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Water-Jacketed,
US Autoflow Automatic CO_2 Incubator

Models
NU-4500/D/E/G

Operation & Maintenance Manual

Revised
January, 1999

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Water-Jacketed, US Autoflow
Automatic CO_2 Incubator
Operation & Maintenance Manual

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US Autoflow Automatic CO_2, Water-Jacketed Incubator

Models

NU-4500/D/E/G

Operation & Maintenance Manual

1.0 General Description

The NuAire US Autoflow Automatic CO_2 water-jacketed incubator has been designed to provide a reliable controlled in vitro environment for optimum tissue cell culture growth. Five parameters contribute to optimum growth conditions. These are:

1. Humidity
2. Precision temperature control
3. Precise CO_2 control
4. Sterility
5. Reliability

Like all NuAire equipment, the US Autoflow has been designed to provide the highest quality standards of performance with matching computer technology, precise temperature control and CO_2 gas control system combining state-of-the-art technology with years of design, quality and manufacturing experience.

In order to accomplish the foregoing objectives, the US Autoflow features the following:

1.1 Extra Large (16 gallon) Water-Jacket - Each Chamber

The outer stainless steel wall is lined with a space-age insulation providing a R5.0 rating, minimizing heat loss. The large 16 gallon (60.56 liters) water-jacket utilizes water, one of natures best "sinks" of heat. Its high capacity to hold heat makes it the ideal medium to surround a chamber in order to obtain temperature uniformity. In fact, the ability of materials to hold heat, called the specific heat, uses water as the comparative standard. The large water-jacket surrounding the chamber permits the water to circulate within the jacket, producing a temperature uniformity of ±0.2°C. The larger the mass, the less susceptible within the chamber to environment fluctuations outside. It also adds cabinet stability for the growth of vibration sensitive cells.

1.2 NuAire Incubator Control Electronics

The NuAire Incubator Control Electronics is a state-of-the-art microcomputer based control system specifically designed to service the precise control requirements of the chambers environment, providing optimum programmable conditions for culture growth. The microcomputer is "user friendly" with status indicators, LED display of control parameters and three touch control key pads to permit efficient operator entry of data.

The microcomputer is supported with Read Only Memory (ROM) containing executable software, Random Access Memory (RAM) for temporary storage and Electronically Erasable Programmable Read Only Memory (EEPROM) for control set points and parameters. The EEPROM provides for indefinite storage of these values during periods of power off or power interruption (power fault tolerant).

The microcomputer includes a complete internal diagnostic software package that permits fault isolation detection down to the failed component.

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1.3 CO_2 Sensor

The NuAire US Autoflow employs a solid-state single gas analyzer for carbon dioxide. This innovative analyzer utilizes a filter correlation technique for non-dispersive infrared analysis of CO_2. The analyzer consists of an optical bench incorporating an infrared source, sample cell, and infrared detector. The amount of power impinging on the detector is an approximate logarithmic function of the CO_2 concentration in the gas between source and detector. Detector linearization is performed with 32-bit digital accuracy. The measurement of CO_2 is independent of humidity and temperature variations within the chamber

1.4 All Stainless Steel Construction

The US Autoflow's exterior is constructed of 16 gauge, type 304 stainless steel with the interior being 16 gauge, type 304 polished stainless steel using crevice free construction, which provides an easily cleanable (for decontamination) inert surface that does not promote biological growth. In addition all shelves, shelf supports and guide rails are easily removable and can be autoclaved to remove contamination.

1.5 Humidity

Humidification of the chamber is achieved through the process of water evaporation from a water reservoir placed within the autoflow chamber. In addition, water condensation, which actually lowers the relative humidity within the chamber, is prevented by having all interior surfaces exposed to the constant temperature water-jacket, or heated separately via an integrated control that regulates door heat to maintain minimal condensation on the glass door.

The US AutoFlow has an available optional relative humidity display and control system. The system controls from ambient to 95% relative humidity. The recovery time to 95% ±2% is typically less than 10 minutes. The accuracy is ±3% from any given set point.

The control system uses a solid state capacitance humidity sensor to monitor the relative humidity within the chamber. If humidity is required, the control system will activate an independent recirculation pump. The pump will then draw chamber air to itself and push it through a 0.3 micron capsule HEPA filter, through a humidified heated enclosure and returned to the chamber. The control will continue until the setpoint is achieved. The relative humidity display and control option offers an accurate and reliable method to control humidity when required.

1.6 CO_2 Backup System

The NuAire US Autoflow employs a unique CO_2 backup system in the event of a CO_2 fault. If the CO_2 backup system is activated in the configuration function, upon a catastrophic sensor calibration fault or failure, the incubator will indicate a CO_2 fault with a timed audible alarm and blinking green LED next to the CO_2 percent display. The CO_2 LED displays "b.up" alternate with CO_2 level. The CO_2 backup system will then air purge the chamber of all CO_2 for 120 minutes to establish a baseline point of no CO_2. Then, starting from the no CO_2 baseline point, the CO_2 backup system will inject a set amount of CO_2 into the chamber to achieve the CO_2 setpoint. The backup system will then continue to inject a small amount of CO_2 periodically to maintain the CO_2 percentage in the chamber. The alarm condition is cleared by turning the mode switch on the front panel to setup and back to run.

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2.0 Performance Parameters

2.1 Both the interior and exterior of the US Autoflow are constructed of 16-gauge, Type 304 stainless steel. The interior is highly polished using crevice-free construction. All exposed edges are deburred to insure no sharp edges. The exterior is finished in a textured polyurethane finish, which is resistant to chemicals and easily cleaned using mild household detergents.

2.2 Each chamber's water-jacket holds 16 gallons (60.56 liters) of water, that, in conjunction with the microcomputer control system, provides an interior chamber temperature uniformity of ±0.2°C at 37.0°C.

2.3 The US Autoflow's microcomputer temperature control system has two temperature sensors: one in the water-jacket and one in the chamber. The chamber temperature sensor compares the values to a setpoint and executes a time proportional control algorithm that energizes a solid-state switch, supplying power to the heater.

2.4 The CO_2 percentage is controlled by a solid-state infrared gas analyzer which provides accurate monitoring of CO_2, irregardless of changes in temperature or humidity within the chamber.

2.5 Calibration of the infrared CO_2 gas analyzer is accomplished simply through a front panel diagnostic procedure to assure accuracy and minimize downtime.

2.6 Automatic recovery of CO_2 to 5.0±0.2% CO_2 within 2 minutes after a door opening (4 min. for dual chamber).

2.7 The outer door includes a radiant heater in order to minimize condensation on the inner glass door. A magnetic outer door gasket helps to insure a tight seal against the cabinet.

2.8 The inner glass door is 3/16" tempered with smooth-ground edges and seals are tight against a U-grooved silicone rubber gasket. The door latch is cam action. A solid-state magnetic switch monitors door motion.

2.9 All electronic controls are modular and easily removed through the front or side service control center.

2.10 All control electronics are protected with a circuit breaker that will trip at 145% of load rating in less than 2 seconds. Should the circuit breaker open (pop-out button will appear), merely depress to reset.

2.11 A water fill access port is provided on the front of the US Autoflow. Removal of a ¼ inch NPT plated brass fill plug allows filling using a ¼ inch NPT hose adapter (provided).

2.12 The US Autoflow has factory installed adjustable leveling legs to compensate for uneven laboratory surfaces.

2.13 The entire interior shelving assembly is easily removable for decontamination. Shelves and brackets are constructed from 18 gauge, type 304 polished stainless steel.

2.14 A thru-wall access port is provided for operating electrical appliances such as roller apparatus, rockers, etc.

2.15 A CO_2 sample port is provided on the front panel to check the concentration of CO_2 in the chamber.

2.16 A water level sensor is provided to monitor the level of water within the jacket.

2.17 A water-jacket valve is provided on the bottom of the unit for ease of draining.

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3.0 Models & Features

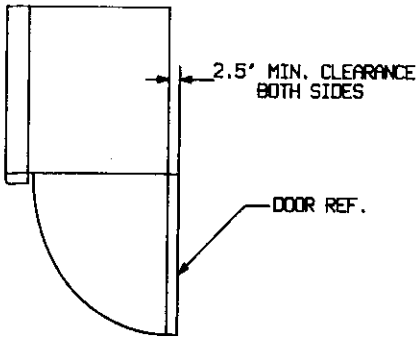
NuAire offers a basic Model NU-4500/D/E/G Water-Jacketed US Autoflow Automatic.

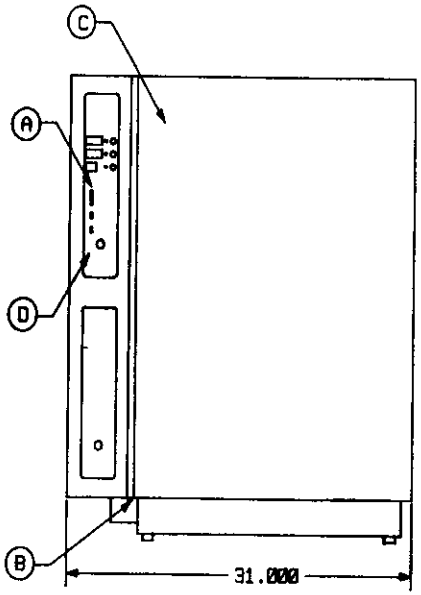
3.1 Dimensions (see also Specification Drawing BCD-04361)

	Model NU-4500/4500E
Overall Dimensions - inches (mm):	**Single Unit**
Width:	31.0 (787.4)
Height:	35.0 (889.0)
Depth:	25.5 (647.7)

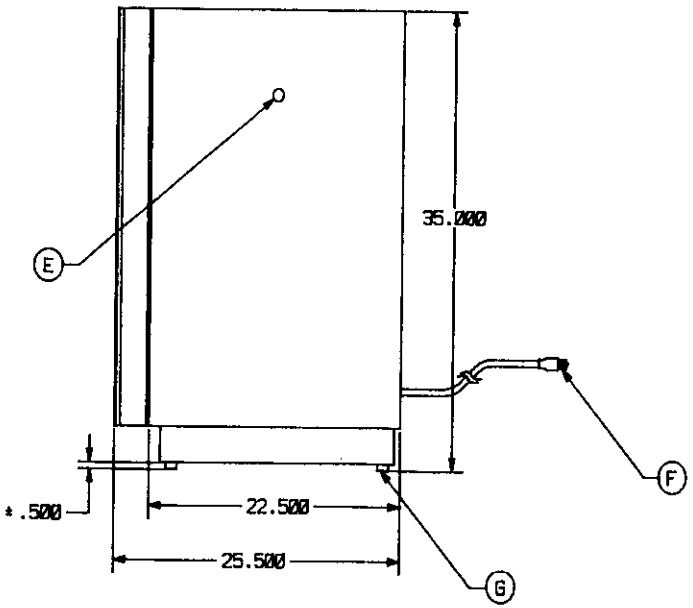
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FRONT VIEW



RIGHT SIDE VIEW

TEMP. RANGE: 5°C ABOVE AMBIENT TO 55°C
TEMP. SENSITIVITY ± 0.125° C
TEMP. UNIFORMITY ± 0.2 AT 37°C
CO_2 RANGE: 0 TO 20%
CO_2 ACCURACY ± 0.1%
CO_2 RECOVERY TO 5%: 2 MINUTES
ELECTRICAL: 115 VAC, 550 W, 50/60HZ.
220 VAC, 550 W, 50/60HZ.
DIMENSIONS INTERIOR:
25.500'H x 21.500'W x 21'D
DIMENSIONS EXTERIOR:
35.000' H x 31.000' W X 25.500' D
SHELF: 19.250' x 19.250'

A - FRONT PANEL CONTROLS & INDICATORS
B - WATER JACKET DRAIN
C - WATER FILL ACCESS PORT (BEHIND DOOR)
D - REMOVABLE PLUG IN/OUT CONTROL PANEL
E - ELECTRICAL ACCESS PORT (1.125' DIA. 28.5 MM)
F - POWER CORD 8' 2.5M.
G - LEG LEVELER ±.500 ADJUSTMENT

NUAIRE
PLYMOUTH, MINNESOTA

DFTM	TH	1/15/93
CHKD		
APPR		
MATERIAL		
SHEET	1 OF 1	

PROPRIETARY
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TITLE
SPECIFICATION DRAWING
MODEL NU-4500/4500E
AUTOMATIC CO2

DRAWING NUMBER BCD-04361

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3.2 Standard Features

- 100% stainless steel chamber construction
- Large capacity water-jacket (16 gallon) (60.56 liters)
- NuAire Incubator Control Electronics Temperature Range: 5°C above ambient to +55°C
- Chamber temperature uniformity: ±0.2°C at 37°C
- Temperature sensitivity: ±0.0125°C
- CO_2 Range: 0-20%
- CO_2 Accuracy: ±0.1%
- CO_2 Recovery to 5.0±0.2%: 2 minutes

