Laboratory Equipment Pty Ltd

INSTRUCTION MANUAL FOR LABEC AIR JACKET INCUBATORS

Laboratory Equipment Pty Ltd
"Proudly Australian Owned and Operated."
26 Farr Street, Marrickville NSW 2204
Phone +61 02 95602811 Fax +61 02 95606131
www.labec.com.au

Introduction
Congratulations on the choice of a Labec quality product. Labec products are manufactured, tested and calibrated to meet published standard specifications under our strict quality assurance guidelines.

This Instruction Manual is for the guidance of operators of Labec Incubators and should be read before the incubator is connected to the electricity supply.

It is hoped that this manual will supply all the information that the customer should require for satisfactory operation of the incubator. If, however, there are any questions that remain unanswered then the customer should contact our Service Department.

Unpacking
Remove all packing and protective wrapping from both the interior and exterior of the incubator. Check the incubator for possible transit damage. Ensure all ordered accessories are present. If any physical damage or shortage is evident, do not discard the packaging material until the incubator is inspected by the distributor, agent or manufacturer.

NOTE: All claims for shortage or damage must be made within fourteen days (14) from delivery.

Subject to our standard published conditions of sale, we have reasonable grounds to believe that we have ensured, so far as is reasonably practical, that the products listed in our catalog and brochures have been designed and constructed so as to be safe and without risk to health when properly installed and used in their environment by appropriate and trained personnel, and where applicable, in accordance with our published instructions.

Installation
Electrical
This equipment must be tagged and tested according to AS/NZS3760:2010 prior to use and thereafter on a regular basis dependent upon the environment.

It is preferable to locate the incubator close to a powerpoint and recommend that double adaptors are not used. Check the total wattage if connecting to multi point outlets. Check the rating plate for power requirements. Installation is to be carried out by a qualified electrician in accordance with the power requirements of the product specifications.

Location
Select a location free from draughts and away from direct sunlight or other heat sources.

Heating
Heating of the incubator is by means of elements located in the air duct or surrounding the working chamber bonded to the chamber walls.

Operation
Connect the chamber to an alternating current supply of voltage as specified on the rating plate mounted on the side or rear of the chamber.

DANGER: THIS INCUBATOR MUST NOT BE CONNECTED TO DIRECT CURRENT SUPPLY

Switch on the mains and check to see that the controller is illuminated. An indicating lamp on the controller will illuminate when the heaters are operating. Set the desired temperature using the up

and down arrow keys on the controller face panel.

Final adjustment of the temperature controller may be required after the chamber has reached operating temperature and this should be checked with a suitable thermometer located in the chamber (A thermometer is not supplied with the chamber).

Safety Controller
The incubator is fitted with an overheat safety thermostat. It must be set to slightly above the desired set point temperature and will prevent overheating. It will maintain the temperature you set on the thermostat. Set the thermostat by turning to full and allowing the chamber to stabilize at the desired set temperature. Then slowly turn the dial anticlockwise until the power to the heaters turns off (thermostat will click on and off as you pass the chamber temperature), note the temperature on the thermostat at this point. Then turn the dial clockwise again to switch the power back on. Turn the dial anticlockwise again until it is slightly above the temperature at which point you noted the chamber switched off. This is now set around 5°C above the desired set point and will switch off all power to the elements should the incubator reach this temperature.

Caution
Please observe the following safety measures before using your LABEC equipment.

- These incubators are **NOT FLAME PROOF** and under no circumstances should inflammable, combustible or explosive material be placed in the incubator.
- Low ignition temperature materials and those materials which give off inflammable or explosive vapors should not be placed in the incubator.
- Avoid heating substances which give off corrosive vapor.
- Users are advised of the dangers of heating combustible materials. The manufacturer can recommend special types of elements which will prohibit the incubator's temperature reaching known ignition points.
- Observe those rules pertaining to wiring and installation of electrical appliances as recommended by the local supply authority.

WARNING
It is detrimental for any of the substances listed below to be inside this equipment. The interior of the incubator may be damaged if exposed to any of them. Corrosion of the stainless steel and other surfaces will be directly attributable to the presence of one or more of these substances and will not be a defect or failure for which the manufacturer will accept responsibility.

