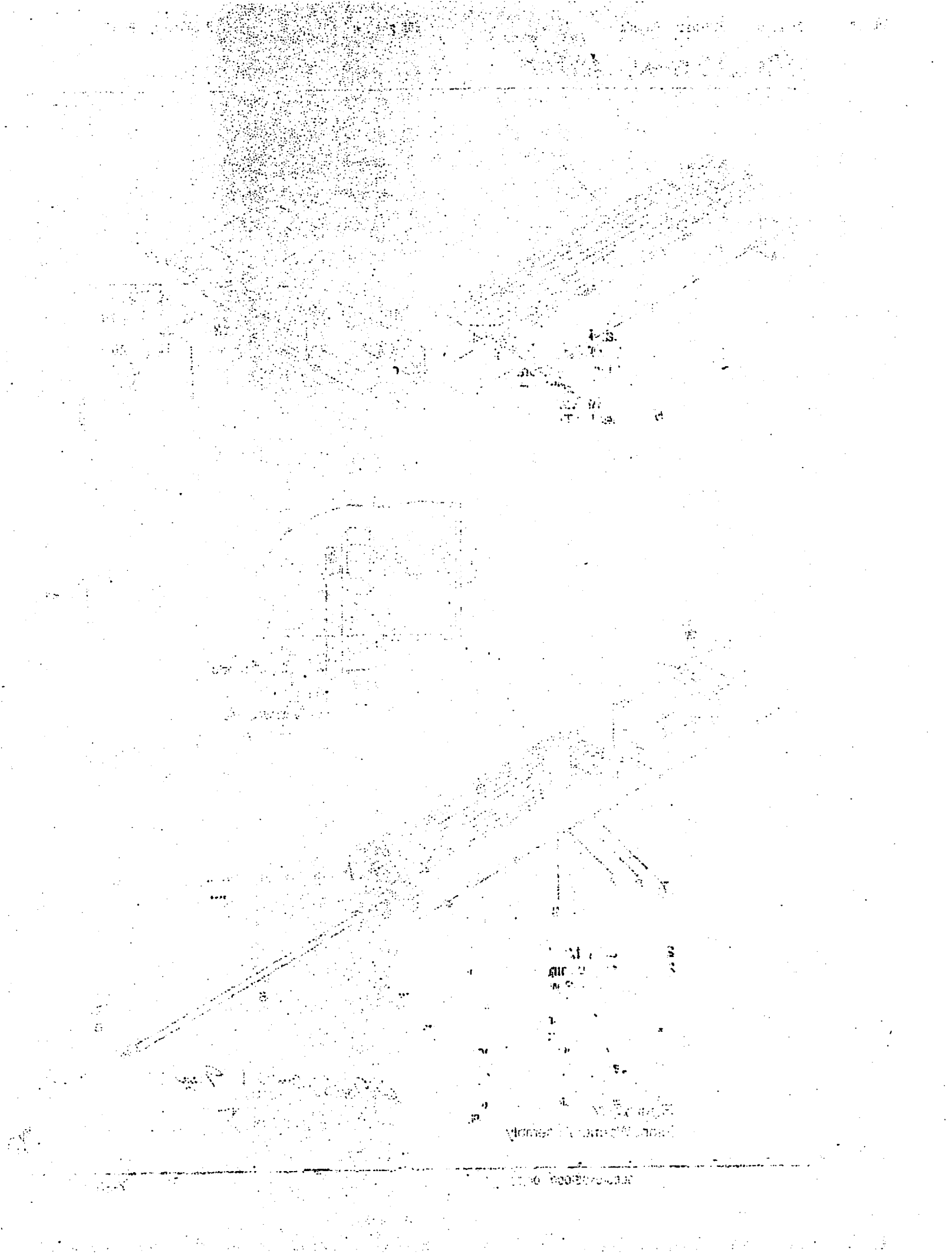


View A-A



0905 0409 910
3

Figure 7-17
Infant Warmer Assembly



7/Illustrated Parts

	Description	Stock Number
1.	Screw 6-32 x 1/2	0140-6124-108
2.	Lamp Socket Sylvania #31099	0686-9000-416
	Lamp GTE Sylvania 120MB 6W	0690-2100-315
3.	Alarm Light Bracket - units prior to HCC serial number	0214-1567-500
	Alarm Light Bracket - unit with HCC serial number	6600-0842-500
4	Front Reflector End Cap	0217-5213-500
5.	Heater Tube	
	120V 440W (2001/series 3000 prior to HCA or HCC)	6600-0284-800
	220V 440W (2001/series 3000 prior to HCA or HCC)	6600-0285-800
	240V 440W (2001/series 3000 prior to HCA or HCC)	6600-0286-800
	100V 440W (2001/series 3000 prior to HCA or HCC)	6600-0287-800
	120V 540W (5000/series 4000)	6600-0280-800
	220V 540W (5000/series 4000)	6600-0281-800
	240V 540W (5000/series 4000)	6600-0282-800
	100V 540W (5000/series 4000)	6600-0283-800
	120V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0014-850
	220V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0015-850
	240V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0016-850
	100V 540W (model 2001/series 3000 w/HCA or HCC)*	6600-0017-850
6.	Nut, #6-32 w/Ext Lock washer	6600-0382-400
7.	Washer	6600-0378-400
8.	Spring	6600-0019-300
9.	Nut	6600-0111-400
10.	Rear Reflector Cap	0217-5212-500
11.	Wire Harness Socket Bracket	0214-1566-500
12.	External lock washer #6	6600-0259-400
13.	Screw, 6-32 x 1/4	6600-0389-400
14.	Exam Light Lens 3 x 5	0217-5306-300
15.	Nut, Keps 4-40	6600-0073-400
16.	Washer #4	6600-0358-400
17.	Lamp holder Bracket	0217-5214-500
18.	Lamp holder kit	
	Units without HCA or HCC serial numbers (sockets)	6600-0010-850
	Units with HCA or HCC serial numbers (pins)	6600-0011-850
19.	Screw, 4-40 x 5/16	6600-0388-400
20.	Lamp 12V 50W GE EXZ(Q50 MR16/NFL) or GE EXN(Q50 MR16/FL)	0208-0516-300
21.	Screw, 6-32 x 1/2	0140-6124-108
22.	Spacer 1/4" Hex 6-32 .75L	0402-0234-300
23.	Snap Bushing 3/8 I.D. for .50 Hole	6600-0519-500
24.	Nut, #6-32 w/Ext Lock washer	6600-0382-400
25.	Hole Plug	6600-0392-400
26.	Insulator Fishpaper	6600-0002-300
27.	Screw 6-32 x 7/8	0140-6124-114
28.	Heater grille, series 3000	6600-0027-500
	Heater grille, series 4000	6600-0007-700

* These tubes are designed for newer units (with HCA and HCC serial number) that have 540 watts heaters. Placing these tubes in older 440 watts unit will cause equipment damage.