3.3 Standard Items Packed with Unit

- (4) Stainless Steel Shelves
- (8) Stainless Steel Shelf Brackets
- (4) Stainless Steel Shelf Bracket Supports
- (1) Full Size Water Pan with Supports
- (1) Fill Port Hose Adaptor
- (1) Fill Port Plug
- (1) Gas Tube with Filter
- (1) 6 feet (2m), Fill Tube
- (1) Electrical Cord 8 foot (2.5m)
- (1) Operation & Maintenance Manual
- (1) Operating Instructions

3.4 Optional Features

• Model Number I01	Automatic CO_2 Tank Switch (Internal)
• Model Number I06	Security Key Lock
• Model Number I11	Internal Coil for Chilled Water
• Model Number I12	Humidity Display & Control (115 VAC)
• Model Number I14	Humidity Display & Control (230 VAC)
• Model Number I16	4 Inner Lexan Doors
• Model Number I18	RS-232 Communications Interface

3.5 Accessories

• Model NU-1550	Automatic Tank Switch (External) (115 VAC)
• Model NU-1550E	Automatic Tank Switch (External) (230 VAC)
• Model NU-1552	CO_2 Tank Alarm (115 VAC)
• Model NU-1551E	CO_2 Tank Alarm (230 VAC)
• Model NU-1553	Stacking Rack (Single Unit)
• Model NU-1554	Stacking Rack (Dual Unit, Side/Side)
• Model NU-1555	Additional Stainless Steel Water Pan
• Model NU-1556	Additional Tubing Kit
• Model NU-1557	Additional Shelves
• Model NU-1559	CO_2 Analyzer Fyrite Kit (Dry) 0-20% (Replacement fluid required)
• Model NU-1561	Replacement Fluid for CO_2 Analyzer (two bottles/carton)**
• Model NU-1564	CO_2 Regulator, Two-Stage
• Model NU-1566	Platform
• Model NU-1571	Platform w/Castors
• Model NU-1575	Moisture Proof Duplex Outlet (115 VAC)
• Model NU-2568	Surge Protector (115 VAC)

**Fyrite Replacement Fluid may only be ordered when shipment is possible by UPS Ground Service.

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4.0 Test Performance & Procedures

All equipment is thoroughly inspected by NuAire at the time of shipment. Quality control is maintained by constant surveillance over each product, beginning at the receipt of purchased material and concluding with a final inspection before packing. In all instances where product quality cannot be easily assessed on the end item (i.e. water-jacket leak tightness), the product is inspected during sub-assembly fabrication. The following test procedures are conducted on each cabinet and a copy of the test report is included with each unit.

4.1 Visual Inspection

4.1.1 Each US Autoflow is visually inspected to insure that the interior is clean and free from scratches, nicks, and burrs, and that all welds, both interior and exterior, are ground and polished smooth.

4.1.2 Painted surfaces are inspected to be free of scratches, nicks, insufficient covering and runs.

4.1.3 The doors open and close freely without binding of the hinges. The gasket seals the inner glass door tightly. The glass door is free of scratches.

4.2 Electrical Tests

4.2.1 Electrical Leakage Test
All autoflow incubators are required to have primary-circuit filtering to meet EMC (electromagnetic compatibility) regulations. Electrical leakage may exceed 0.5 millampere provided it is no greater than 1.0 millamperes.

4.2.2 Dielectric Voltage
All Autoflow Incubators are required to withstand 1770 VDC (2150 VDC for 230 VAC units) between dead metal parts and the hot/neutral power source leads with no electrical breakdown. This is factory tested using an Associated Research Model 4045AI or 3560D Insulation Tester.

4.2.3 Grounding Continuity
The resistance between the green bonding conductor of supply cord and any dead metal part of the cabinet shall not exceed 0.10 ohms.

4.3 Functional Tests

The following functional tests are performed on every unit at the end of a continuous 48-hour burn in period.

4.3.1 Control Systems
All diagnostic functions are exercised to insure proper operation of control systems, components and alarms.

4.3.2 CO_2 Control
Each unit is calibrated to function at 5%. CO_2 is introduced into the chamber and allowed to stabilize for ten minutes at 5% concentration. The concentration is checked with a fyrite measurement instrument. Each unit is monitored during the 48-hour burn in period and only accepted with zero failures.

4.3.3 CO_2 Recovery
Each unit is exercised for CO_2 recovery time at the end of the 48-hour burn in period. The door is opened for 1 minute to deplete the CO_2. After the door is closed, the unit shall recover to 5.0 $\pm$0.2% within 2 minutes.

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5.0 Warranty

NuAire, Inc. warrants that it will repair F.O.B. its factory or furnish without charge F.O.B. its factory a similar part to replace any material in its equipment within 18 months after the date of sale if proven to the satisfaction of the company to have been defective at the time it was sold provided that all parts claimed defective shall be returned, properly identified to the company at its factory, charges prepaid. Factory installed equipment or accessories are warranted only to the extent guaranteed by the original manufacturer and this warranty shall not apply to any portion of the equipment modified by the user. Claims under this warranty should be directed to NuAire, Inc. setting forth in detail the nature of the defect, the date of the initial installation and the serial and model number of the equipment.

NuAire, Inc. warrants the water-jacket and will repair or replace F.O.B. its factory or furnish without charge F.O.B. its factory the water-jacket within five years after the date of sale if proved to the satisfaction of the company to have been defective at the time it was sold.

This warranty shall not apply to any NuAire product or part thereof which has been subject to misuse, abuse, filling the water-jacket improperly, using additives in water-jacket, accident, shipping damage, improper installation or service, or damage by fire, flood or acts of God. If the serial number of this product is altered, removed or defaced as to be illegible, the warranty shall be null and void in its entirety.

The warranty is for the sole benefit of the original purchaser and is not assignable or transferable. Prior to returning any item, for any reason, contact NuAire for a Return Authorization Number. This number must accompany all returns. Any product shipped to NuAire without this number will be returned, refused shipment, or collect freight.

6.0 Shipments

NuAire, Inc. takes every reasonable precaution to assure that your Incubator arrives without damage. Motor carriers are carefully selected and shipping cartons have been specifically designed to insure your purchase. However, damage can occur in any shipment and the following outlines the steps you should take on receipt of a NuAire Incubator to be sure that if damage has occurred, the proper claims and actions are taken immediately.

6.1 Damaged Shipments

6.1.1 Terms are F.O.B. factory, unless stated otherwise. Therefore, it is important to check each shipment before acceptance.

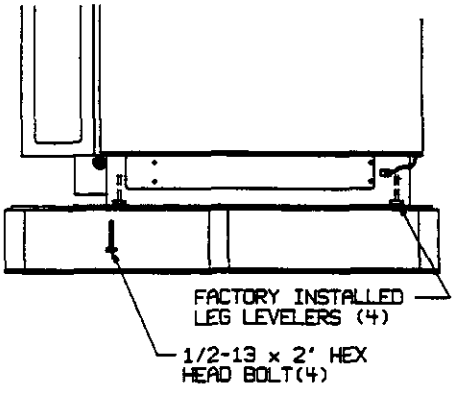
6.1.2 If there is visible damage, the material can be accepted after the driver makes a notation on the consignee's copy of the freight bill. Then an inspection must be made to verify the claim against the carrier. This inspection is the basis of your filing the claim against the carrier.

6.1.3 If concealed damage is found, it is absolutely necessary to NOTIFY THE FREIGHT AGENT AT ONCE, and request an inspection. Without this inspection, the transportation company may not accept a claim for loss or damage. If the carrier will not perform the inspection, an affidavit must be prepared stating that he was contacted on a certain date and that he failed to comply with the request. This, along with other papers in the customer's possession, will support the claim.

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7.0 Installation

The US Autoflow is fastened to the base skid and it is usually the best procedure to leave the skid attached until the US Autoflow is located in its approximate position, to facilitate ease in handling. The base skid can then be removed by removing the four bolts holding the cabinet to the skid. Examine the US Autoflow carefully. INSPECT both the exterior and the interior of the US Autoflow for any transit damage before discarding the shipping crate (see Section 6.1.3).

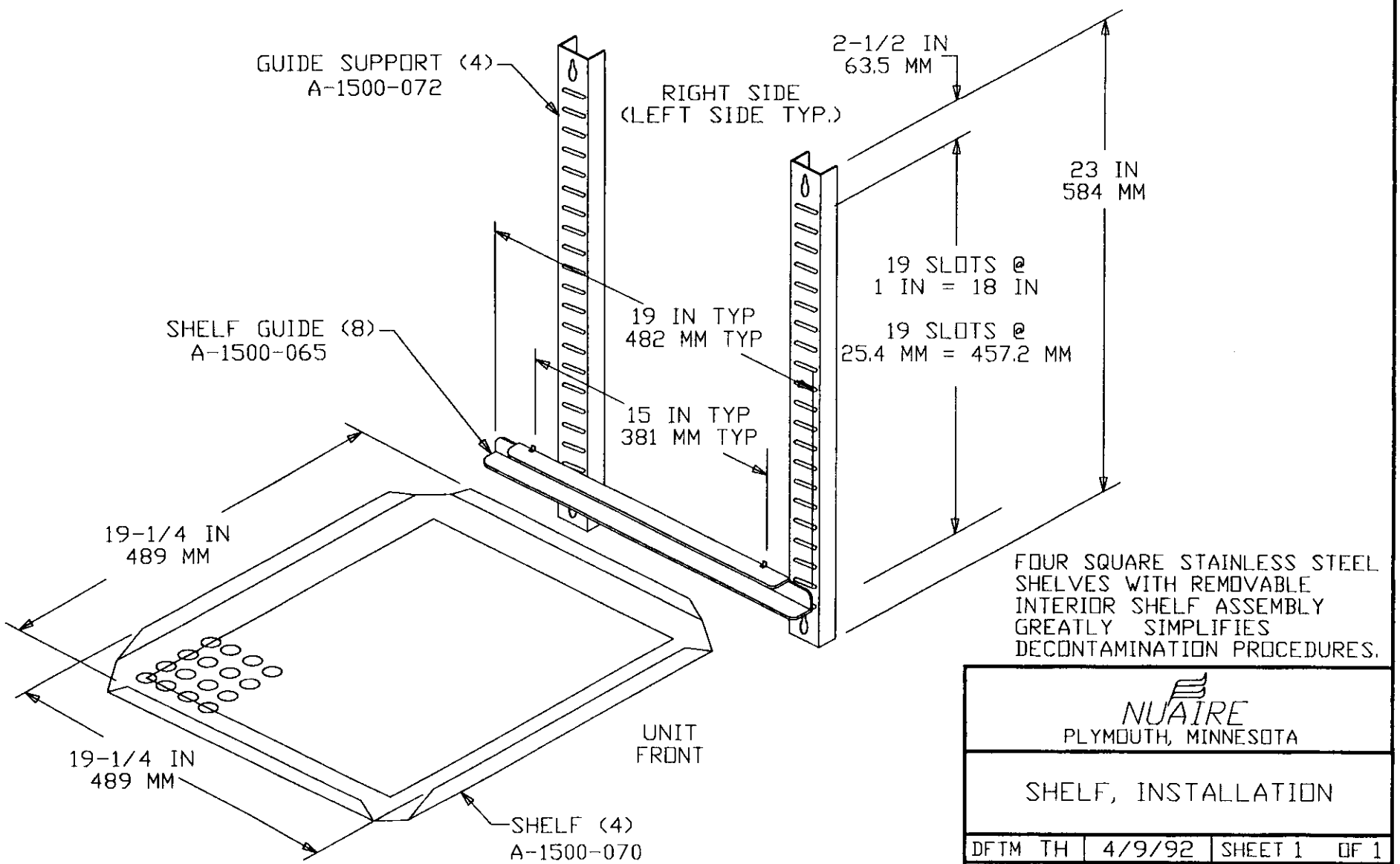


7.1 Location

In locating the US Autoflow, consider all possible conditions that might affect its performance, as well as laboratory procedures for its intended purpose. Do not locate near heating or cooling ducts, or next to equipment that generates heat (steam radiators, stoves, ovens, autoclaves, etc.). Avoid direct sun rays and rapidly moving air currents. The US Autoflow needs even heat loss on all surfaces in order to maintain an internal temperature variation of less than 0.2 degrees C. As a result, a minimum of 2 inches (50 mm) must be allowed between the rear and sides of the US Autoflow and any walls, partitions or obstructions to facilitate adequate convection of air around the US Autoflow's water-jacket. For maintenance/service purposes, the control center side containing the electronics should remain accessible.

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A	4825	UPDATED DRAWING	7/14/95	TW	
B	4855	ADDED PART #'S TO PICTURE	8/23/95	CL	



FOUR SQUARE STAINLESS STEEL SHELVES WITH REMOVABLE INTERIOR SHELF ASSEMBLY GREATLY SIMPLIFIES DECONTAMINATION PROCEDURES.