ORGANIC SUBSTANCES	**SALT**	**ACIDS**	**MISCELLANEOUS**
ALKAFORM	AMMONIUM BROMIDE	ACETIC	BROMIDE
ANAESTHESIA	AMMONIUM CHLORIDE	BORIC	CHLORINE
CARBON	CALCIUM CHLORIDE	CARBOLIC (PHENOL)	FLUORINE
TETRACHLORIDE	CALCIUM HYPOCHLORITE	CHROMIC	IODINE
FORMALDEHYDE	FERRIC CHLORIDE	HYDROCYAIC	SULPHUR DIOXIDE
LYSOL (CRESOLS ETC)	HYDROGEN PEROXIDE	NITRIC	
TRICHLORETHYLENE	MAGNESIUM CHLORIDE	OXALIC	

	MERCURIC CHLORIDE	HYDROCHLORIC	
	POTASSIUM CHLORIDE	PHOSPORIC	
	POTASSIUM HYPOCHLORITE	SULPHURIC	
	POTASSIUM HYPOCHLORITE	SULPHUROUS	
	SODIUM CHLORIDE	TARTARIC	
	SODIUM HYPOCHLORITE		

Safety Information
Isolate the incubator from the electrical supply before changing elements or thermocouples or undertaking other routine maintenance. Ensure that the incubator is cold.

When reconnecting the incubator, ensure that the electrical connections are sound including earth supply continuity.

Wear appropriate safety clothing when operating the incubator including a heat resistant face shield (tinted for eye protection), gloves and apron.

Load and unload "hot" work with incubator tongs.

Do NOT use the incubator in the presence of inflammable or combustible chemicals fire or explosion may result.

To avoid fire, do not expose combustible materials to heat from the open incubator door.

Trouble Shooting

SYMPTOM	**REMEDY**
No Power (Indicator Light is off)	1. Check the incubator is plugged in and power switched on. 2. Ensure the mains power supply point is functioning by using a test appliance on the power socket. 3. Check internal RCD has not tripped.
Failure to heat or maintain temperature (Indicator light is on)	1. Ensure the temperature controller set point is above ambient. 2. Check the safety controller fitted is above the main controller setting.

If the fault cannot be found, call your distributor or the manufacturer quoting the serial number of the unit from the manufacturer's label.

Maintenance
The cabinet is finished with stainless steel and to maintain appearance should be wiped over with a cloth and non abrasive cleanser. The chamber is manufactured from stainless steel and may be cleaned with a cloth and non abrasive cleanser. If the chamber is grained stainless steel, a stainless steel scratch pad may be used. The pad should be rubbed in the same direction as the grain pattern of the stainless steel.

Some incubators are fitted with a fan motor with sealed and pre-lubricated bearings which should not require maintenance for some time depending upon the extent of usage. The shelves are manufactured from stainless steel and a cloth and non abrasive cleanser should be used. The door gasket should be cleaned with detergent only, ensuring it is dried completely after washing.

Safety Note Insulation
This incubator contains refractory fibers in its thermal insulation. The materials used may be in the form of fiber blanket or felt, vacuum formed board or shapes, mineral wool slab or loose fill fiber. Normal use of the incubator will not result in any significant level of airborne dust from these materials but much higher levels may be encountered in maintenance or repair.

Whilst there is no evidence of any long-term health hazards, we strongly recommend that safety precautions are taken whenever the materials are handled.

Exposure to dust from fiber which has been used at high temperature may cause respiratory disease.

When handling fiber always use an approved mask, eye protection, gloves and long sleeved clothing.

After handling, rinse exposed skin with water and wash work clothing separately.

Before commencing any major repairs we recommend reference to:
- ECFIA Bulletin Number 11
- Guidance Note EH46 (UK Health and Safety Executive.)

We will be pleased to provide further information on request. Alternatively our Service Department will quote any repairs to be carried out at your premises or at our works.

Declaration of Conformity
Each product is thoroughly inspected and tested to not only ensure that it meets the specifications provided, but to also meet Australian Electrical Standard AS3820 and EMC Standard AS/NZ1044:1995,and therefore being accredited with a C Tick label.

Appendix A

Eurotherm Controllers 3216, 2416 and 2404 Instructions

General
The control panel is fitted with two controls: an ON/OFF SWITCH, and a TEMPERATURE CONTROLLER.

On/Off Switch
The On/Off switch isolates mains power to the temperature controller and to the solid state relay. If access to electrical connections inside the equipment is required, ensure that the electrical power is switched
off where the equipment is connected to the main supply.

Temperature Controller
The Eurotherm microprocessor temperature controller has the facility for a single ramping rate and then hold function. To set up a full program in °C/seconds/minutes/hours you must purchase the fully programmable optioned controller.

Indicator and Button Functions
The Eurotherm controller has the following buttons and indicators:

Indicator or button	Name	Function
OP1	Output 1	When lit, this indicates that the element output is on.
ALM	Alarm 4	When lit, this indicates that an alarm condition exists.
	Page button	Press to select a new list of parameters.
	Scroll button	Press to select a new parameter in a list.
	Down button	Press and release to view the set point or a selected parameter. Keep pressed to decrease the value.
	Up button	Press and release to view the set point or a selected parameter. Keep pressed to increase the value

Display
The display normally indicates actual temperature or parameter mnemonic and it will indicate set point temperature or parameter value when up or down keys are pressed.

