

OPERATOR'S MANUAL**MODELS 5100, 5200, 5300****ANALOG DISPLAY AUTOMATIC CO₂
WATER-JACKETED INCUBATOR****NOTICE**

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For repair information or replacement parts assistance from the manufacturer, please contact Customer Service at any of the following Numbers:

800-621-8820**312-227-2660****(FAX) 312-227-1828**

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INSTALLATION AND OPERATION INSTRUCTIONS MODELS 5100, 5200 AND 5300 ANALOG DISPLAY WATER-JACKETED CO₂ INCUBATOR

Position Incubator

Place the incubator in the desired position and adjust the four corner leveling feet to level the incubator.

Install Shelves

Slide shelves in with lip up.

Connect Power Cord to Receptacle on Back of Incubator

CAUTION

First ensure that all switches are in the "off" position. Turn regulating knobs fully counterclockwise. Turn safety knobs fully clockwise. Turn CO₂ control knobs fully counterclockwise. Now plug the line cord into a suitable receptacle. The air circulating motors will be operating. Turn "power" switches to the "on" position. The low water indicator for each chamber will be illuminated.

Fill Unit with Water

Fill the water-jacket(s) with distilled water through the water fitting(s) in the top corner of the chamber(s). To fill water-jackets, pull or unscrew the protective cap from the water fill port. Connect the water hose to the fill port by pushing on the outside ring of the port and sliding the metal tube into the port. The metal tube is supplied on one end of the water hose. Units with the threaded cap will have a plastic hose barb supplied that threads into the port. On Model 5300, lower water-jacket should be filled first.

The use of warm water at the desired operating temperature will expedite the process of heating the unit. Fill one water-jacket until the associated *low water* indicating LED shuts off (approximately 10.5 gallons or 39.7 liters).

One ounce of quaternary ammonium type germicide (dimethyl benzyl ammonium chloride) should be added to each water-jacket, with the water, to reduce the possibility of fungus growth. Repeat procedure to fill other water-jacket. **NEVER OPERATE UNIT WITHOUT WATER IN THE WATER-JACKET.** Failure to do so may result in damage to the heating elements and/or regulating sensors.

If it becomes necessary to drain water from the water-jacket(s), the same hose may be used for siphoning. To remove the water hose, push on the outside ring of the port and pull metal tube out of fitting, or unscrew the hose barb. Replace protective cap.

Humidity — Optional

A glass or stainless steel tray filled with distilled water can be placed on the lower shelf of each incubator chamber to supply humidity. These pans should not exceed 5/8" in height.

NOTE

Trays are not furnished. To attain maximum humidity, pour distilled water directly into bottom of the incubator chambers. When active chemicals are used, they should never be placed directly in the bottom of the chamber. The chamber liner is made of stainless steel but continuous use of chemicals can cause damage and will void the warranty. (See instructions for maintenance of stainless steel, page 8). Stainless steel trays for this purpose are available from Precision Scientific, Inc. (P/N 102633001.) These trays are designed to slide into the lower set of shelf slides.

Control and Indicator Description

1. **Power Switch.** Applies power to the heat and CO₂ switches.
2. **Heat Switch.** Enables associated temperature control circuitry.
3. **CO₂ Switch.** Enables associated CO₂ control circuitry.
4. **Meters.** There are two (2) meters located on the control panel for each chamber. One meter indicates CO₂ percentage within the chamber. The other meter indicates chamber temperature in degrees C.

5. **Low Water Indicators.** The *Low Water Indicator* will illuminate if the associated water-jacket water level falls below the desired operating level. If the *Low Water Indicator* illuminates, add approx. 0.7 gallons or 2.5 liters of distilled water to the water fill port. This will return the water to the desired level and extinguish the *Low Water Indicator*.
6. **High Temp Indicators and Alarms.** When the *Safety Control* indicator illuminates and the alarm sounds, it indicates that the regulating control has failed and the safety control is now regulating incubator temperature, or that the safety control was set too close to the regulating temperature setting.
7. **Temperature Controls.** Refer to Temperature Adjustment Procedure (see p. 6).
8. **CO₂ Controls.** Refer to CO₂ System Adjustment procedure (see p. 6).

9. Door Heater Adjustment.

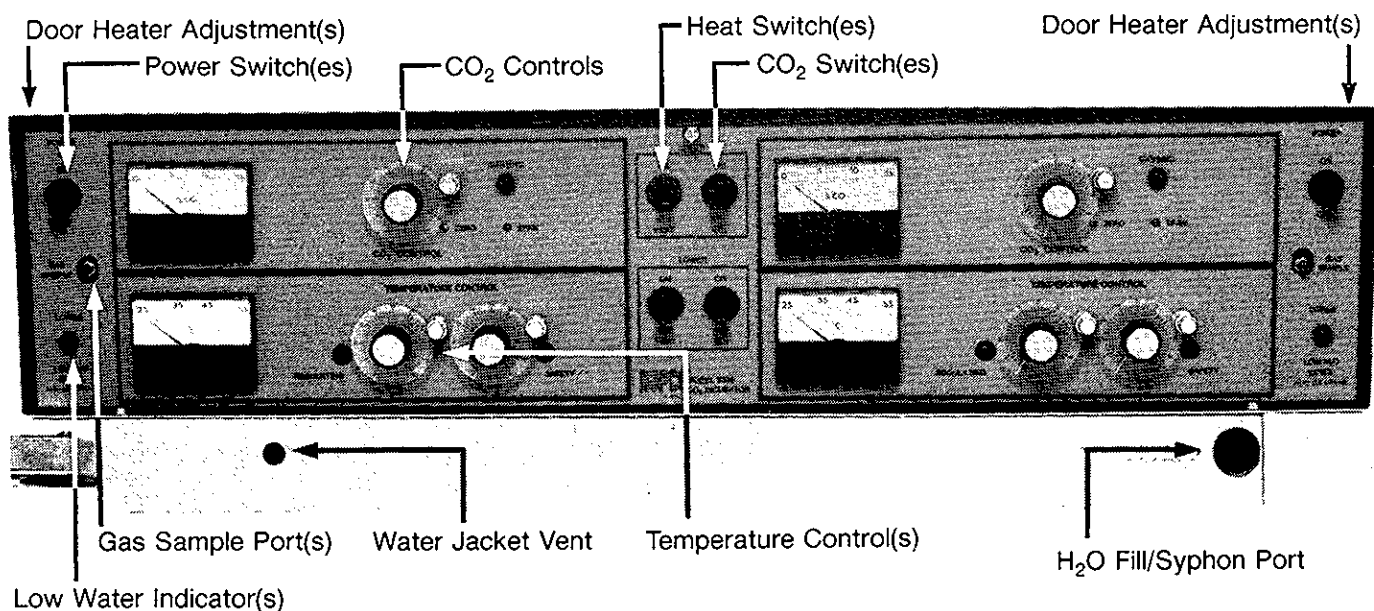
Model 5100 Adjustment Location — The door adjustment is located at the left front area of the top of the unit.