NUAIRE
PLYMOUTH, MINNESOTA

SHELF, INSTALLATION

DFTM TH	4/9/92	SHEET 1	OF 1

DRAWING NUMBER ACD-04119 B

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7.2 Leveling

The US Autoflow should be leveled prior to filling the water, and should rest firmly on the bench or floor. Uneven water levels may cause false "add water" indications on the front panel as well as to affect the water circulation paths within the water-jacket, which could cause condensation on the walls of the chamber. Leveling feet are provided for this purpose, factory installed into the base of the US Autoflow. Turning the adjustable leveling feet counter-clockwise raises the US Autoflow. The leveling feet height should be approximately ¼ inch (6 mm) below the US Autoflow Base.

7.3 Spring Pump Assembly Shipping Foam

The spring pump assembly contains a piece of foam packing used to immobilize the pump during shipping: **IMPORTANT: FOAM MUST BE REMOVED BEFORE OPERATION!** To access, first remove side access cover. After popping front control panel open, grasp foam from end and carefully remove. It may be saved for any future shipping. Close front control panel and replace side access cover and screws. If incubator is equipped with an R.H. control option, then a similar procedure is required for the humidity pump.

7.4 Shelf & Water Pan Installation

Before installation of the shelves, NuAire recommends to decontaminate all surfaces within the interior chamber, glass door and outer door with gasket. They can be wiped down with a disinfectant of 70 percent alcohol or similar non-corrosive antimicrobial agent.

Provided with each US Autoflow are four shelves. The shelves are easily installed per Drawing ACD-04119, by attaching the guide supports to the stainless steel pins in the interior of the chamber. Additional shelves and shelf guides are available. The water pan is installed on two shelf guides at the bottom of the shelf rack.

7.5 Electrical

The electrical supply circuit to the US Autoflow must conform to all national and local electrical codes. Consult the US Autoflow's serial-data plate, located inside the door, for voltage, cycle, phase and ampere requirements before making connection. Plug the power cord securely into a grounded power source. VOLTAGE SHOULD NOT VARY MORE THAN 5% FROM SERIAL PLATE RATINGS. A separate branch circuit is recommended to prevent possible loss of product due to overloading or failure of other equipment on the same circuit. A SURGE PROTECTOR IS STRONGLY RECOMMENDED to avoid power-related faults.

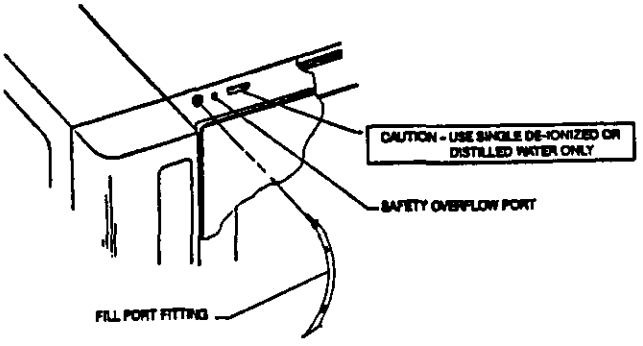
7.6 Precaution for US Autoflow Filling

To prepare the US Autoflow for filling, turn on main power switch located on back panel and set mode switch to setup. The digital indicator should light up as well as the add water light.

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7.7 Filling & Draining the Water-Jacket

The fill port plug is located on the front top left side behind the exterior door. Install the fill port fitting. Place the tubing over the adapter and connect the other end to either a funnel or serrated tap. **USE SINGLE *DISTILLED OR DE-IONIZED WATER.*** NO PURER THAN 5 MEGOHM WATER SHOULD BE USED. Fill the water-jacket until the "LOW WATER" light turns off. Add an additional 3 to 4 liters of water, remove the tube adapter and replace with the fill port plug.



CAUTION

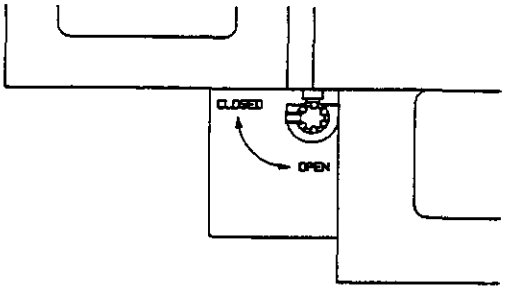
Be sure to position and level the US Autoflow as desired before filling with water.

DO NOT OVERFILL!

The water-jacket requires no anti-bacterial agents. The US Autoflow already incorporates a copper tube producing copper sulfate which eliminates bacterial growth within the water-jacket. **ABSOLUTELY NO CHLORINATED OR HALOGEN MATERIALS ARE TO BE USED IN THE WATER-JACKET.**

A safety overfill port is located next to the fill port plug so if overfill does occur, the water will be relieved through the port.

The water jacket can be drained from the drain plug located on the bottom left side. The drain uses a ball valve to control the drain water. If the valve stem is horizontal, the drain is closed and if it is vertical, the drain is open. A white safety plug must be removed prior to draining located on the bottom of the ball valve. It also insures no leakage will occur.

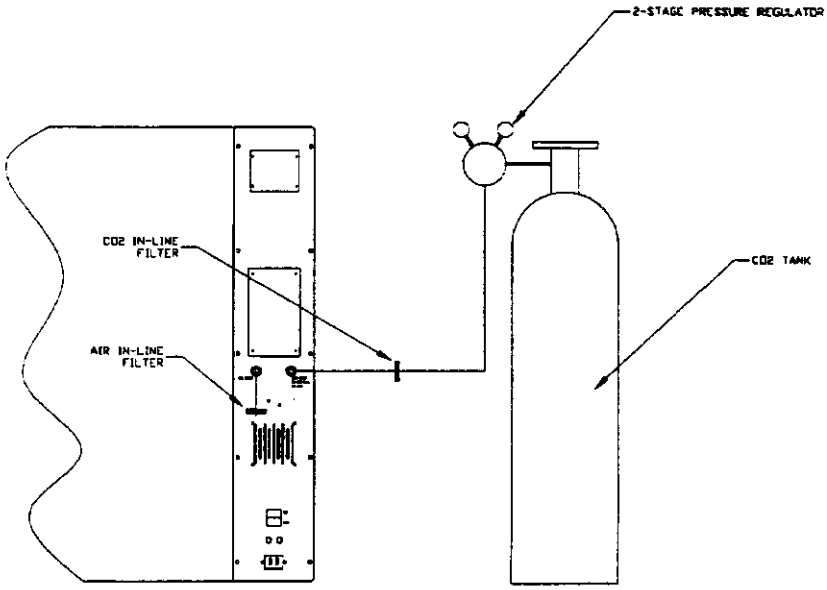


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7.8 Air Inlet Connection

An air inlet tubing kit consists of one foot clear vinyl tube and (1) 50mm polypropylene .3 micron HEPA filter. Locate the air inlet port on the back panel of the unit. Remove the cover cap, connect one end of tubing to the air inlet port, and the other end of tubing to the air filter.

CAUTION: This is a free air supply. DO NOT CONNECT to pressurized source.



7.9 CO_2 Tube Connection

Included with every US Autoflow is a tubing kit consisting of (1) six foot (2 m) vinyl tube and (1) 50 mm polypropylene 0.3 micron HEPA filter.

7.9.1 CO_2 Supply

1. Before the CO_2 supply is turned on to the US Autoflow, fill the water-jacket and set the temperature (See Section 8.7.1.).

CAUTION:
CO_2 Pressure to the US Autoflow is rated at 20 PSIG or 1.4 BAR.
Do not exceed 25 PSIG or 1.8 BAR

2. CO_2 of medical grade is recommended.
3. A two-stage pressure regulator, Linde #19590, or equal, is recommended.
4. DO NOT USE a single stage regulator.

7.9.2 CO_2 Regulators

The regulator's high-pressure stage direct from supply cylinder must have a range of 0 to 2000 PSI or 0 to 140 BAR. This gauge indicates actual tank pressure. The low-pressure stage should have a range of 0 to 30 PSI or 0 to 2 BAR (100 PSI or 6 BARS maximum). This gauge will indicate the actual CO_2 pressure into the US Autoflow system. Some single stage CO_2 pressure regulators have two gauges. USE A TWO STAGE REGULATOR. All NuAire Autoflow's use CO_2 in such small quantities that precise metering of CO_2 input pressure is important for maximum performance of the US Autoflow.

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To connect the regulator: First, open the CO_2 cylinder slightly for an instant (this is termed "cracking the valve."). This will blow out dust or dirt that may have collected in the valve outlet. BE SURE to keep your face away from the valve outlet to protect your eyes from dust or dirt. Second, MAKE SURE the regulator pressure-adjusting screw is released by turning it counterclockwise until it turns freely. Third, attach the regulator to the cylinder valve and tighten the connection nut with a wrench. BE SURE DISC GASKET IS IN PLACE BEFORE MAKING CONNECTION.

7.9.3 CO_2 Connection

Connect the CO_2 supply from the low-stage of the two-stage regulator to the inlet fitting located on the incubator back panel. The filter should be inserted downstream of the low-stage regulator before the inlet nozzle to the US Autoflow. Observe proper flow orientation of the filter (look for "in" on filter). The tubing is easily cut with a sharp knife.

7.9.4 CO_2 Supply Adjustment

With the regulator OFF (i.e. fully counterclockwise), open the cylinder valve slowly-usually 1 to 2 turns is sufficient.

NEVER STAND IN FRONT OR BEHIND THE REGULATOR WHEN OPENING THE VALVE. ALWAYS STAND TO ONE SIDE.

The cylinder tank pressure should read 700 to 800 PSI or 48 to 55 BAR, more or less, depending on the temperature of the cylinder. Next, turn the regulator's pressure adjusting screw clockwise until the low-pressure gauge reads 20 PSI or 1.4 BAR. The CO_2 connection is now complete.

NOTE: OSHA requires the CO_2 tanks to be physically restrained (i.e. via chained to wall) to prevent accidental damage to cylinder.

If optional feature Model Number I01, CO_2 Automatic Tank Switch (Internal) is purchased; separate installation instructions are provided.

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8.0 US Autoflow Operation

CAUTION: All maintenance actions on this equipment must be performed by a qualified technician who is familiar with the proper maintenance procedures required for this equipment, as well as repair.

The US Autoflow is designed to provide a sterile, constant temperature and high humidity controlled atmosphere for optimum growth of tissue cell cultures or other organisms requiring this precise environment. To operate the US Autoflow properly, the following parameters must be reviewed, carefully set and/or prepared.

8.1 Sterility

The environment provided by the US Autoflow is not selective. As a result, any contamination within the chamber is subjected to the same environment as the specimens. Therefore, before placing any cultures in the US Autoflow, the shelves, and shelf brackets should be sterilized. The interior sidewalls, top, bottom, door, as well as the gasket should be wiped clean with a 70% solution of isopropyl alcohol or other disinfectant, to remove any contamination. Use mild detergent to clean exterior of US Autoflow.

8.2 Humidity

Humidification of the US Autoflow is achieved through the process of water evaporation (vapor water pressure) from a stainless steel water pan (NuAire Model NU-1555) placed near the bottom of the US Autoflow shelf rack. Materials of different thermal resistance (i.e. glass, plastic) do not offer sufficient thermal recovery and are not recommended for use. Although some metals offer better thermal coefficients than stainless steel, dissimilar metals cause electrolysis in the acid atmosphere (carbonic acid) and should **never** be used, or placed within the US Autoflow's chamber.

Use only distilled or de-ionized water in the stainless steel pan. The water should be changed at least once a week, preferably more often. FLOODING THE BOTTOM OF THE US AUTOFLOW IS NOT RECOMMENDED since it is difficult to change the water weekly and almost necessitates the use of chemicals which are not recommended and may damage the stainless steel. Also, it promotes condensation on the US Autoflow's inner walls because it steals the natural convection, heat flow through the inner chamber and condensation points occur. **ABSOLUTELY NO CHLORINATED OR HALOGEN MATERIALS ARE TO BE USED IN THE CHAMBER.**

Humidity recovery will be back 95% within 15-20 minutes after a 30 second door opening with a water reservoir area of 361 square inches (i.e. a NU-1555 full-sized pan). Contamination in the water pan may be avoided by adding a small amount of copper sulfate to the water pan after every decontamination of the chamber.

Condensation on the door walls, top or bottom of the chamber indicates an incorrect balance of door heat, which should be corrected by calibration.

If the US AutoFlow has the optional relative humidity display and control system, most of the above can be applied with the exception of the water pan. The RH Reservoir, located on the left side of the unit, can be monitored for water level visually. **USE ONLY SINGLE DISTILLED OR DE-IONIZED WATER** to fill the reservoir. The humidity control system will control any given setpoint between ambient and 95% RH. The alarm setpoints are preset at 5% over the setpoint and not being able to reach the setpoint to within 5% after 5 hours.

8.3 System Introduction

The NuAire Incubator Control Electronics (NICE) system is designed to service the control requirements of the US Autoflow incubator chamber. Temperature and CO_2 level are controlled by preset values to provide optimum conditions for culture growth within a chamber. Operator input is coordinated through the control panel keypad and status displays. Figure 1 shows the various inputs and outputs of the system.