Changing the Set Point (standard model)
Press the up and down arrows until the desired set point is displayed. Allow the controller to flash (store the value into memory). Nothing else is required to set or change the temperature.
If a non programmable controller is fitted now set the safety thermostat or set Alarm point (AL4) if required.

Changing the Set Point, Ramp Rate and Hold Timer (if programmable model is fitted)
The temperature controller's normal display shows the actual temperature. The set point can be changed using the Λ or V buttons and the equipment will hold at that temperature.

Pressing the scroll button once changes the display to **oP** or % output power.
Pressing the scroll button again changes the display to **Sprr** or set point ramp rate and can be set to either OFF or from 1 to 60°C/min
Pressing the scroll button again changes the display to **dwEll** or set point hold time and can be set to either off or 999.9 minutes.
Pressing the scroll button again changes the display to **StAt** or program status and can be set to **on** or **off**. In the on status, the dwell timer will function, in the off status the controller ignores the dwell setting. The status will change to off automatically when the dwell period ends.

Autotune List (only perform if fault found or recalibrating)
Pressing the Page key once changes the display to the Autotune list **Atun**.
Pressing the Scroll key changes the display to **tune** or tune function selection. Auto tune may now be selected using the /\ or \/ buttons.

PID List
Pressing the Page key again changes the display to the PID List **PID**.

Pressing the Scroll key changes the display to **Pb**, **ti**, **td**, **Hcb**, and **Lcb**. The values for these may be accessed and changed using the /\ or \/ buttons. A full description of their meanings is in the Tuning section.

Operating the Equipment
When the equipment is first turned on the controller will carry out self checks and then start controlling at the set point value.

Set the parameters detailed in the manual.

To reset the controller after dwell end (**End**) or other alarm press the PAGE and SCROLL keys simultaneously. If a ramp dwell program is to be run again set status back to **on**.

When running the equipment at a new temperature that varies more than about 25% from the previous temperature it may be necessary to run the auto tuning program to reset the PID parameters. **The equipment will overshoot the set point when running the autotune program especially at low temperatures.**

Error Messages

Alarm	What it means	What to do about it
FSH1	*Full Scale High Alarm:* The equipment measured temperature has exceeded the equipment maximum temperature.	This fault may be caused by a faulty solid state relay or by exothermic reaction of the equipment load. Reset the alarm by pressing the Page and Scroll buttons simultaneously and check the operation of the solid state relay.
EE.Er	*Electrically Erasable Memory Error:* The value of an operator or configuration parameter has been corrupted.	This fault will automatically take you into configuration level. Check all of the configuration parameters before returning to operator level. Once in operator level, check all of the operator parameters before resuming normal operation. If the fault persists or occurs frequently, contact Laboratory Equipment Pty

		Ltd.
S.br	*Sensor Break:* Input sensor is unreliable or the input signal is out of range.	Check that the sensor is correctly connected.
L.br	*Loop Break:* The feedback loop is open circuit.	Check that the heating and cooling circuits are working properly.
Ld.f	*Heater circuit fault:* Indication that the power controller device has detected a fault in the heating circuit.	Check the functioning of the power control device and heating circuit. (E.g. fuse failure).
LLLL	*Out of range low reading*	Check the value of the input
HHHH	*Out of range high reading*	Check the value of the input
Err1	*Error 1:* ROM selftest fail	Return the controller for repair
Err2	*Error 2:* RAM selftest fail	Return the controller for repair
Err3	*Error 3:* Watchdog fail	Return the controller for repair
Err4	*Error 4: Keyboard failure* Stuck button or a button was pressed during power up.	Switch the power off and then on without touching any of the controller buttons.

Tuning

In tuning, you match the characteristics of the controller to those of the process being controlled in order to obtain good control. Good control means:

- Stable, ‘straightline’ control of the temperature at set point without fluctuation.
- No overshoot, or undershoot, of the temperature set point.
- Quick response to deviations from the set point caused by external disturbances, thereby rapidly restoring the temperature to the set point value.

Tuning involves calculating and setting the value of the parameters listed in Table 41. These parameters appear in the ‘Pid’ list.

Table 41 Tuning parameters

Parameter	Code	Meaning or Function
Proportional band	Pb	The bandwidth, in display units, over which the output power is proportioned between minimum and maximum.
Integral time	ti	Determines the time taken by the controller to remove steady state error signals.
Derivative time	td	Determines how strongly the controller will react to the rate of change of the measured value.