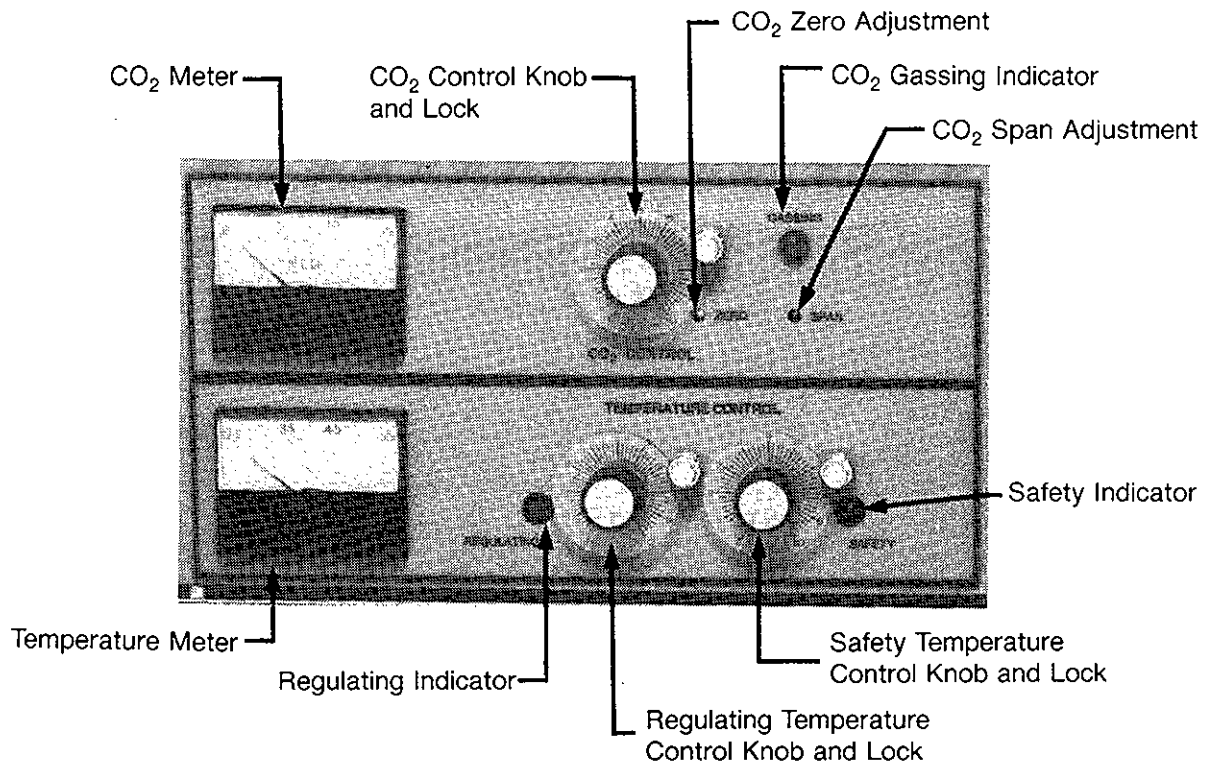
Model 5200 Adjustment Location — The left door adjustment is located at the left front area of the top of the unit. The right door adjustment is located at the middle front area of the top of the unit.

Model 5300 Adjustment Location — The upper door adjustment is located at the right front area of the top of the unit. The lower door adjustment is located at the left front area of the top of the unit.

Adjustment is made through an access hole with a screwdriver. Turn clockwise to increase and counterclockwise to decrease door heat. Adjustment should be made to remove 90% to 95% of condensation of glass door. If adjusted higher than necessary, the door heater will degrade the temperature uniformity within the chamber. Adjusted fully counterclockwise, heater is "off".

Controls Location





Temperature Adjustment

The following procedures may be done simultaneously for each chamber.

Turn the regulating control knob and the safety control knob fully clockwise. Turn the heat switch to the "on" position. When the temperature reaches the desired operating level (as indicated on the meter) turn the regulating control knob counterclockwise until the regulating indicator light just turns off. Lock the dial at that point. Now rotate the safety control knob counterclockwise until the audible alarm sounds. Now rotate the knob clockwise approximately 1/2 of one minor division and lock the knob at that point. Allow the temperature to cycle on and off several times to make sure the unit has stabilized. The safety control indicator and audible alarm should stay off while the regulating indicator light periodically cycles on and off, indicating normal operation.

After temperature stability has been reached, verify that the control knob locks are locked to prevent accidental turning. If at any time the safety indicator light is on for any one chamber, check the temperature controls to make certain the safety control is not set below the regulating control.

The temperature meter may be adjusted $\pm 1^\circ\text{C}$ with the slotted meter screw on the front panel. This will allow you to have the meter correspond to actual chamber temperature.

NOTE

This applies to the temperature meter only. Do not move the CO₂ meter screw.

CO₂ Supply

CO₂ of medical grade is recommended. A suitable regulator is required to provide an even flow of CO₂ at 15 PSI (25 PSI maximum). The regulator should have two (2) gauges: one to indicate CO₂ tank pressure and the other to indicate the line pressure to the CO₂ control of the incubator. A regulator can be ordered from Precision Scientific, Inc., (P/N 220412500).

Operation

The unit is completely serviceable in the field. *Zero set and Span adjustment are factory set for approx. 37°C and for operation at 90% \pm 7% relative humidity. Special setting of "zero set" is required if an incubator is to be operated at other humidity levels.* The accuracy of indicated CO₂ concentration should be $\pm .25\%$ of the indicated reading under *stable* temperature and humidity conditions. Chamber temperature changes have very little effect on CO₂ sensors.

CO₂ Sample Port: Sample ports for the chambers are located on the control panel. *DO NOT* close ports. This will cause a pressure build-up in the chambers. A gas sample may be drawn to check CO₂ concentration. A "FYRITE" CO₂ indicator is suitable, or a laboratory blood gas analyzer may be used. Both items are available from your scientific supply company.

During normal operation with the chamber doors closed, the temperature, humidity, and CO₂ concentration will remain stable. Moderate air circulation by the built-in blower will provide the chambers with an even distribution of temperature, humidity, and CO₂ concentration.

Operation after opening door: Opening the door of a chamber obviously upsets the controlled environment in the chamber. The automatic control system will return the environment to the pre-set condition faster and more uniformly than is possible with "flow-through" systems.

Frequent and lengthy door openings will result in lowering the average relative humidity in the chamber. This results in a lowering of the "average CO₂ concentration", until the pre-set humidity and temperature levels are restored to the incubator environment.

CO₂ System Adjustment Procedure

Zero Set. Repeat or do the following procedure simultaneously for each chamber:

1. First, be sure CO₂ supply is turned "off". Turn the CO₂ switch on.

Allow incubator to reach normal operating temperature and operating humidity. To obtain this condition, the doors of the incubator must be closed a *minimum* of 1 hour. At this time there should be no CO₂ in the chamber. The CO₂ sensor is sensitive to humidity changes within the chamber. This is the reason the doors must be closed for proper zero set. Adjust *zero* potentiometer through access hole in front panel with a small screwdriver until the meter reads "0".

2. Set CO₂ regulator on supply tank to 15 PSI and connect to incubator at hose connector on back of unit.

Span. Repeat or do the following procedure simultaneously for each chamber:

Span calibration is preset at factory. Further adjustment of span requires an accurate CO₂ measuring instrument: Bacharach "Fyrite" or equivalent.

1. Turn CO₂ control knob to 5.
2. Wait five (5) minutes, then turn knob fully counterclockwise.
3. Wait two (2) minutes, then check CO₂ level by connecting CO₂ sampling instrument to sample tube outlet on control panel.
4. Adjust *span* trim potentiometer until display agrees with CO₂ sampling instrument.
5. With the CO₂ control knob turned fully counterclockwise, open door of incubator to empty all CO₂.
6. To insure that no CO₂ is in the chamber, close door, wait 1 hour, then check with CO₂ sampling instrument.
7. Repeat calibration procedure if *zero* and *span* require further adjustment.

If relative humidity condition is changed within a chamber to a different level, the CO₂ system adjustment procedure should be followed for proper calibration of the CO₂ control.