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The NuAire Incubator Control Electronics is a state-of-the-art microcomputer based system that provides:

8.3.1 Single chamber control in a single electronic package.

8.3.2 Enhanced information presentation of the following:

- Chamber temperature (set point and actual)
- CO_2 level (set point and actual)
- Optional, humidity level (set point and actual)
- Optional, security key lock
- Output and alarm status:
    - Water-jacketed heater status
    - CO_2 control status
    - Water-jacket low water status
    - System alarm condition status
    - Optional, CO_2 tank selection

8.3.3 Simplified operator controls. The control panel is operated using three keypads, up and down arrow key and the SELECT key. As the SELECT key is repeatedly depressed, the corresponding green LED next to the parameter will indicate the parameter which is active. Each depression advances to the next parameter. Entry of setpoint values (with mode switch in setup) is accomplished by depressing the up or down arrow key when the selected parameter is activated.

8.3.4 Automatic notification of abnormal situations. The red alarm LED on the control panel indicators will light to indicate a fault within the system. Such faults include:

- System Intermittent
- Temperature Control Fault (temperature exceeds set point by more than 1.0°C)
- CO_2 Control Fault (CO_2 exceeds set point by more than 1.0% or doesn't reach setpoint within 30 minutes)

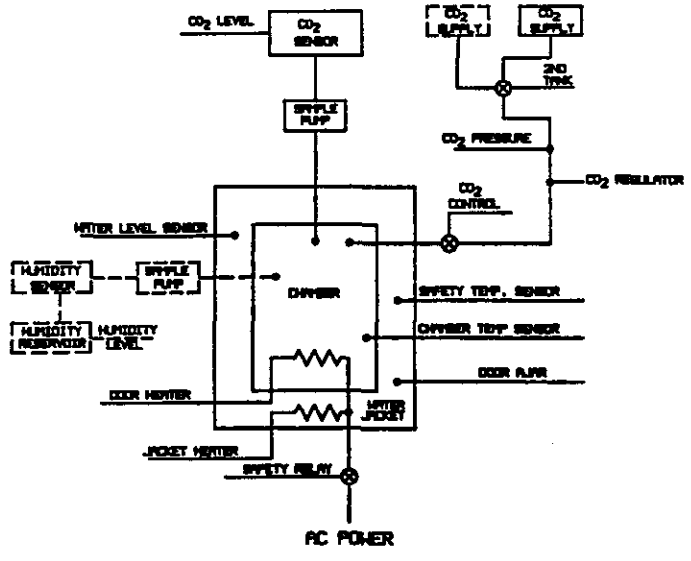


Figure 1. US AUTOFLOW CONTROL INPUTS AND OUTPUTS

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8.3.5 Provision for add on expansion capability. Options include:

- Remote communication capability (RS-232)
- Chart recorder output of monitored values
- Automatic tank switch
- Humidity control and display

8.3.6 Diagnostic and calibration assists. By removing diagnosis jumper on main control board, diagnostic mode is entered. In this mode:

- Individual analog inputs may be displayed to assist calibration
- Individual outputs may be forced to an on or off condition
- Individual digital inputs may be displayed
- Front panel lamps may be tested
- Memory and internal processor diagnostics may be selected
- All options may be individually tested

Packaging is designed such that all modules are easily removed and replaced. All external wiring is connected through screw terminal connectors. All expansion models are plugged in. All printed circuit boards are held in place with machine screws and all connector blocks to expansion modules are keyed to insure correct placement.

8.4 Front Control Panel

The system front control panel contains the following functions described in detail (see Drawing BCD-04375).

8.4.1 Heat Jacket Status LED

The jacket heat green LED indicates when the chamber heater is turned on. A blinking LED indicates chamber heater is being cycled to maintain chamber setpoint temperature.

8.4.2 Door Ajar Status LED

The door ajar yellow LED indicates when the inner glass door is not closed. The LED acts upon a magnetic switch located along the lower right corner of the inner glass door.

8.4.3 Low Water Status LED

The low water yellow LED indicates when the water-jacket requires additional water. If the low water light is lit, the water-jacket should be filled as soon as possible to avoid uneven heating of the chamber.

8.4.4 Inject CO_2 Status LED

The control CO_2 green LED indicates when the CO_2 control valve is open and CO_2 is flowing into the chamber.

8.4.5 CO_2 Tank 1 Status LED

The CO_2 tank 1 green LED indicates when the US Autoflow is consuming CO_2 from tank 1.

8.4.6 CO_2 Tank 2 Status LED (Option)

The CO_2 tank 2 yellow LED indicates when the US Autoflow is consuming CO_2 from tank 2.

8.4.7 Alarm Status LED

The alarm red LED indicates an abnormal status condition. The alarm LED is always accompanied by an additional LED that specifies the abnormality. If the Alarm Status LED is on continuously, a catastrophic condition exists. A catastrophic temperature control condition will de-energize the safety relay and cause the chamber to cool below the set point. A catastrophic CO_2 control condition will enable the CO_2 backup system to maintain the CO_2 level until the alarm is cleared by turning the mode switch on the front panel.

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8.4.8 Chamber Sample

The chamber sample port is provided to measure CO_2 percentage manually with a fyrite CO_2 indicator, or other suitable instrument.

8.4.9 Parameter Indicators

The parameter indicators, located next to the display indicate the activated parameter being shown in the three-digit display. If the parameter indicator is activated, the parameter (i.e. CO_2) may be altered via the arrow keypad.

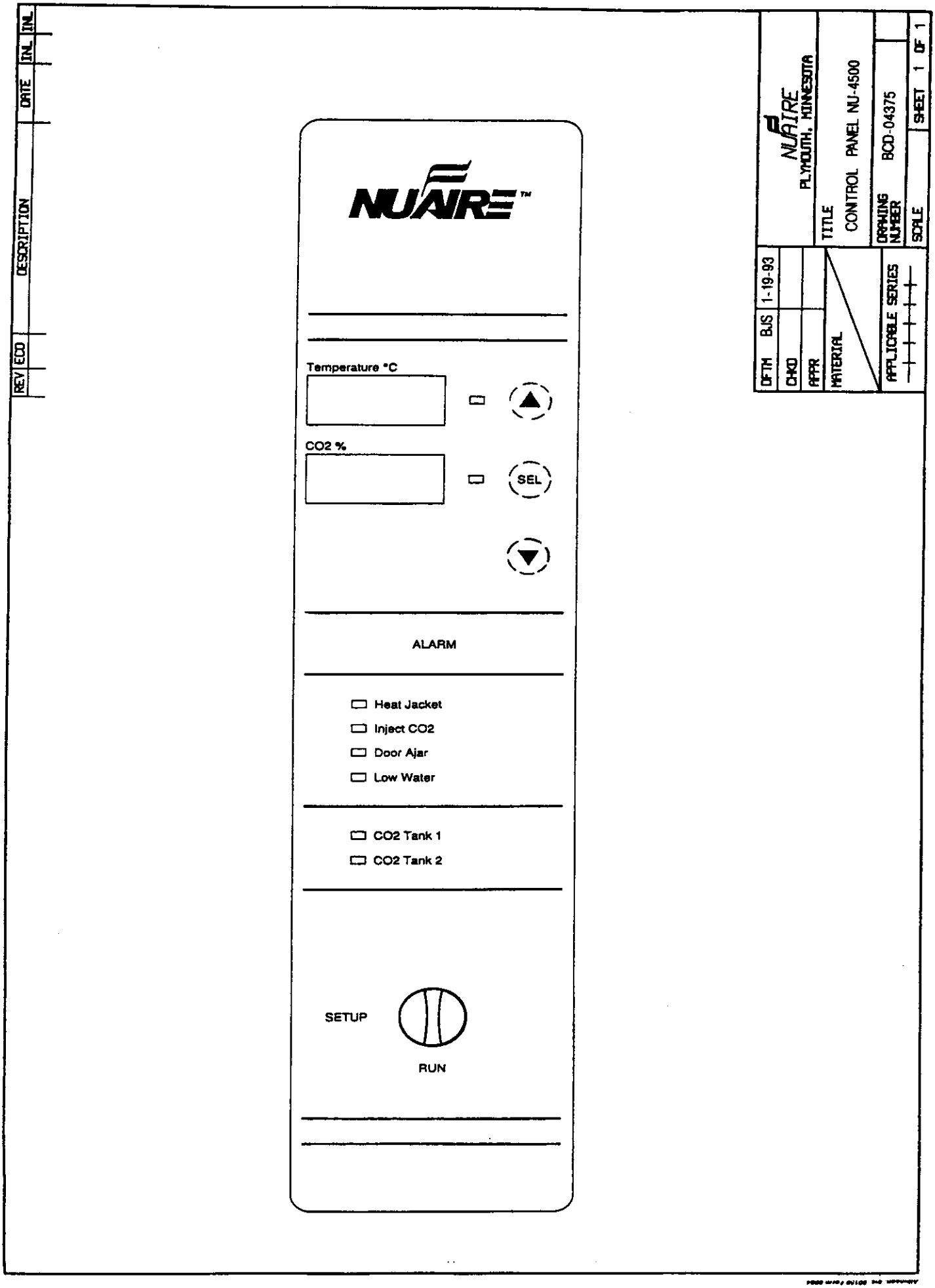
8.4.10 Mode Switch

The mode switch is used to select the operating mode of the US Autoflow chamber, set up or run.

8.4.11 Selection & Arrow Keypad

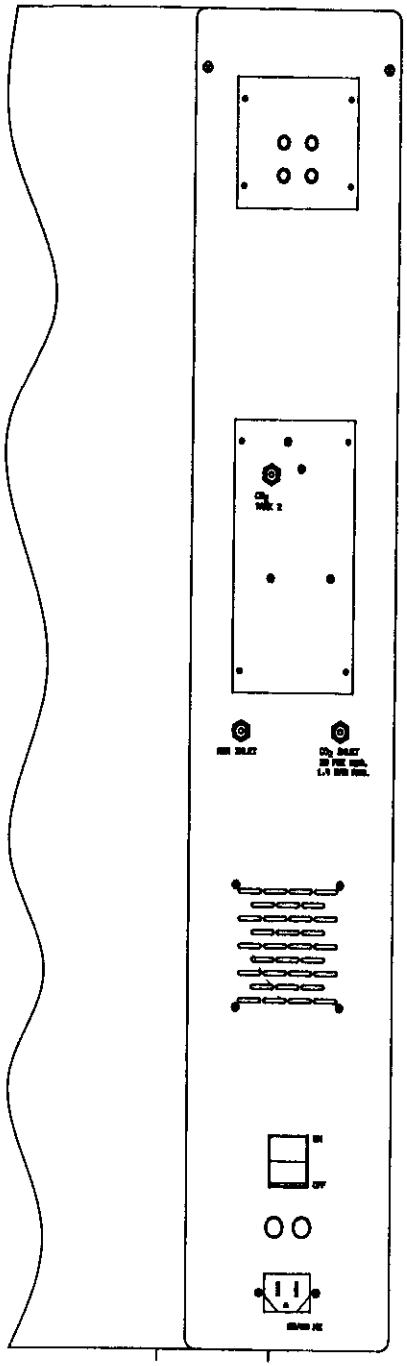
The selection and arrow keypad (KEYPAD INPUT SHOULD BE DONE WITH FINGER ONLY, DO NOT USE PENCIL OR SHARP INSTRUMENTS) is used for all operator interaction with the system. The "SEL" key is always active, repeated depression of this key causes display of the next value in sequence as listed for the parameter indicators. The arrow keypads are used to input setpoints and access the calibration functions.

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TITLE
NU-4500
REAR PANEL, ARRANGEMENT

DRAWING NUMBER BCD-04384

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8.5 US Autoflow Rear Panel

The US Autoflow rear control panel contains the following functions described in detail (see Drawing BCD-04384).

8.5.1 Power Cord

The power cord is an 8-foot (2 m) in length, type "SVT" molded plug, allowing for long life and easy cleanability.

8.5.2 Circuit Breaker

All control electronics are protected with a circuit breaker that will trip at 145% of load rating in less than 2 seconds. Should the circuit breaker open (pop-out button will appear), merely depress to reset.

8.5.3 CO_2 Inlet

The CO_2 inlets provide a fitting for clear vinyl tubing. Be sure to follow the recommended inlet pressure to insure proper flow rates and consistent CO_2 percentage readings.

8.5.4 Air Inlet

The air inlet provides a fitting for clear vinyl tubing. The incubator is provided with clear vinyl tubing and 0.3 micron HEPA filter. This is a free air supply, DO NOT CONNECT with pressurized source.

8.5.5 Power Switch

The power switch, located at the bottom of the rear panel, controls all power to the incubator.

8.5.6 Internal Tank Switch (Option)

The internal tank switch is an option which is customer installed in the field, or factory installed at the time of manufacture. The tank switch performs the critical back-up function of switching tank 1 and tank 2 and back again when each depleted tank is replaced.

8.6 Run Mode Operator Interactions

In general, there is no need for operator interaction in "run" mode. However, operator interaction is required to perform calibration functions and abnormal condition status. If an abnormal condition has, or does, exist for a particular parameter, a blinking green LED next to the parameter will be lit. This could be a catastrophic alarm condition, which could harm the tissue culture cells. It does indicate an operational abnormality and should be checked. To acknowledge the abnormality, simply turn the mode switch to setup and back to run to clear the system. The blinking green LED will then extinguish. If the abnormality still exists, the blinking green LED will again be lit.

Let run normally, if the blinking green LED doesn't come back on, everything is normal. If the blinking green LED does come back on, use the troubleshooting guide to correct the abnormality (see Section 11.0).

8.7 Setup Mode Operator Interactions

8.7.1 Chamber Temperature Setpoint, CO_2 Percent Setpoint, Humidity Percent Setpoint

Setpoint values are entered by pressing the "SEL" key until the LED is lit next to the desired parameter indicator. The value of the selected parameter will be shown in the display in the form "XX.X". To enter a setpoint, perform the following:

Chamber Temperature

- Turn mode switch to setup.
- Press [SEL] to indicate green LED next to chamber temperature display.
- Press ↑ or ↓ to indicate desired temperature.
- Turn mode switch back to run.

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CO_2 Percent

- Turn mode switch to setup.
- Press [SEL] to indicate green LED next to CO_2 percent display.
- Press ↑ or ↓ to indicate desired CO_2 percent.
- Turn mode switch back to run.

Humidity Percent (optional)

- Turn mode switch to setup.
- Press [SEL] to indicate green LED next to humidity percent display.
- Press ↑ or ↓ to indicate desired humidity percent.
- Turn mode switch back to run.

8.8 Diagnostic Interactions

The US Autoflow has two types of general diagnostic methods.

- The power-up self test runs every time the controller experiences a power interruption. It verifies that the main control board is working correctly.

- Diagnostic mode allows the main control board outputs (heaters, valves, etc.) to be turned on and off to aid in troubleshooting.

8.8.1 Power-Up Self Test

The power-up self test is comprised of the following sequential tests:

1) Turns on all LED and all segments of the display for a few seconds.
2) Sounds the audible alarm for a few seconds.
3) Tests all main control board memory. If an error is detected, the audible alarm (rising sawtooth pattern) will sound and the temperature display will show the low portion of the failing memory address, and the CO_2 display will show the incorrect data found at the address.
4) Verifies its non-volatile memory. If the memory is not valid, an intermittent audible alarm (high/low pattern) will sound for 5 seconds and the main control board will automatically rewrite default values into the incubator parameters. The incubator will then begin parameter control again.
5) All the displays will blink until either the mode switch is turned to setup and back to run or the [SEL] key is pressed.

8.8.2 Diagnostic Mode Tests

The Diagnostic Mode Tests allows the main control board outputs to be turned on and off. To access the diagnostic mode, perform the following sequence:

1) Turn the incubator off.
2) Open the front panel exposing the main control board (note, the incubator outer door must be opened to fully open front panel).
3) Locate and remove lower diagnostic jumper from main control board (Note: upper jumper is to be left in place when using DCS IR CO_2 sensor).
4) Set mode switch to setup.
5) Press and hold the [SEL] key.
6) Turn on incubator while holding [SEL] key until the 8's clear from the displays.

The diagnostic mode test is active until the mode switch is set to RUN or the incubator is turned off.

The RH RESERVOIR, DOOR AJAR, and LOW WATER LEDs indicate inputs to the controller as usual. If the CO_2 pressure input indicates low pressure, the CO_2 display shows "Lo".

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The outputs are turned on and off by pressing the ↑ or ↓ arrow keys. The diagnostic mode "rotates" through the outputs as shown below.

When an output is accessed, the temperature display indicates one of the abbreviated outputs below and turns on the output function. When the next output is selected, the current output will be turned off and the new output turned on.

CHA Chamber Temperature Probe - Displays current temperature value. Press both ↑ and ↓ arrow keys simultaneously to clear offsets.

JAC Jacket Temperature Probe - Displays current temperature value. Press both ↑ and ↓ arrow keys simultaneously to clear offsets.

ALr Remote Alarm - Turns on the remote alarm and the alarm light on the front panel.

HtJ Heat Jacket - Turns on the safety relay, jacket heater, and HEAT JACKET LED.

ICo Inject CO_2 - Opens the CO_2 injection valve and turns on the INJECT CO_2 LED.

Htd Heat door - Turns on the safety relay and door heater.

tn1 Select CO_2 tank 1 - Selects CO_2 tank 1 and turns on the CO_2 TANK 1 LED.

Pur Purge CO_2 - Turns on air purge.

rHH Humidity Reservoir Heater - Turns on the reservoir heater and pump. If the humidity option is not installed, this step and the related "off" half-steps are skipped.

IrH Inject Humidity - Turns on the humidity inject solenoid and the INJECT RH LED. If the humidity option is not installed, this step and the related "off" half-steps are skipped.

FIL Fill Humidity Reservoir - Opens the reservoir fill valve. If the humidity option is not installed, this step and the related "off" half-steps are skipped.

To exit diagnostic mode, turn off incubator. Reinstall diagnostic jumper plug on main control board and turn on incubator. Remember, if temperature offsets were cleared, temperature calibration is required.

8.9 CO_2 Backup System

The CO_2 Backup system is a programmed sequence in the microcomputer that is accessed upon a catastrophic CO_2 fault (Ex: CO_2 sensor calibration fault or failure). If a CO_2 fault occurs, the incubator will indicate the CO_2 fault with a timed audible alarm and blinking green LED next to the CO_2 percent display. The backup system will then air purge the chamber of all CO_2 for 120 minutes to establish a baseline point of no CO_2. The air purge time of 120 minutes is necessary to assure, upon a CO_2 fault of too much CO_2, that all the CO_2 has been purged to establish the baseline point of no CO_2. Then, starting from the no CO_2 baseline point, the backup system will inject a set amount of CO_2 into the chamber to achieve the CO_2 setpoint. The incubator will then continue to inject a small amount of CO_2 periodically to maintain the CO_2 percentage in the chamber. The backup system will continue in effect until the alarm condition is cleared by turning the mode switch on the front panel to setup and back to RUN.

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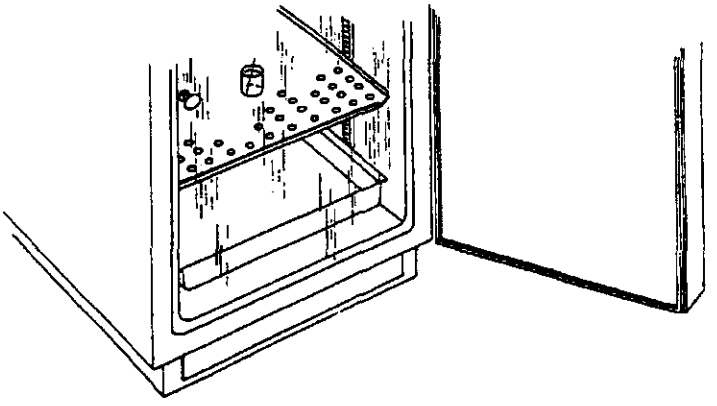
9.0 Calibration

Proper calibration of the US Autoflow involves four parameters: chamber temperature, door temperature, CO_2 sensor, and humidity sensor (option). The first two, chamber and door temperature should be completed and stabilized before any CO_2 sensor/humidity sensor calibration is performed. Below, each calibration procedure is described in detail. For the best results, follow the procedure carefully, and if the desired result is not achieved, try procedure again from the start.

9.1 Chamber Temperature Calibration

The US Autoflow's TEMPERATURE CALIBRATION MUST BE PERFORMED WITHIN 1°C OF THE PLANNED OPERATING TEMPERATURE. Normally, 37.0°C is the most common setpoint. To initiate the procedure, turn on the US Autoflow via the power switch on the back panel. Turn mode switch to standby setup to check the temperature value parameter for your planned operating temperature and change if necessary. Turn mode switch back to run and let stabilize for 8 to 12 hours.

At the beginning of this procedure, set a mercury glass thermometer in a glass beaker filled with water resting on a shelf in the middle of the US Autoflow chamber. Do not place the glass beaker on the bottom of the chamber because it will result in a slightly higher temperature due to the heater pan being located just below the chamber bottom. Placing the thermometer in glass beaker on the middle shelf will give the most accurate results for calibration.



When the unit has stabilized at the operating temperature, perform the following calibration procedure.

- Turn mode switch to run.
- Press [SEL] to indicate green LED next to temperature display.
- Press and hold one ↑ key for four seconds, display blinks.
- Press ↑ or ↓ key to indicate same temperature as thermometer.
- Press [SEL] key to complete calibration.

The chamber temperature calibration is complete. Let unit stabilize for 8 to 12 hours. If the chamber temperature (actual thermometer) still does not match the display, perform the above procedure again. In some cases it might be necessary to calibrate several times to achieve a stable condition due to ambient conditions of temperature and humidity within the laboratory.

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9.2 Door Temperature Calibration

The US Autoflow's inner glass door temperature calibration is best accomplished by running the incubator 24 hours with the water pan in place and perform the following calibration sequence, if required.
Open the incubator door and look for general condensation. Some condensation on the glass door is desirable as an indication of adequate humidity in the chamber. Typically one to two inches of condensation in the corners of the glass door indicates a properly calibrated door heater. However, if calibration is required, simply perform the procedure as stated below. The door heater operates as a percentage ON/OFF (0 is Off, 100 is Full ON). Typically, 40 to 60 percent is the most effective setpoint range.

- Turn mode switch to setup.
- Press [SEL] to indicate green LED next to temperature display.
- Press both ↑ and ↓ keys simultaneously, display blinks "dor"/door heat % on (XX).
- Press ↑ or ↓ key to desired door heat % on.
- Press [SEL] key to complete the calibration.
- Turn Mode switch back to RUN.

9.3 CO_2 Calibration

The US Autoflow infrared CO_2 sensor may be calibrated using one of two techniques: CO_2 control and CO_2 sensor internal calibration. The CO_2 control procedure is a simple offset performed on the front panel similar to the temperature offset requiring no tools. The CO_2 sensor internal procedure is more in depth requiring approximately one half hour to perform.

The US Autoflow's infrared CO_2 sensor calibration must be performed at the planned operating temperature, usually 37°C. Both calibration procedures require a use of a CO_2 fyrite measuring instrument with a 0 to 20 percent measuring range. **BE SURE TO READ THE CO_2 FYRITE OPERATING AND SAFETY INSTRUCTIONS FOR PROPER CO_2 MEASUREMENTS AND SAFETY CONSIDERATIONS.**

The CO_2 measurement is independent of humidity and temperature variations within the chamber. However, with the sensor located outside of the chamber, it is imperative to keep the sensor temperature consistent with operating conditions. To ensure an accurate calibration, please be sure to leave control center panel in place as much as possible during calibration.

If questions arise, feel free to contact service personnel at 1-800-328-3352.

9.3.1 CO_2 Control Calibration

CO_2 Control Calibration can be performed anytime the CO_2 fyrite measurement doesn't correlate to the front panel display. However, this calibration SHOULD NOT BE PERFORMED MORE THAN ONCE PER WEEK. Sensor calibration should be performed if the CO_2 fyrite measurement doesn't match the display within ±0.3 percent after one week. Before doing the following calibration, check and change, if necessary, the incubator in-line filter found within the control center.

When unit has stabilized at the operational temperature and CO_2 percentage, take a CO_2 fyrite measurement and, if necessary, perform the following:

- Turn mode switch to RUN.
- Press [SEL] to indicate green LED next to CO_2 % display.
- Press and hold one ↑ key for four seconds, CO_2 display blinks (clears all previous offsets) (compare the display CO_2 to the CO_2 fyrite measurement. If these two readings have a difference less than 2.0 percent, proceed to enter the fyrite value. If the difference is greater than 2.0 %, proceed to CO_2 sensor calibration, Section 9.3.2).
- Press ↑ or ↓ key to indicate same CO_2 % as fyrite measurement.
- Press [SEL] to set current value and exit calibration.

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9.3.2 CO_2 Sensor Internal Calibration

CO_2 sensor front panel calibration should only be performed when required due to reoccurring error indicators. The CO_2 sensor has two calibration points, a zero point (ambient CO_2 percentage) and a span point (high CO_2 percentage). The following calibration procedure should be performed ONLY after the chamber temperature is stabilized and the CO_2 sensor has been operating at the stabilized temperature for 2 hours. If the incubator has been in operation for a year or more, in line filter replacement may be necessary. After the above conditions are satisfied, proceed with the following:

Step 1: Remove control center side panel.

Step 2: Remove sensor housing via (2) thumbscrews.

Step 3: Check and replace, if necessary, in-line filters.

Step 4: Replace sensor housing and secure it.

Step 5: Turn mode switch to setup

- Press [SEL] to indicate green LED next to CO_2% display.
- Press both ↑ and ↓ keys simultaneously, display blinks "dor".

Step 6: Open inner glass door and evacuate chamber for 1 minute. Close door and allow chamber environment to stabilize for 1 minute.

Step 7: Zero CO_2 Sensor

- Press ↑ key, display blinks "ZEr" and a positive or negative number.
- Locate the access panel on the sensor housing and open it.
- Locate the ZERO POT on the CO2 sensor and adjust with trim pot tool provided until the CO_2 displayed window reads 0 $\pm$.010V (Allow 30 seconds between adjustments for sensor to stabilize).