Periodic Maintenance

1. Periodically check gas supply Output Pressure.
2. Check supply lines and hose connections for leaks with a liquid soap solution. If checking for leaks inside unit, DO NOT ALLOW SOLUTION TO DRIP ON CIRCUIT BOARDS and perform check only when power is "OFF".
3. To minimize fungus growth, the doors should remain closed as much as possible so airborne organisms will not enter the chamber. The chamber interiors should be cleaned periodically to eliminate fungus and other contamination buildup. The incubator has been specifically designed for interior cleaning ease. The fan blower duct and shelf supports are easily removable, which allows access to the sensors and blower wheel. The interior of the chamber is completely accessible for cleaning. To remove the shelf supports and fan blower duct, follow these steps:
 - a. Remove contents from incubator shelves and remove shelves.
 - b. Disconnect power cord from electrical service.
 - c. Grasp the bottom of the right shelf support panel with both hands.
 - d. Pull the lower end away from the side of the chamber.
 - e. Support the fan blower duct with one hand while lifting the shelf support panel out of the chamber.
 - f. Remove the fan blower duct from the chamber.
 - g. Grasp the bottom of the left side shelf support panel with both hands and pull the lower end away from the side of the chamber.
 - h. Remove the left shelf support panel from the chamber. The fan motor/sensor plate is now exposed.
4. Every 12 months add one ounce of quaternary ammonium type germicide to water fill port.
5. Every 24 months, siphon sample of waterjacket water and check its pH. If the pH level is below 5.0, replace the water in the waterjacket.
6. The water in the chambers for humidity should be checked frequently and replenished as required.
7. Check the CO₂ filter periodically for contamination. It is located inside the control housing. BE SURE TO DISCONNECT POWER BEFORE OPENING THE CONTROL HOUSING.
8. Check glass door gaskets seal and fan motor mounting plate gaskets for tightness to assure proper gas concentrations.
9. If an incubating chamber fails to maintain set temperature, verify temperature adjustment. If the regulating or safety controls do not function as specified, contact your Service Representative.
10. If power is removed from unit, remove the humidity water, or open all doors to avoid moisture condensation on the CO₂ sensor(s).
11. CO₂ controller recalibration is recommended every six months.

Maintenance of Stainless Steel

The remarkable durability of stainless steel requires surface exposure to the oxygen in our atmosphere or aerated water. Proper use and maintenance will assure many years of service. We recommend the following:

1. Clean regularly with mild soapy water followed by rinsing and drying.
2. If it is necessary to use the following chemicals, limit the time to a maximum of four hours and then clean surfaces immediately.

Aluminum Chloride	Barium Chloride
Calcium Chloride	Bichloride of Mercury
Citric Acid (boiling)	Lysol
Ferrous Chloride	Dakin's Solution
Mercury Salts	Mercuric Chloride
Phenol	Chlorinated Lime
Potassium Permanganate	Potassium Thiocyanate
Sodium Hypochlorite	Stannous Chloride
Tartaric Acid	Carbolic Acid

3. Never use the following:

Sodium Azide	Ferric Chloride
Aqua Regia	Sulphuric Acid
	Iodine

4. Should stainless steel become discolored by iron rust, follow this method to remove all traces and restore stainless steel.



Observe the following safety precautions!

Use heavy gloves or other adequate protection for hands. Wear goggles or other adequate eye protection. Ensure adequate ventilation when handling the following:

- a. Prepare a solution of 20% nitric and 1 1/2% Hydrochloric Acid. Swab solution over surface, allowing it to remain until all rust is loosened. (1 to 2 minutes usually). IMMEDIATELY flush surface with clean water until all acid is removed. Dry thoroughly.
- b. If preferred a 2% to 5% solution of warm Oxalic Acid may be used. This too, should be thoroughly removed with fresh water.



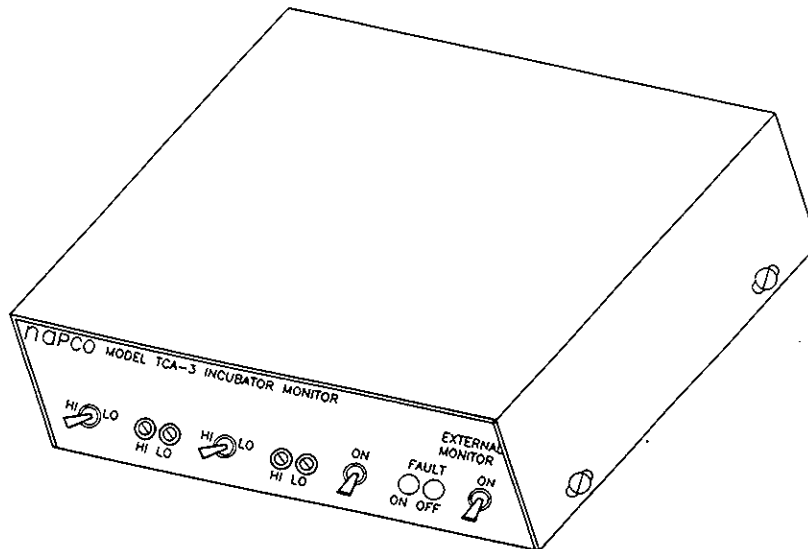
Electrolysis can damage stainless steel. This can occur if an object is allowed to rest directly on the surface, trapping moisture that becomes oxygen starved but is surrounded by water containing oxygen. The resulting electrolytic action will pit or erode the metal.

SPECIFICATIONS

MODEL	5100	5200	5300
Chamber volume			
Cu. ft.	5	10	10
Liters	150	300	300
Number of chambers	1	2	2
Inside dimensions, usable	(W-D-H)	(W-D-H)	(W-D-H)
Inches	17.5x17.8x25	17.5x17.8x25	17.5x17.8x25
Centimeters	44.5x45.2x63.5	44.5x45.2x63.5	44.5x45.2x63.5
Outside dimensions	(W-D-H)	(W-D-H)	(W-D-H)
Inches	25x24.5x39.5	49x24.5x39.5	25x24.5x73
Centimeters	63.5x62.2x100.3	124.5x62.2x100.3	63.5x62.2x185.4
Temperature range	5°C above ambient to 55°C	5°C above ambient to 55°C	5°C above ambient to 55°C
Temperature control	0.2°C	0.2°C	0.2°C
Temperature uniformity	± 0.35°C	± 0.35°C	± 0.35°C
CO ₂ range	0-15%	0-15%	0-15%
CO ₂ control	0.25%	0.25%	0.25%
CO ₂ uniformity	± 0.25%	± 0.25%	± 0.25%
Humidity range	Above ambient to 98%	Above ambient to 98%	Above ambient to 98%
Shelf capacity			
Sq. ft.	6/12	12/24	12/24
Sq. m.	6/1.1	12/2.2	12/2.2
Max shelf capacity			
Sq. ft.	9/18	18/36	18/36
Sq. m.	9/1.6	18/3.3	18/3.3
Electrical service	525 Watts, 120 VAC 50/60 Hz, 4.4 Amps	1000 Watts, 120 VAC 50/60 Hz, 8.3 Amps	1000 Watts, 120 VAC 50/60 Hz, 8.3 Amps
Net weight			
Pounds	199	361	339
Kilograms	90	164	154

OPTIONS

The remainder of this manual is devoted to miscellaneous options/accessories available for your incubator.



MODEL TCA-3 INCUBATOR MONITOR

Features:

1. One set-point for each of the two monitor functions, Temperature and CO₂. Set-point switches enable operator to see either the high or low monitoring set-points on the incubator indication meters.
2. One high and one low set-point potentiometer for each of the two monitor functions. Can be easily set by operator to the desired high and low set-point. Monitor is activated if incubator exceeds these set-points by four minutes.
3. Audio alert on-off switch; enables operator to manually disable audio indicator.
4. External monitor on-off switch; enables operator to manually switch monitor "Off" as seen by central monitoring systems.
5. Fault indicating LED's. A green LED is illuminated under "no fault" condition (also indicates power is present). A red LED is illuminated when there is a fault condition.

Internal Features:

1. Power loss activates monitor relay as seen by central monitoring systems. Form "C" contacts available at rear terminal block.
2. Three to five minute monitor delay; gives ample time for chamber recovery after door openings and prevents invalid fault conditions.
3. Recorder outputs for voltage type recorders.

NOTE:

Refer to set-up instructions for the incubator before attempting to operate monitor.

1. Remove shorting plug from 9-pin connector on back of incubator.
2. Connect the cable from the TCA-3 to the 9-pin connector on back of incubator.
3. Plug power cord into a suitable outlet.

Operating Procedure:

With power to monitor and monitor connected to unit(s), you may now adjust your high and low set-points.

Set-point adjustment:

1. Push the associated 3-position set-point switch to the left and hold in position. Your "Hi" set-point is now being displayed on your incubator panel meter. Using the supplied adjustment tool or jewelers screwdriver, rotate the "Hi" potentiometer until the meter indicates your desired high set-point.

Push the set-point switch to the right and hold in this position. Your "Lo" set-point is now being displayed on your incubator panel meter. Using the adjustment tool, rotate the "Lo" potentiometer until the meter indicates your desired low set-point.

2. Repeat above procedure for other half of monitor.
3. Do not set-points closer than necessary. For temperature, try to avoid setting closer than 0.5°C to operating temperature. For CO₂, try to avoid setting closer than 0.5% to operating CO₂ percentage.
4. If a fault condition occur's recheck set-points by pushing set-point switches to both "Hi" and "Lo" positions, while observing incubator panel meter(s).

NOTE:

The "Hi" set-points must be above ther incubator operating point. The "Lo" set-points must be below the incubator operating point.

Audio Indicator Switch:

1. Place switch in "On" position if you desire the audio indicator to sound when there is a fault condition.
2. Place switch in "Off" position to disconnect audio portion of monitor.

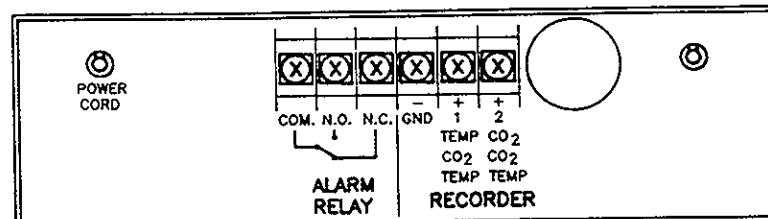
External Monitor Switch: (for use by central monitoring system)

1. Place switch in "On" position if you desire that the central monitoring system indicates when there is a fault condition.
2. Place switch in "Off" position if you do not want central monitoring system to indicate fault conditions. This is sometimes used during working hours when personnel are using lab.

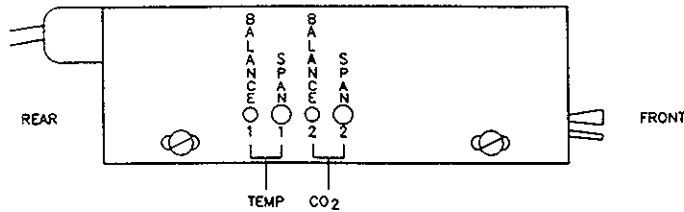
Conditions which will activate monitor:

1. When any monitor set-point is exceeded; after 3-5 minute delay.
2. If monitor cord to incubator is accidentally disconnected, monitor will be activated after a 3-5 minute delay.
3. If power to incubator is lost, monitor will be activated after 3-5 minute delay.
4. If power to the monitor is lost and external monitor switch is in "On" position, your central monitoring system will indicate a fault condition immediately.

Output connections: (see illustration of output terminal block below).



Recorder Output Adjustments (located on left side of alarm)



1. Monitor relay connections: This was designed to be used by a central alarm (monitoring) system. If you desire "normally open" relay contact connections, connect central alarm to #1 "Com" and #2 "N.O.". If you desire "normally closed" relay contact connections, connect central alarm to #1 "Com" and #3 "N.C.".
2. Recorder outputs: Your TCA incubator monitor is equipped with recorder output circuitry. You will have DC voltage outputs available between terminal block connection #4 and #5 and between connection #4 and #6.

Temperature outputs are 0.25V to 0.55V for 25°C to 55°C. CO₂ outputs are 0.0V to 1.0V for 0% CO₂ to 10% CO₂. These outputs can be modified if desired by internal adjustments. (Consult factory).

Recorder output adjustments: (located on left side of monitor).

1. Span Adjustments have been calibrated at factory. Do not adjust. Consult factory if you feel you have a problem with the span (gain) settings.
2. Balance adjustments are used to shift the recorder output voltages up or down over a narrow range. There are separate balance adjustment potentiometers for each output, see above illustration. Turn proper balance potentiometer clockwise to shift output voltage lower, turn C.C.W. to shift output voltage higher.

Recorder output voltages for temperature are 0.25 volts at 25°C to 0.55 volts at 55°C. CO₂ output voltages are 0.0 volts at 0.0% CO₂ to 1.0 volts at 10% CO₂.

To attain the most accuracy, adjust associated balance potentiometers at incubator operating levels. **EXAMPLE:** At 37.0°C and 5.0% CO₂ indication on incubator panel meters, adjust associated balance potentiometers until output voltage for temperature is 0.370 volts and 0.500 volts for CO₂ output. Use supplied screwdriver or jewelers screwdriver to make adjustments.

NOTE:

If monitor must be disconnected from incubator, install shorting plug in 9-pin connector in back of incubator. The shorting plug is permanently attached to the rear of the incubator by a chain.

Warranty

PRECISION SCIENTIFIC warrants its products against defects in material or in workmanship when used under appropriate conditions and in accordance with appropriate operating instructions for a period of no less than one (1) year from the date of delivery of the products.

The sole obligation of **PRECISION SCIENTIFIC** shall be to repair or replace at our option, FOB factory or locally, without charge, any part(s) that prove defective within the warranty period, provided that the customer notifies **PRECISION SCIENTIFIC** promptly and in writing of any such defect. Compensation for labor by other than **PRECISION SCIENTIFIC** employees will not be our obligation. Part(s) replacement does not constitute an extension of the original warranty period.

PRECISION SCIENTIFIC makes no warranty of merchantability, fitness for a particular purpose, or any other warranty, express or implied, as to the design, sale, installation, or use of its products, and shall not be liable for consequential damages resulting from the use of its products.

PRECISION SCIENTIFIC will not assume responsibility for unauthorized repairs or failure as a result of unauthorized repairs, replacement, or modifications made negligently or otherwise improperly made or performed by persons other than **PRECISION SCIENTIFIC** employees or authorized representatives.

While our personnel are available to advise customers concerning general application of all manufactured products, oral representations are not warranties with respect to particular application and should not be relied upon if inconsistent with product specification or the terms stated herein.

In any event, the terms and conditions continued in **PRECISION SCIENTIFIC, INC.**, formal sales contracts shall be controlling; and any changes must be in writing and signed by an authorized executive of **PRECISION SCIENTIFIC, INC.**

All defective components will be replaced without charge for one (1) year from the date of delivery. There will be no charge for labor if the apparatus is returned to the factory prepaid.

Conditions and qualifications of the warranty statement shall prevail at all times.