Note: For Service Tech personnel, voltmeter should be used to check sensor output voltage for accuracy, or new replacement of IR sensor by following instructions.

- Open the front control panel by opening outer door and quickly tapping on left side of front control panel.
- Measure sensor voltage output on main control board at P-7, pin 3 and 4, marked G and CO_2, respectively.
- Locate the ZERO POT on the CO2 sensor and adjust with trim pot tool provided until the Voltmeter reads 0$\pm$.005V (Allow 30 seconds between adjustments for sensor to stabilize).

Step 8: Span CO2 Sensor

- Press ↑ key, display blinks "SPn" and the CO_2 percent.

Allow the unit to self inject CO_2 for 90 seconds. Wait an additional minute or until the display CO_2 percent reading is stable. The CO_2 inject green LED will indicate CO_2 flow into the chamber during the 90 second automatic CO_2 injection.

Step 9: Fyrite the incubator to determine correct CO_2 percentage.

Locate the SPAN POT on the CO_2 sensor control board (see Figure 2) and adjust with trim pot tool until the display CO_2 percent is the same as the fyrite CO_2 percentage (Allow 30 seconds between adjustments for sensor to stabilize.)

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Step 10:Open inner glass door and evacuate chamber for 1 minute. Then, close the door.

- Press ↑ key to complete the calibration.
- Replace sensor access and control center side panel.
- Turn mode switch back to run.

Allow unit to run and stabilize for 2 hours. Check calibration with the fyrite. Compare the display CO_2 percent to your fyrite measurement. If these two readings have a difference greater than 0.5%, repeat above procedure beginning with Step 5. If these two readings have a difference of less than 0.5%, perform the CO_2 control calibration procedure in Section 9.3.1.

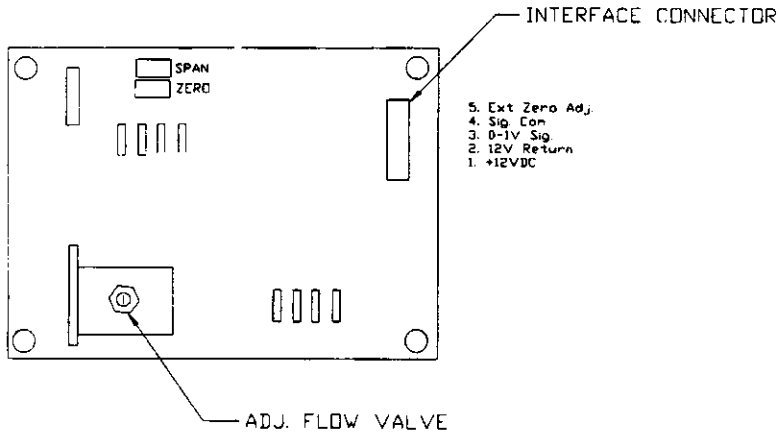


Figure 2

9.4 Relative Humidity Calibration (Option)

Relative humidity calibration can be performed anytime if the relative humidity option has been installed. The relative humidity sensor can be calibrated from a known source of humidity within the incubator chamber. Typically, the water pan is used because it has a known humidity level of 96 percent after 1 hour in the chamber.

The calibration procedure is a two step process. The first step is to perform an RH control calibration. The second step, RH sensor calibration is only required if the RH control calibration cannot be performed.

When unit is stabilized at the operational temperature, CO_2 percentage and water pan in place, perform the following calibration procedure:

RH CONTROL CALIBRATION

Step 1: Enter calibration mode

- Turn Mode Switch to RUN.
- Press [SEL] to indicate green LED next to RH % display.
- Press and hold ↑ arrow key for four seconds, RH % display blinks (clears all previous offsets) (If the RH % display is between 93 to 99 percent, proceed to next step. If the RH % display is not between 93 to 99 percent, proceed to RH sensor calibration below).
- Press ↑ or ↓ arrow key to indicate 96 percent or known humidity percent.
- Press [SEL] to set current value and exit calibration.

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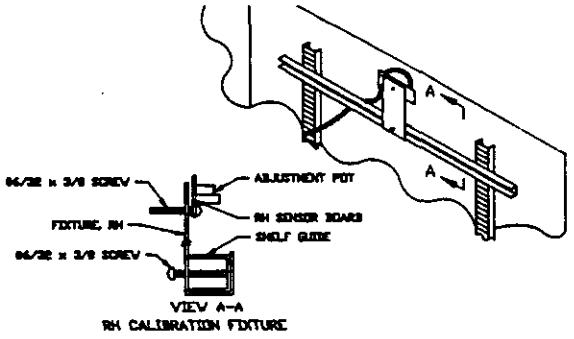
RH SENSOR CALIBRATION

Since the location of the humidity sensor board is difficult to reach, the calibration method described below, removes the humidity sensor board from the rear wall and mounts it to a calibration fixture next to the side access port of the chamber, to allow the calibration to be performed outside the chamber.

Step 2: Remove RH sensor from upper wall of chamber.

Step 3: Attach RH sensor cable extension and calibration fixture. Be sure the RH sensor adjustment pot is accessible through the side access port.

Step 4: Close incubator doors, and, with the water pan in place, let incubator stabilize for a minimum of one hour.



Step 5: When operational temperature and CO_2 percentage have stabilized with the water pan in place, perform the following calibration procedure:

- Turn mode switch to RUN
- Press [SEL] to indicate green LED next to RH % display. Press and hold ↑ arrow key for four seconds until display starts blinking (clears all previous offsets), adjust RH sensor pot through side access port. Adjust pot counter-clockwise to increase display or clockwise to decrease display. The goal is to achieve 96% or a known measurement).
- Press [SEL] to set current value and exit calibration.

Allow incubator to stabilize for 2 hours and repeat above steps if necessary. When calibration is complete, return RH sensor to original position.

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10.0 Maintaining Your US Autoflow

US Autoflow Chamber

The chamber maintenance is up to the discretion of the owner and the extent of cleanliness and sterility desired. The shelves and bracket supports are all removable and autoclavable. The interior should be wiped down with an appropriate disinfectant such as 70% ISOPROPYL ALCOHOL or equivalent. **DO NOT USE ANY CHLORINATED OR HALOGEN MATERIALS IN THE CHAMBER. SUCH MATERIAL IS HARMFUL TO THE POLISHED STAINLESS STEEL.** *The humidity pan should also be sterilized and the water changed regularly to assure sterility. A small amount of copper sulfate may be added to the humidity pan to inhibit bacterial growth.*

US Autoflow Water-Jacket

The water-jacket required no anti-bacterial agents. The US Autoflow already incorporates a copper tube producing copper sulfate which eliminates bacterial growth within the water-jacket. **DO NOT USE ANY CHLORINATED OR HALOGEN MATERIALS IN THE WATER-JACKET.**

CO_2 Supply Filter (50 mm, Bi-Directional In-Line, Dry)

The CO_2 Supply Filter should be replaced every fifth empty CO_2 tank or when the filter is visibly discolored (yellow-brown).

Air Inlet Filter (50 mm, Uni-Directional In-Line, Dry)

The Air Inlet Filter is located on the pack panel. The purpose of the filter is to cleanse the room air which is drawn into the chamber, via the pump, for three seconds every minute, assuring the proper amount of oxygen is available to the cultures. The air inlet filter should be replaced every six months. Note direction of flow (inlet is indicated by "IN" or "Greendot" on one side of filter) when replacing filter.

CO_2 Sensor Filter (Capsule, Uni-Directional In-Line, Wet)

The CO_2 Sensor Filter should be replaced EVERY TWO YEARS to assure optimum performance. A visual check should be performed during CO_2 sensor calibration to assure filter integrity. Remove sensor housing cover to perform visual check. A similar procedure should be followed with the RH filter as well (option). Inlet port is on flat bottom sides.

RH Reservoir

THE RH RESERVOIR REQUIRES NO ANTI-BACTERIAL AGENTS. The RH Reservoir is filled using single de-ionized or distilled water. NO PURER THAN 5 MEG OHM WATER. Do not use any chlorinated or halogen materials in the RH Reservoir.

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11.0 Error Indicators & Troubleshooting

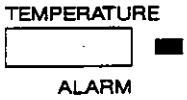
Step 1 NOTE ALL ERROR INDICATORS. When the incubator is running, any and all red or yellow LEDs indicate an error.

Step 2 CLEAR ERROR INDICATORS. Error indicators can be cleared by turning mode switch to setup and back to run.

Step 3 MONITOR RE-OCCURRENCE OF ERROR INDICATORS. If re-occurrence of the error indicator is immediate or daily, use guide below to correct the situation.

Error Indicator Troubleshooting Guide

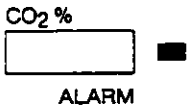
CHAMBER TEMPERATURE



Indicates:
- Chamber temperature has exceeded allowable range or incubator not heating.
- Temp. sensor (chamber or jacket) are faulty or out of calibration.

Correction:
- Perform temperature sensor calibration.
- Check or replace fuse on main control board.
- Check or replace main control board.

CO_2 PERCENT



Indicates:
- Backup CO_2 control system is in effect. Turning the mode switch to setup and back to run will clear it and allow the CO_2 control system to resume as normal.
- Reoccurring indicator is due to the CO_2 percentage value exceeding its allowable range.

Correction: Check CO_2 gas supply to unit.
-If display over setpoint, reduce gas cylinder regulator pressure.
-If display under setpoint, increase gas cylinder regulator pressure.
- Replace in-line filters.
- Perform CO_2 sensor and control calibration using fyrite instrument.

RH PERCENT



Indicates: RH value has exceeded allowable range. Usually due to a low water pan.

Correction:
- Fill water pan.
- Perform RH sensor and control calibration.

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GENERAL INDICATORS

■ DOOR AJAR

Indicates:
- Inner glass door is not closed.
- Magnetic switch needs a position adjustment.

Correction: Close door or adjust switch position by loosening acorn nut.

■ LOW WATER

Indicates:
- Low water level in water jacket.
- Faulty level indicator switch.

Correction:
- Fill jacket until light goes out.
- Replace level indicator switch.

■ RH RESERVOIR (option)

Indicates:
- Low water in RH reservoir
- Faulty level indicator switch.

Correction:
- Fill RH reservoir.
- Replace level indicator switch.

LED DISPLAY INDICATORS

Sto (with intermittent high/low audible alarm)

Indicates: Main control board failed to read correct setup information.

Correction: Turn incubator on and off. If error indicator is continuous, replace main control board. If error indicator appears once, recalibrate incubator temperature and CO_2 control.

dely

Indicates: CO_2 control is in delay for one of the following reasons:

1) Power interruption just occurred. Will resume CO_2 control within 30 minutes.

To bypass, perform following:
- Turn mode switch to setup.
- Press {SEL} to indicate green LED next to CO_2% display.
- Press both ↑ or ↓ keys simultaneously, display flashes "dor".
- Press ↓ key four times quickly to exit bypass.
- Turn mode switch back to run.

2) Chamber temperature is not within 2.0°C of setpoint. Cannot bypass.

b.up

Indiates:
- CO_2 control is on backup mode.

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AUDIBLE ALARM W/NO INDICATORS LIT

Indicates: Tank switch occurrence.

Correction: Press [SEL] key to silence indicator.

BLINKING DISPLAYS

Indicates: Interruption of power.

Correction: Turn mode switch to setup and back to run.

For further assistance, call NuAire Customer Service at 1-800-328-3352 or (612) 553-1270 USA.

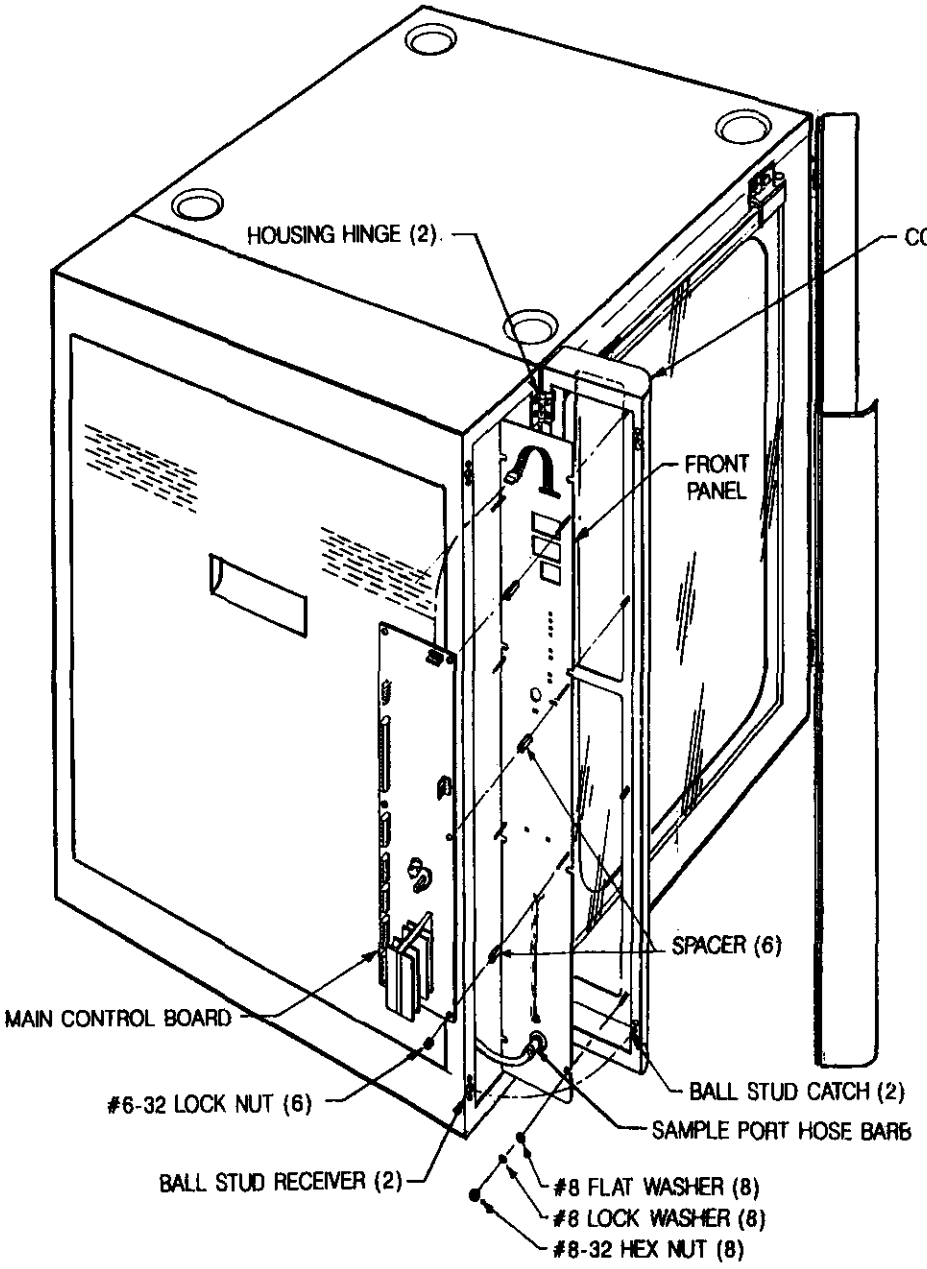
12.0 Remote Alarm Contacts

The NuAire US Autoflow contains a set of contact points to connect to a remote alarm system. The two contact points are located in the control center. One contact point is located on the main control board connector (P6) position 5. The other contact point is on terminal block 2, position 3. The contact points upon an alarm produce a 12 VDC signal capable of energizing a relay coil up to 20 ma. The alarm contact points do not distinguish between a CO_2 or temperature alarm. Each will produce a signal to the alarm system.

The contact points are shown on the electrical schematic BCD-04364. The actual connection is made by inserting a bare wire into the connector and screwing down tight. The wire may be neatly routed through the existing wire routings in the control center.

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REV	ECO	DESCRIPTION	DATE	INL	IN
A	9921	UPDATED PRINT	10-13-95	TW	



PROCEDURE:

1. DISCONNECT ALL ELECTRICAL POWER.
2. OPEN INCUBATOR FRONT DOOR.
3. PLACE HANDS ON OUTSIDE EDGE (TOP & BOTTOM) OF CONTROL PANEL HOUSING AND PULL OPEN.
4. DISCONNECT FRONT PANEL CONNECTORS.
5. SEPARATE MAIN CONTROL BOARD BY REMOVING #6-32 LOCKNUTS AND SPACERS.
6. REMOVE FRONT PANEL BY REMOVING (10) #8-32 HEX NUTS, FLAT WASHERS AND LOCK WASHERS.
7. TO INSTALL NEW FRONT PANEL REVERSE THE ABOVE STEPS.

DFTM	BJS	1-19-93
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MATERIAL		
APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
FRONT PANEL ASSEMBLY

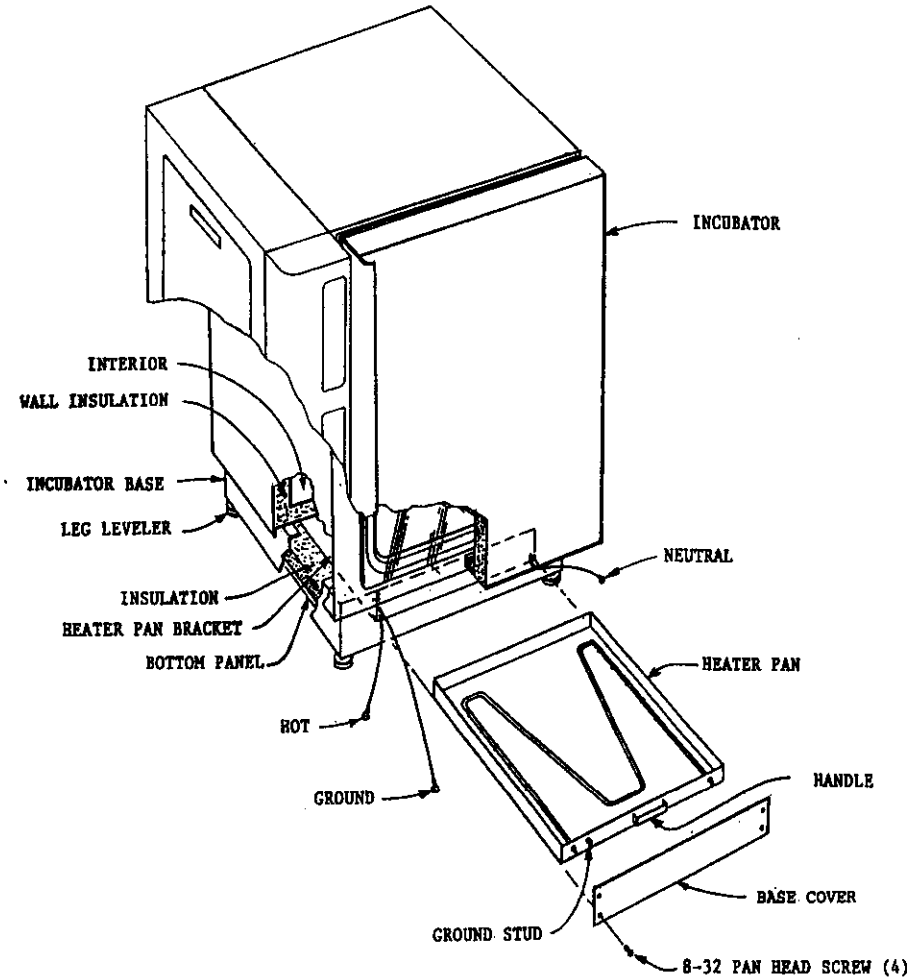
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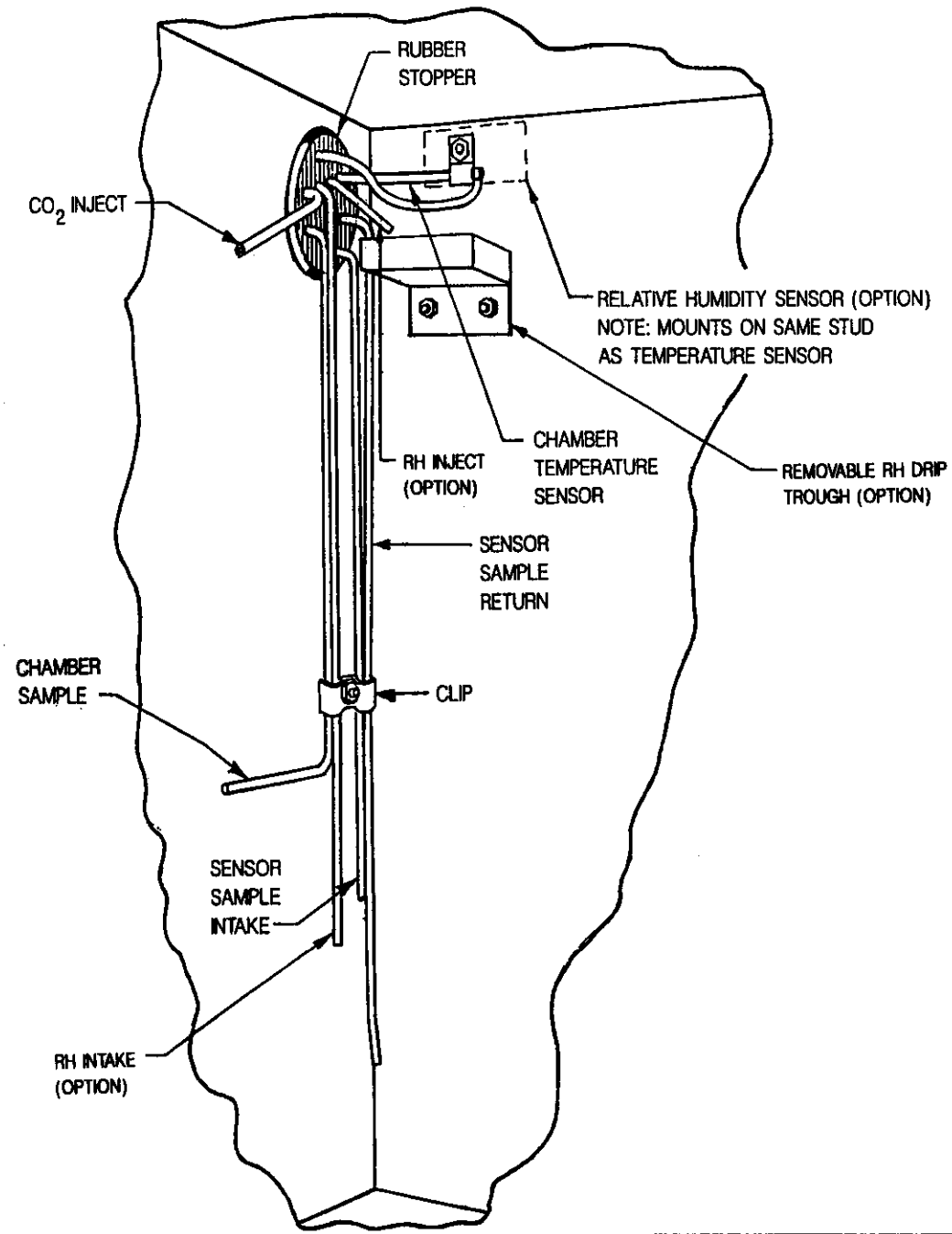
PROCEDURE:

1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE (4) SCREWS AND BASE COVER.
3. REMOVE WIRE TERMINATIONS WITH 3/8" OPEN END WRENCH (HOT, NEUTRAL, AND GROUND).
4. TO REMOVE HEATER PAN, SLOWLY PULL HANDLE OUTWARD.

DFTM BRAD R	1-8-93	NUAIRE PLYMOUTH, MINNESOTA	
CHKD			
APPR		TITLE: HEATER PAN ASSEMBLY	
MATERIAL		DRAWING NUMBER: BCD-04362	
APPLICABLE SERIES		SCALE ~	SHEET 1 OF 1

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A	4291	REVISED	4-7-94	BJS	SS