MANUAL INSTRUCTIONS FOR XEROX

102219021

PGS 11-6 HANDLER 1SIDE-2SIDE

5-4 SIDE FEEDER 1SIDE-2SIDE * PHOTO_{MODE}

3-COVER HANDLER 1SIDE-2SIDE

Bill Brenden 11/30/90

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INSTALLATION AND OPERATION INSTRUCTIONS MODELS 5100, 5200 AND 5300 ANALOG DISPLAY WATER-JACKETED CO₂ INCUBATOR

Position Incubator

Place the incubator in the desired position and adjust the four corner leveling feet to level the incubator.

Install Shelves

Slide shelves in with lip up.

Connect Power Cord to Receptacle on Back of Incubator

CAUTION

First ensure that all switches are in the "off" position. Turn regulating knobs fully counterclockwise. Turn safety knobs fully clockwise. Turn CO₂ control knobs fully counterclockwise. Now plug the line cord into a suitable receptacle. The air circulating motors will be operating. Turn "power" switches to the "on" position. The low water indicator for each chamber will be illuminated.

Fill Unit with Water

Fill the water-jacket(s) with distilled water through the water fitting(s) in the top corner of the chamber(s). To fill water-jackets, pull or unscrew the protective cap from the water fill port. Connect the water hose to the fill port by pushing on the outside ring of the port and sliding the metal tube into the port. The metal tube is supplied on one end of the water hose. Units with the threaded cap will have a plastic hose barb supplied that threads into the port. On Model 5300, lower water-jacket should be filled first.

The use of warm water at the desired operating temperature will expedite the process of heating the unit. Fill one water-jacket until the associated *low water* indicating LED shuts off (approximately 10.5 gallons or 39.7 liters).

One ounce of quaternary ammonium type germicide (dimethyl benzyl ammonium chloride) should be added to each water-jacket, with the water, to reduce the possibility of fungus growth. Repeat procedure to fill other water-jacket. **NEVER OPERATE UNIT WITHOUT WATER IN THE WATER-JACKET.** Failure to do so may result in damage to the heating elements and/or regulating sensors.

If it becomes necessary to drain water from the water-jacket(s), the same hose may be used for siphoning. To remove the water hose, push on the outside ring of the port and pull metal tube out of fitting, or unscrew the hose barb. Replace protective cap.

Humidity — Optional

A glass or stainless steel tray filled with distilled water can be placed on the lower shelf of each incubator chamber to supply humidity. These pans should not exceed 5/8" in height.

NOTE

Trays are not furnished. To attain maximum humidity, pour distilled water directly into bottom of the incubator chambers. When active chemicals are used, they should never be placed directly in the bottom of the chamber. The chamber liner is made of stainless steel but continuous use of chemicals can cause damage and will void the warranty. (See instructions for maintenance of stainless steel, page 8). Stainless steel trays for this purpose are available from Precision Scientific, Inc. (P/N 102633001.) These trays are designed to slide into the lower set of shelf slides.

Control and Indicator Description

1. **Power Switch.** Applies power to the heat and CO₂ switches.
2. **Heat Switch.** Enables associated temperature control circuitry.
3. **CO₂ Switch.** Enables associated CO₂ control circuitry.
4. **Meters.** There are two (2) meters located on the control panel for each chamber. One meter indicates CO₂ percentage within the chamber. The other meter indicates chamber temperature in degrees C.

5. **Low Water Indicators.** The *Low Water Indicator* will illuminate if the associated water-jacket water level falls below the desired operating level. If the *Low Water Indicator* illuminates, add approx. 0.7 gallons or 2.5 liters of distilled water to the water fill port. This will return the water to the desired level and extinguish the *Low Water Indicator*.

6. **High Temp Indicators and Alarms.** When the *Safety Control* indicator illuminates and the alarm sounds, it indicates that the regulating control has failed and the safety control is now regulating incubator temperature, or that the safety control was set too close to the regulating temperature setting.

7. **Temperature Controls.** Refer to Temperature Adjustment Procedure (see p. 6).

8. **CO₂ Controls.** Refer to CO₂ System Adjustment procedure (see p. 6).

9. **Door Heater Adjustment.**

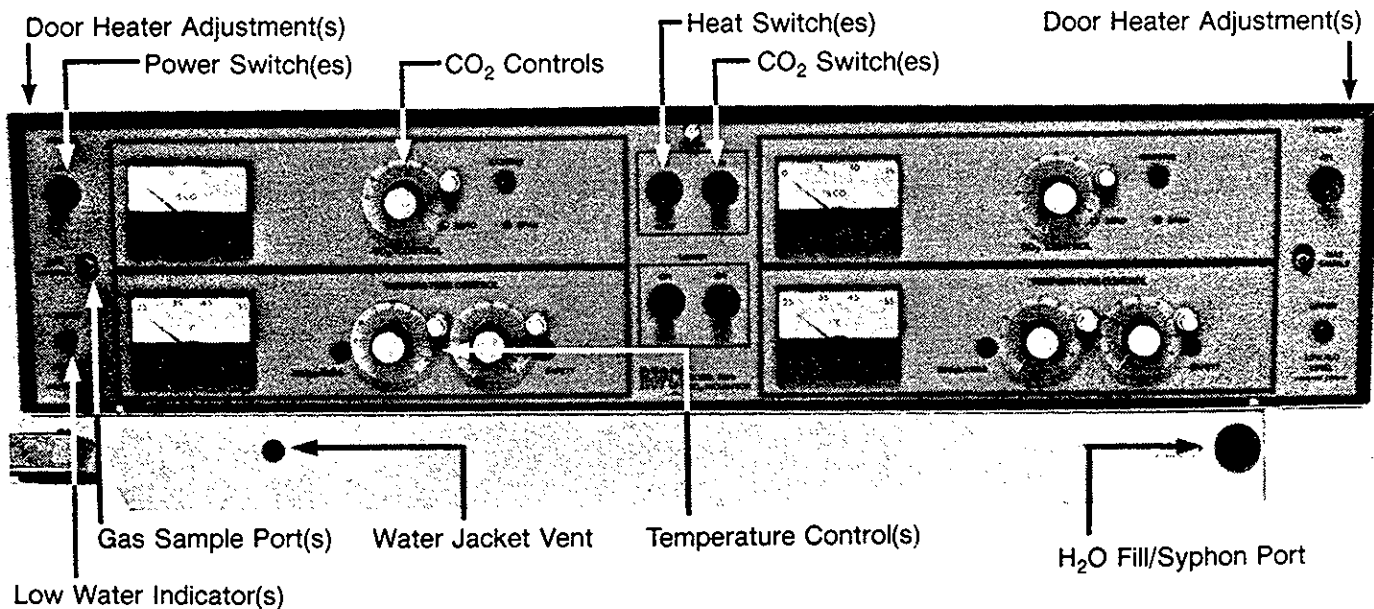
Model 5100 Adjustment Location — The door adjustment is located at the left front area of the top of the unit.