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APPLICABLE SERIES		

NUAIRE
PLYMOUTH, MINNESOTA

TITLE
CHAMBER TUBING ASSEMBLY

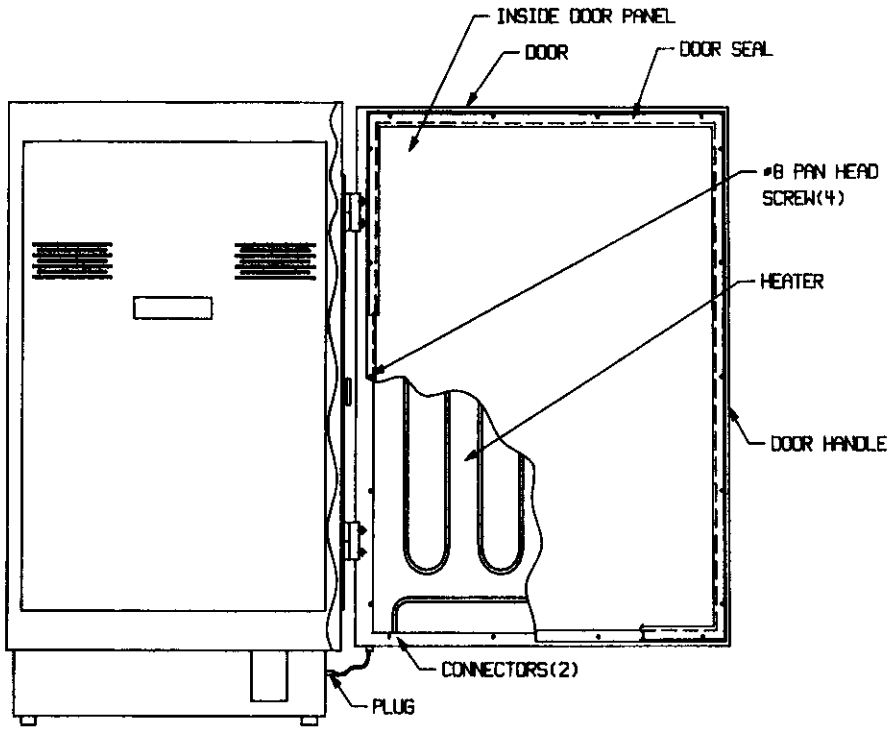
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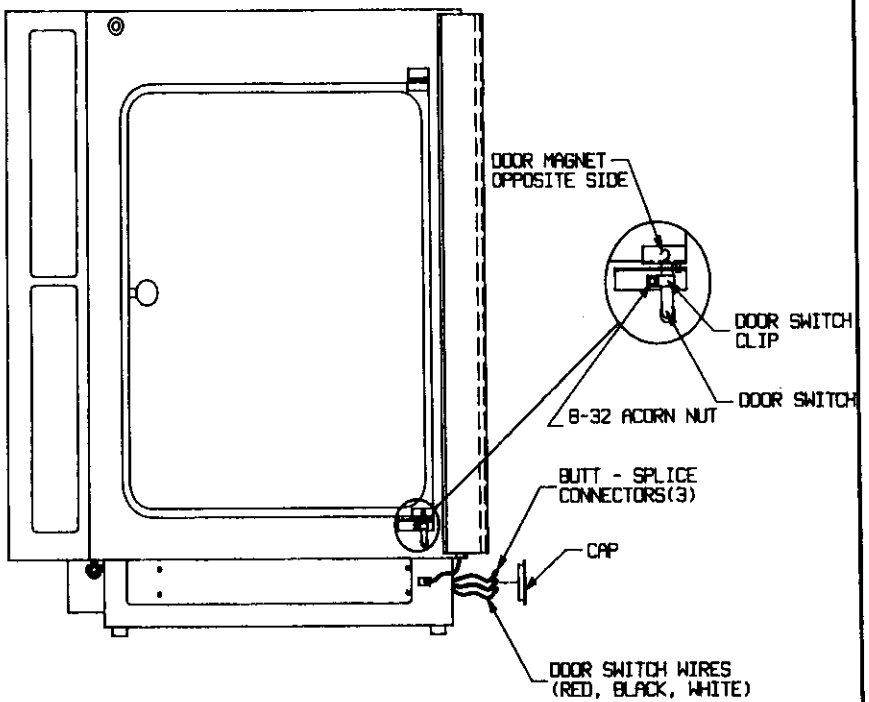
SCALE

SHEET 1 OF 1

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REV	ECO	DESCRIPTION	DATE	INL	INL





DOOR SWITCH REPLACEMENT PROCEDURE

1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE DOOR SWITCH CLIP (1) 8/32 ACORN NUT.
3. PULL SWITCH AWAY FROM DOOR HINGE AREA.
4. REMOVE BLACK CAP ON SIDE OF BASE COLLAR.
5. PULL OUT DOOR SWITCH WIRES.
6. CUT BUTT SPLICE (3) AND PULL OUT DOOR SWITCH FROM FRONT OF UNIT.
7. INSTALL NEW DOOR SWITCH FROM FRONT OF UNIT REVERSING THE ABOVE STEPS. NOTE COLOR CODE. (NOTE, CHECK DOOR SWITCH OPERATION SO, THE DOOR SWITCH IS ACTIVATED BY THE MAGNET.)

DOOR HEATER REPLACEMENT PROCEDURE

1. DISCONNECT ALL ELECTRICAL POWER.
2. REMOVE (10) #8 PAN HEAD SCREWS LOCATED UNDER THE DOOR SEAL.
3. REMOVE DOOR PANEL W/SEAL. MOVING SLOWLY AWAY FROM DOOR EXPOSING WIRES.
4. CUT BUTT SPLICE CONNECTORS FROM DOOR HEATER, NOTE COLOR CODE.
5. REMOVE DOOR HEATER.
   -PULL OFF DOOR HEATER AND REPLACE.
   NOTE,SILICON RTV MUST BE APPLIED TO CORNERS OF HEATERS
6. REPLACE DOOR HEATER REVERSING THE ABOVE STEPS.

NUAIRE
PLYMOUTH, MINNESOTA

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SHEET	1 OF 1	

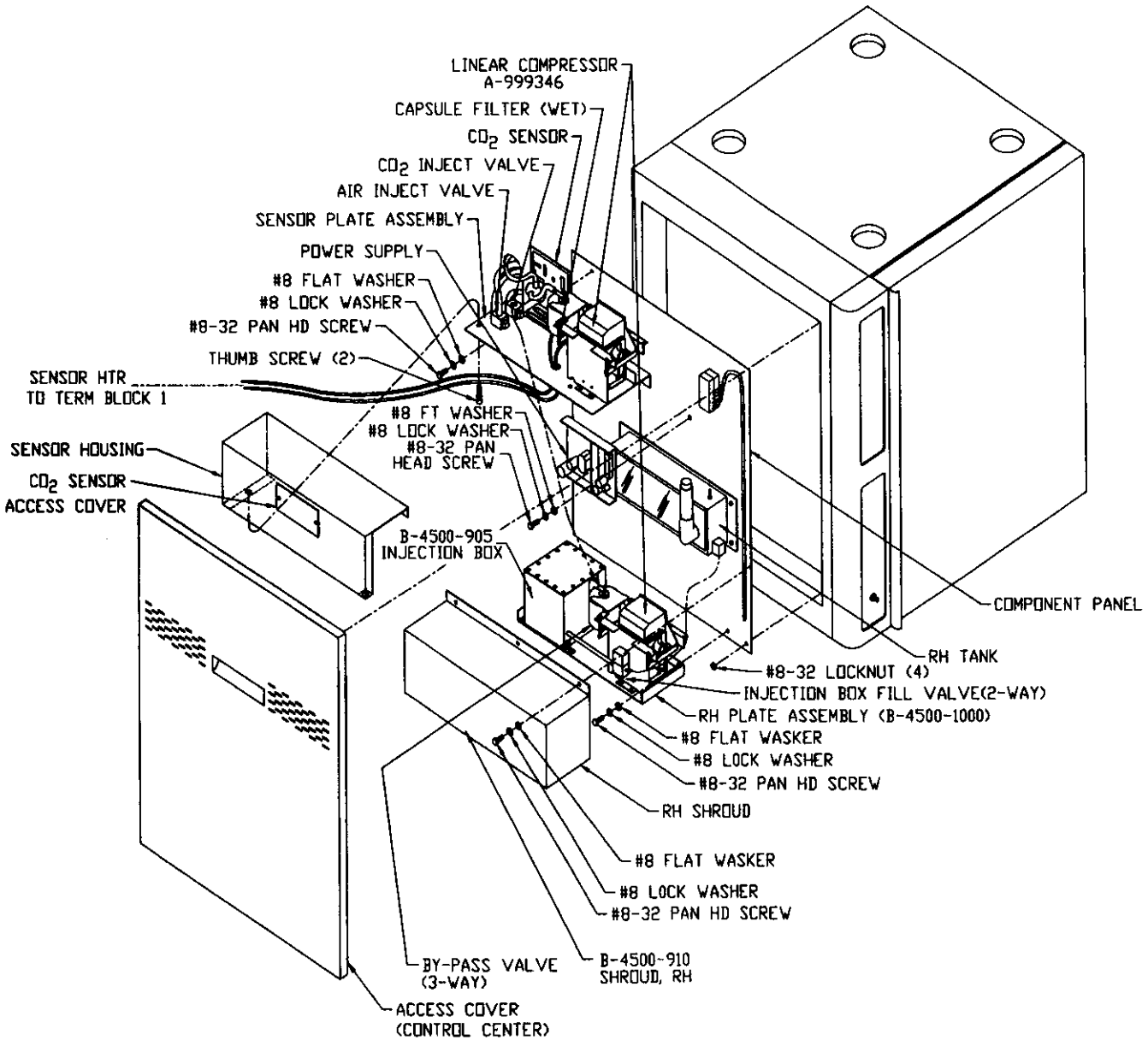
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TITLE
DOOR HEATER AND SWITCH ASSEMBLY

DRAWING NUMBER BCD-04363

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REV	ECO	DESCRIPTION	DATE	DFTM	CHKD
H	7023	NEW CO2 SENSOR CONFIG.	2/12/98	DB	LS



PROCEDURE:

1. DISCONNECT ALL ELECTRICAL POWER.
2. IDENTIFY COMPONENT FOR REPLACEMENT.
3. DISCONNECT ANY ELECTRICAL CONNECTIONS. (NOTE COLOR CODE)
4. REMOVE COMPONENT AS SHOWN.
5. REPLACE COMPONENT BY REVERSING THE ABOVE STEPS.

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DFTM	TW
CHKD	DB

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TITLE: CONTROL CENTER ASSEMBLY

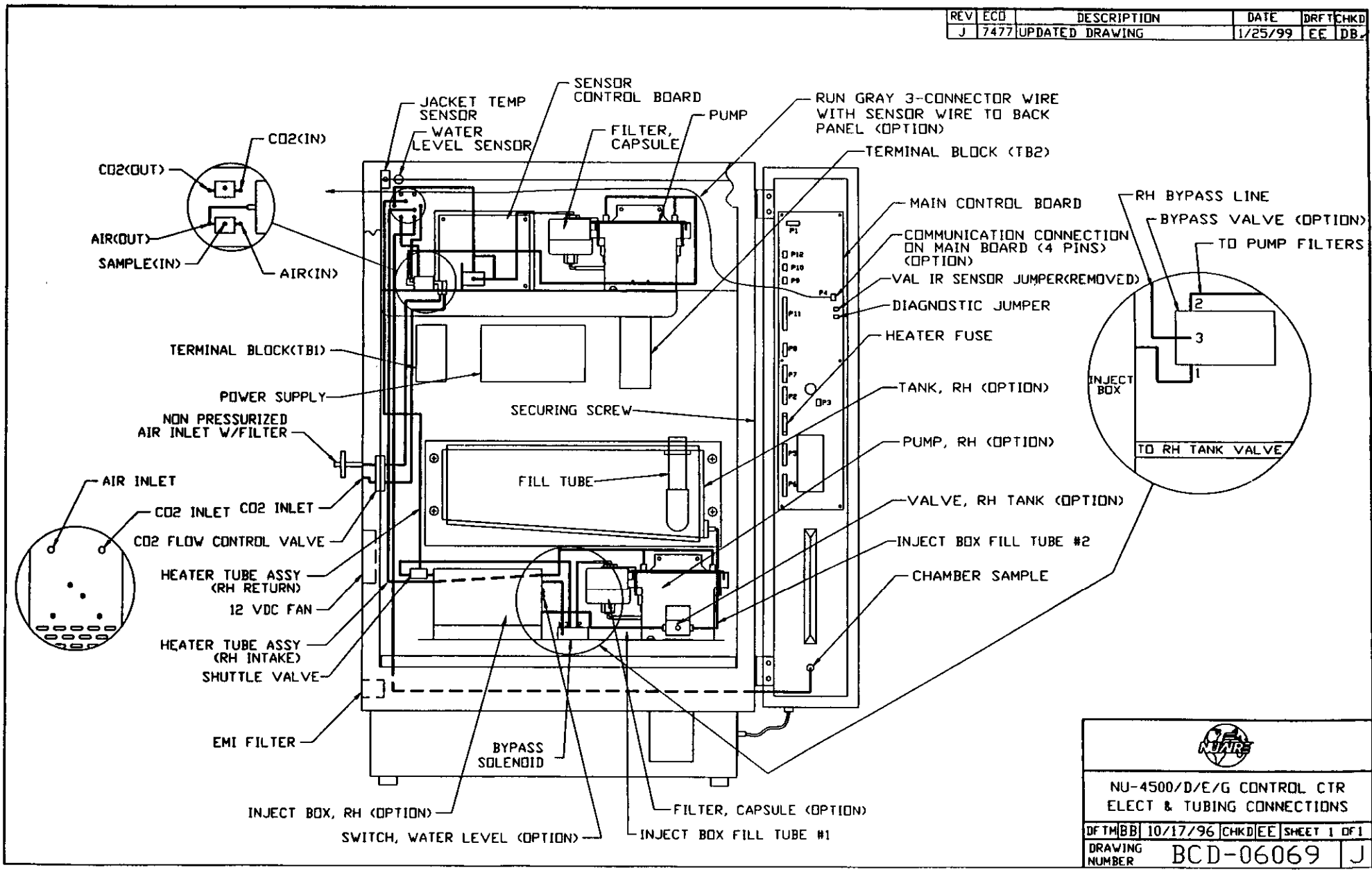
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REV	ECO	DESCRIPTION	DATE	DRFT	CHKD
J	7477	UPDATED DRAWING	1/25/99	EE	DB



NU-4500/D/E/G CONTROL CTR
ELECT & TUBING CONNECTIONS

DFTM	BB	10/17/96	CHKD	EE	SHEET 1 OF 1

DRAWING NUMBER BCD-06069 J

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