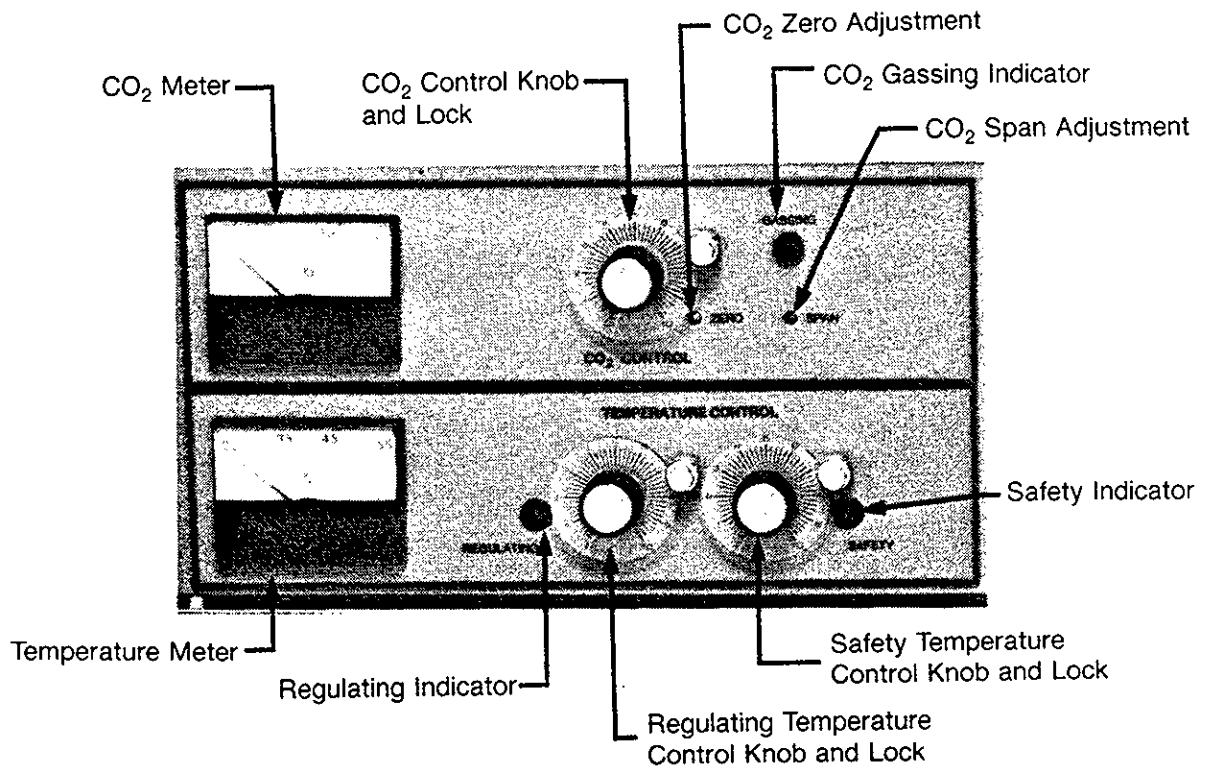
Model 5200 Adjustment Location — The left door adjustment is located at the left front area of the top of the unit. The right door adjustment is located at the middle front area of the top of the unit.

Model 5300 Adjustment Location — The upper door adjustment is located at the right front area of the top of the unit. The lower door adjustment is located at the left front area of the top of the unit.

Adjustment is made through an access hole with a screwdriver. Turn clockwise to increase and counterclockwise to decrease door heat. Adjustment should be made to remove 90% to 95% of condensation of glass door. If adjusted higher than necessary, the door heater will degrade the temperature uniformity within the chamber. Adjusted fully counterclockwise, heater is "off".

Controls Location





Temperature Adjustment

The following procedures may be done simultaneously for each chamber.

Turn the regulating control knob and the safety control knob fully clockwise. Turn the heat switch to the "on" position. When the temperature reaches the desired operating level (as indicated on the meter) turn the regulating control knob counterclockwise until the regulating indicator light just turns off. Lock the dial at that point. Now rotate the safety control knob counterclockwise until the audible alarm sounds. Now rotate the knob clockwise approximately 1/2 of one minor division and lock the knob at that point. Allow the temperature to cycle on and off several times to make sure the unit has stabilized. The safety control indicator and audible alarm should stay off while the regulating indicator light periodically cycles on and off, indicating normal operation.

After temperature stability has been reached, verify that the control knob locks are locked to prevent accidental turning. If at any time the safety indicator light is on for any one chamber, check the temperature controls to make certain the safety control is not set below the regulating control.

The temperature meter may be adjusted $\pm 1^{\circ}\text{C}$ with the slotted meter screw on the front panel. This will allow you to have the meter correspond to actual chamber temperature.

NOTE

This applies to the temperature meter only. Do not move the CO₂ meter screw.

CO₂ Supply

CO₂ of medical grade is recommended. A suitable regulator is required to provide an even flow of CO₂ at 15 PSI (25 PSI maximum). The regulator should have two (2) gauges: one to indicate CO₂ tank pressure and the other to indicate the line pressure to the CO₂ control of the incubator. A regulator can be ordered from Precision Scientific, Inc., (P/N 220412500).

Operation

The unit is completely serviceable in the field. Zero set and Span adjustment are factory set for approx. 37°C and for operation at 90% $\pm 7\%$ relative humidity. *Special setting of "zero set" is required if an incubator is to be operated at other humidity levels.* The accuracy of indicated CO₂ concentration should be $\pm .25\%$ of the indicated reading under stable temperature and humidity conditions. Chamber temperature changes have very little effect on CO₂ sensors.

CO₂ Sample Port: Sample ports for the chambers are located on the control panel. *DO NOT* close ports. This will cause a pressure build-up in the chambers. A gas sample may be drawn to check CO₂ concentration. A "FYRITE" CO₂ indicator is suitable, or a laboratory blood gas analyzer may be used. Both items are available from your scientific supply company.

During normal operation with the chamber doors closed, the temperature, humidity, and CO₂ concentration will remain stable. Moderate air circulation by the built-in blower will provide the chambers with an even distribution of temperature, humidity, and CO₂ concentration.

Operation after opening door: Opening the door of a chamber obviously upsets the controlled environment in the chamber. The automatic control system will return the environment to the pre-set condition faster and more uniformly than is possible with "flow-through" systems.

Frequent and lengthy door openings will result in lowering the average relative humidity in the chamber. This results in a lowering of the "average CO₂ concentration", until the pre-set humidity and temperature levels are restored to the incubator environment.

CO₂ System Adjustment Procedure

Zero Set. Repeat or do the following procedure simultaneously for each chamber:

1. First, be sure CO₂ supply is turned "off". Turn the CO₂ switch on.

Allow incubator to reach normal operating temperature and operating humidity. To obtain this condition, the doors of the incubator must be closed a *minimum* of 1 hour. At this time there should be no CO₂ in the chamber. The CO₂ sensor is sensitive to humidity changes within the chamber. This is the reason the doors must be closed for proper zero set. Adjust zero potentiometer through access hole in front panel with a small screwdriver until the meter reads "0".

2. Set CO₂ regulator on supply tank to 15 PSI and connect to incubator at hose connector on back of unit.

Span. Repeat or do the following procedure simultaneously for each chamber:

Span calibration is preset at factory. Further adjustment of span requires an accurate CO₂ measuring instrument: Bacharach "Fyrite" or equivalent.

1. Turn CO₂ control knob to 5.
2. Wait five (5) minutes, then turn knob fully counterclockwise.
3. Wait two (2) minutes, then check CO₂ level by connecting CO₂ sampling instrument to sample tube outlet on control panel.
4. Adjust *span* trim potentiometer until display agrees with CO₂ sampling instrument.
5. With the CO₂ control knob turned fully counterclockwise, open door of incubator to empty all CO₂.
6. To insure that no CO₂ is in the chamber, close door, wait 1 hour, then check with CO₂ sampling instrument.
7. Repeat calibration procedure if *zero* and *span* require further adjustment.

If relative humidity condition is changed within a chamber to a different level, the CO₂ system adjustment procedure should be followed for proper calibration of the CO₂ control.

Periodic Maintenance

1. Periodically check gas supply Output Pressure.
2. Check supply lines and hose connections for leaks with a liquid soap solution. If checking for leaks inside unit, DO NOT ALLOW SOLUTION TO DRIP ON CIRCUIT BOARDS and perform check only when power is "OFF".
3. To minimize fungus growth, the doors should remain closed as much as possible so airborne organisms will not enter the chamber. The chamber interiors should be cleaned periodically to eliminate fungus and other contamination buildup. The incubator has been specifically designed for interior cleaning ease. The fan blower duct and shelf supports are easily removable, which allows access to the sensors and blower wheel. The interior of the chamber is completely accessible for cleaning. To remove the shelf supports and fan blower duct, follow these steps:
 - a. Remove contents from incubator shelves and remove shelves.
 - b. Disconnect power cord from electrical service.

- c. Grasp the bottom of the right shelf support panel with both hands.
 - d. Pull the lower end away from the side of the chamber.
 - e. Support the fan blower duct with one hand while lifting the shelf support panel out of the chamber.
 - f. Remove the fan blower duct from the chamber.
 - g. Grasp the bottom of the left side shelf support panel with both hands and pull the lower end away from the side of the chamber.
 - h. Remove the left shelf support panel from the chamber. The fan motor/sensor plate is now exposed.
4. Every 12 months add one ounce of quaternary ammonium type germicide to water fill port. This germicide is available from Precision Scientific, Inc.
 5. Every 24 months, siphon sample of waterjacket water and check its pH. If the pH level is below 5.0, replace the water in the waterjacket.
 6. The water in the chambers for humidity should be checked frequently and replenished as required.
 7. Check the CO₂ filter periodically for contamination. It is located inside the control housing. BE SURE TO DISCONNECT POWER BEFORE OPENING THE CONTROL HOUSING.
 8. Check glass door gaskets seal and fan motor mounting plate gaskets for tightness to assure proper gas concentrations.
 9. If an incubating chamber fails to maintain set temperature, verify temperature adjustment. If the regulating or safety controls do not function as specified, contact your Service Representative.
 10. If power is removed from unit, remove the humidity water, or open all doors to avoid moisture condensation on the CO₂ sensor(s).
 11. CO₂ controller recalibration is recommended every six months.

Maintenance of Stainless Steel

The remarkable durability of stainless steel requires surface exposure to the oxygen in our atmosphere or aerated water. Proper use and maintenance will assure many years of service. We recommend the following:

- Clean regularly with mild soapy water followed by rinsing and drying.
- If it is necessary to use the following chemicals, limit the time to a maximum of four hours and then clean surfaces immediately.

Aluminum Chloride	Barium Chloride
Calcium Chloride	Bichloride of Mercury
Citric Acid (boiling)	Lysol
Ferrous Chloride	Dakin's Solution
Mercury Salts	Mercuric Chloride
Phenol	Chlorinated Lime
Potassium Permanganate	Potassium Thiocyanate
Sodium Hypochlorite	Stannous Chloride
Tartaric Acid	Carbolic Acid

- Never use the following:

Sodium Azide	Ferric Chloride
Aqua Regia	Sulphuric Acid
	Iodine

- Should stainless steel become discolored by iron rust, follow this method to remove all traces and restore stainless steel.

CAUTION

Observe the following safety precautions!

Use heavy gloves or other adequate protection for hands. Wear goggles or other adequate eye protection. Ensure adequate ventilation when handling the following:

- Prepare a solution of 20% nitric and 1 1/2% Hydrochloric Acid. Swab solution over surface, allowing it to remain until all rust is loosened. (1 to 2 minutes usually). **IMMEDIATELY** flush surface with clean water until all acid is removed. Dry thoroughly.
- If preferred a 2% to 5% solution of warm Oxalic Acid may be used. This too, should be thoroughly removed with fresh water.

WARNING

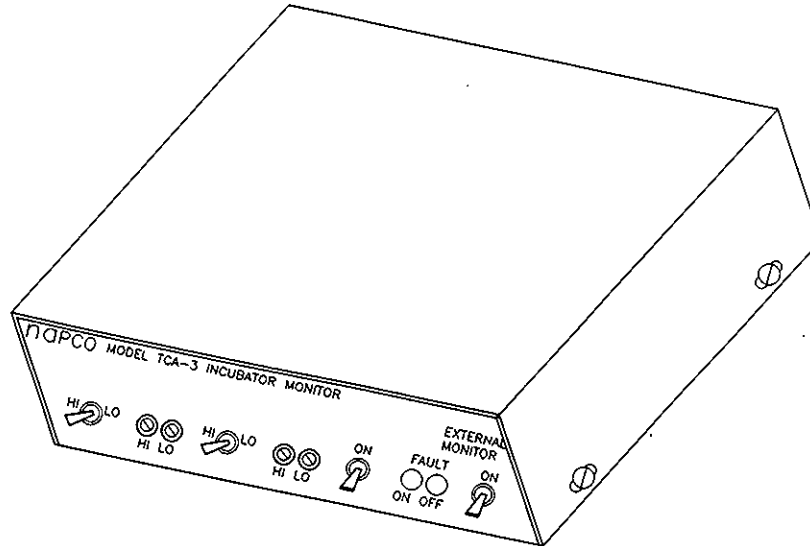
Electrolysis can damage stainless steel. This can occur if an object is allowed to rest directly on the surface, trapping moisture that becomes oxygen starved but is surrounded by water containing oxygen. The resulting electrolytic action will pit or erode the metal.

SPECIFICATIONS

MODEL	5100	5200	5300
Chamber volume			
Cu. ft.	5	10	10
Liters	150	300	300
Number of chambers	1	2	2
Inside dimensions, usable	(W-D-H)	(W-D-H)	(W-D-H)
Inches	17.5x17.8x25	17.5x17.8x25	17.5x17.8x25
Centimeters	44.5x45.2x63.5	44.5x45.2x63.5	44.5x45.2x63.5
Outside dimensions	(W-D-H)	(W-D-H)	(W-D-H)
Inches	25x24.5x39.5	49x24.5x39.5	25x24.5x73
Centimeters	63.5x62.2x100.3	124.5x62.2x100.3	63.5x62.2x185.4
Temperature range	5°C above ambient to 55°C	5°C above ambient to 55°C	5°C above ambient to 55°C
Temperature control	0.2°C	0.2°C	0.2°C
Temperature uniformity	±0.35°C	±0.35°C	±0.35°C
CO ₂ range	0-15%	0-15%	0-15%
CO ₂ control	0.25%	0.25%	0.25%
CO ₂ uniformity	±0.25%	±0.25%	±0.25%
Humidity range	Above ambient to 98%	Above ambient to 98%	Above ambient to 98%
Shelf capacity			
Sq. ft.	6/12	12/24	12/24
Sq. m.	6/1.1	12/2.2	12/2.2
Max shelf capacity			
Sq. ft.	9/18	18/36	18/36
Sq. m.	9/1.6	18/3.3	18/3.3
Electrical service	525 Watts, 120 VAC 50/60 Hz, 4.4 Amps	1000 Watts, 120 VAC 50/60 Hz, 8.3 Amps	1000 Watts, 120 VAC 50/60 Hz, 8.3 Amps
Net weight			
Pounds	199	361	339
Kilograms	90	164	154

OPTIONS

The remainder of this manual is devoted to miscellaneous options/accessories available for your incubator.



MODEL TCA-3 INCUBATOR MONITOR

Features:

1. One set-point for each of the two monitor functions, Temperature and CO₂. Set-point switches enable operator to see either the high or low monitoring set-points on the incubator indication meters.
2. One high and one low set-point potentiometer for each of the two monitor functions. Can be easily set by operator to the desired high and low set-point. Monitor is activated if incubator exceeds these set-points by four minutes.
3. Audio alert on-off switch; enables operator to manually disable audio indicator.
4. External monitor on-off switch; enables operator to manually switch monitor "Off" as seen by central monitoring systems.
5. Fault indicating LED's. A green LED is illuminated under "no fault" condition (also indicates power is present). A red LED is illuminated when there is a fault condition.

Internal Features:

1. Power loss activates monitor relay as seen by central monitoring systems. Form "C" contacts available at rear terminal block.
2. Three to five minute monitor delay; gives ample time for chamber recovery after door openings and prevents invalid fault conditions.
3. Recorder outputs for voltage type recorders.

NOTE:

Refer to set-up instructions for the incubator before attempting to operate monitor.

1. Remove shorting plug from 9-pin connector on back of incubator.
2. Connect the cable from the TCA-3 to the 9-pin connector on back of incubator.
3. Plug power cord into a suitable outlet.

Operating Procedure:

With power to monitor and monitor connected to unit(s), you may now adjust your high and low set-points.

Set-point adjustment:

1. Push the associated 3-position set-point switch to the left and hold in position. Your "Hi" set-point is now being displayed on your incubator panel meter. Using the supplied adjustment tool or jewelers screwdriver, rotate the "Hi" potentiometer until the meter indicates your desired high set-point.

Push the set-point switch to the right and hold in this position. Your "Lo" set-point is now being displayed on your incubator panel meter. Using the adjustment tool, rotate the "Lo" potentiometer until the meter indicates your desired low set-point.

2. Repeat above procedure for other half of monitor.
3. Do not set-points closer than necessary. For temperature, try to avoid setting closer than 0.5°C to operating temperature. For CO₂, try to avoid setting closer than 0.5% to operating CO₂ percentage.
4. If a fault condition occur's recheck set-points by pushing set-point switches to both "Hi" and "Lo" positions, while observing incubator panel meter(s).

NOTE:

The "Hi" set-points must be above ther incubator operating point. The "Lo" set-points must be below the incubator operating point.

Audio Indicator Switch:

1. Place switch in "On" position if you desire the audio indicator to sound when there is a fault condition.
2. Place switch in "Off" position to disconnect audio portion of monitor.

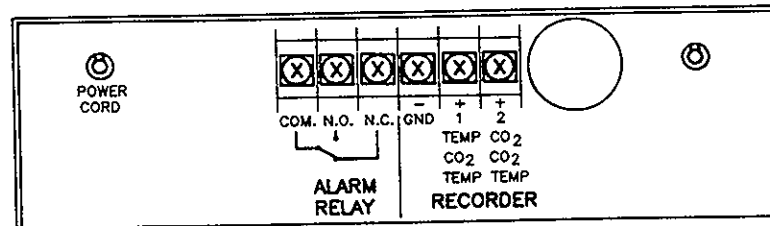
External Monitor Switch: (for use by central monitoring system)

1. Place switch in "On" position if you desire that the central monitoring system indicates when there is a fault condition.
2. Place switch in "Off" position if you do not want central monitoring system to indicate fault conditions. This is sometimes used during working hours when personnel are using lab.

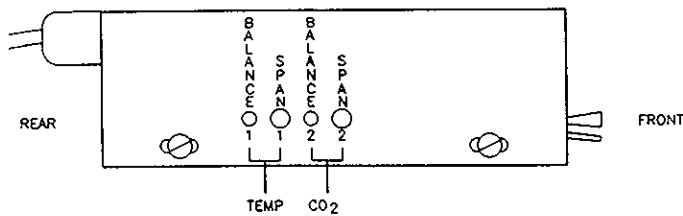
Conditions which will activate monitor:

1. When any monitor set-point is exceeded; after 3-5 minute delay.
2. If monitor cord to incubator is accidentally disconnected, monitor will be activated after a 3-5 minute delay.
3. If power to incubator is lost, monitor will be activated after 3-5 minute delay.
4. If power to the monitor is lost and external monitor switch is in "On" position, your central monitoring system will indicate a fault condition immediately.

Output connections: (see illustration of output terminal block below).



Recorder Output Adjustments (located on left side of alarm)



1. Monitor relay connections: This was designed to be used by a central alarm (monitoring) system. If you desire "normally open" relay contact connections, connect central alarm to #1 "Com" and #2 "N.O.". If you desire "normally closed" relay contact connections, connect central alarm to #1 "Com" and #3 "N.C.".

2. Recorder outputs: Your TCA incubator monitor is equipped with recorder output circuitry. You will have DC voltage outputs available between terminal block connection #4 and #5 and between connection #4 and #6.

Temperature outputs are 0.25V to 0.55V for 25°C to 55°C. CO₂ outputs are 0.0V to 1.0V for 0% CO₂ to 10% CO₂. These outputs can be modified if desired by internal adjustments. (Consult factory).

Recorder output adjustments: (located on left side of monitor).

1. Span Adjustments have been calibrated at factory. Do not adjust. Consult factory if you feel you have a problem with the span (gain) settings.

2. Balance adjustments are used to shift the recorder output voltages up or down over a narrow range. There are separate balance adjustment potentiometers for each output, see above illustration. Turn proper balance potentiometer clockwise to shift output voltage lower, turn C.C.W. to shift output voltage higher.

Recorder output voltages for temperature are 0.25 volts at 25°C to 0.55 volts at 55°C. CO₂ output voltages are 0.0 volts at 0.0% CO₂ to 1.0 volts at 10% CO₂.

To attain the most accuracy, adjust associated balance potentiometers at incubator operating levels. **EXAMPLE:** At 37.0°C and 5.0% CO₂ indication on incubator panel meters, adjust associated balance potentiometers until output voltage for temperature is 0.370 volts and 0.500 volts for CO₂ output. Use supplied screwdriver or jewelers screwdriver to make adjustments.

NOTE:

If monitor must be disconnected from incubator, install shorting plug in 9-pin connector in back of incubator. The shorting plug is permanently attached to the rear of the incubator by a chain.

Warranty

PRECISION SCIENTIFIC warrants its products against defects in material or in workmanship when used under appropriate conditions and in accordance with appropriate operating instructions for a period of no less than one (1) year from the date of delivery of the products.

The sole obligation of **PRECISION SCIENTIFIC** shall be to repair or replace at our option, FOB factory or locally, without charge, any part(s) that prove defective within the warranty period, provided that the customer notifies **PRECISION SCIENTIFIC** promptly and in writing of any such defect. Compensation for labor by other than **PRECISION SCIENTIFIC** employees will not be our obligation. Part(s) replacement does not constitute an extension of the original warranty period.

PRECISION SCIENTIFIC makes no warranty of merchantability, fitness for a particular purpose, or any other warranty, express or implied, as to the design, sale, installation, or use of its products, and shall not be liable for consequential damages resulting from the use of its products.

PRECISION SCIENTIFIC will not assume responsibility for unauthorized repairs or failure as a result of unauthorized repairs, replacement, or modifications made negligently or otherwise improperly made or performed by persons other than **PRECISION SCIENTIFIC** employees or authorized representatives.

While our personnel are available to advise customers concerning general application of all manufactured products, oral representations are not warranties with respect to particular application and should not be relied upon if inconsistent with product specification or the terms stated herein.

In any event, the terms and conditions continued in **PRECISION SCIENTIFIC, INC.**, formal sales contracts shall be controlling; and any changes must be in writing and signed by an authorized executive of **PRECISION SCIENTIFIC, INC.**

All defective components will be replaced without charge for one (1) year from the date of delivery. There will be no charge for labor if the apparatus is returned to the factory prepaid.

Conditions and qualifications of the warranty statement shall prevail at all times.