High Cutback	Hcb	The number of display units, above set point, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low cutback	Lcb	The number of display units, below the set point, at which the controller will cut back the output power, in order to prevent overshoot on heat up.
Relative cool gain	rEL	Only present if cooling has been configured and a module is fitted. Sets the cooling proportional band: divide the Pb value by the rEL value.

AUTOMATIC TUNING

TWO AUTOMATIC TUNING PROCEDURES ARE PROVIDED IN THE 2408 AND 2404: ● A one shot tuner, which automatically sets up the initial values of the parameters listed in Table 41 on the previous page.

● **Adaptive tuning,** which continuously monitors the error from set point and modifies the PID values, if necessary.

Oneshot Tuning

The 'oneshot' tuner works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

If the process cannot tolerate full heating or cooling being applied during tuning, then the level of heating or cooling can be restricted by setting the heating and cooling power limits in the 'oP' list. However, the measured value *must* oscillate to some degree for the tuner to be able to calculate values.

A Oneshot Tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), you can retune again for the new conditions.

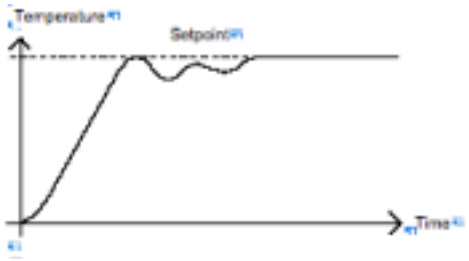
It is best to start tuning with the process at ambient temperature. This allows the tuner to calculate more accurately the low cutback and high cutback values which restrict the amount of overshoot, or undershoot.

How to tune

1. Set the set point to the value at which you will normally operate the process. 2. In the 'Atun' list, select 'tunE' and set it to 'on'.
3. Press the Page and Scroll buttons together to return to the Home display. The display will flash 'tunE' to indicate that tuning is in progress.
4. The controller induces an oscillation in the temperature by first turning the heating on, and then off. The first cycle is not complete until the measured value has reached the required set point.
5. After two cycles of oscillation the tuning is completed and the tuner switches itself off.
6. The controller then calculates the tuning parameters listed in Table 41 and resumes normal control action.

If you want 'Proportional only', 'PD', or 'PI' control, you should set the 'ti' or 'td' parameters to OFF before commencing the tuning cycle. The tuner will leave them off and will not calculate a value for them.

Typical automatic tuning cycle



Calculation of the cutback values

Low cutback and *High cutback* are values that restrict the amount of overshoot, or undershoot, that occurs during large step changes in temperature (for example, under start-up conditions). If either low cutback, or high cutback, is set to 'Auto' the values are fixed at three times the proportional band, and are not changed during automatic tuning.

Adaptive tune

Adaptive tuning is a background algorithm, which continuously monitors the error from set point and analyzes the control response during process disturbances. If the algorithm recognises an oscillatory, or underdamped response, it recalculates the Pb, ti and td values. Adaptive tune is triggered whenever the error from set point exceeds a trigger level. This trigger level is set in the parameter 'drA.t', which is found in the Auto tune list. The value is in display units. It is automatically set by the controller, but can also be manually readjusted.

Adaptive tune should be used with:

1. Processes whose characteristics change as a result of changes in the load, or set point. 2. Processes that cannot tolerate the oscillation induced by a Oneshot tune.

Adaptive tune should not be used:

1. Where the process is subjected to regular external disturbances that could mislead the adaptive tuner.
2. On highly interactive multi loop applications. However, moderately interactive loops, such as multizone extruders, should not give a problem.

MANUAL TUNING

If for any reason automatic tuning gives unsatisfactory results, you can tune the controller manually. There are a number of standard methods for manual tuning. The one described here is the ZieglerNichols method.

With the process at its normal running temperature:

- Set the Integral Time 'ti' and the Derivative Time 'td' to OFF.
- Set High Cutback and Low Cutback, 'Hcb' and 'Lcb', to 'Auto'.
- Ignore the fact that the temperature may not settle precisely at the set point. If the temperature is stable, reduce the proportional band 'Pb' so that the temperature just starts to oscillate. If the temperature is already oscillating, increase the proportional band until it just stops oscillating. Allow enough time between each adjustment for the loop to stabilize. Make a note of the proportional band value 'B' and the period of oscillation 'T'.
- Set the Pb, ti, td parameter values according to the calculations given in Table 42.

Table 42 Tuning values

Type of control	Proportional band ‘Pb’	Integral time ‘ti’	Derivative time ‘td’
Proportional only	2xB	OFF	OFF
P + I control	2.2xB	0.8xT	OFF
P + I + D control	1.7xB	0.5xT	0.12xT

Setting the cutback values

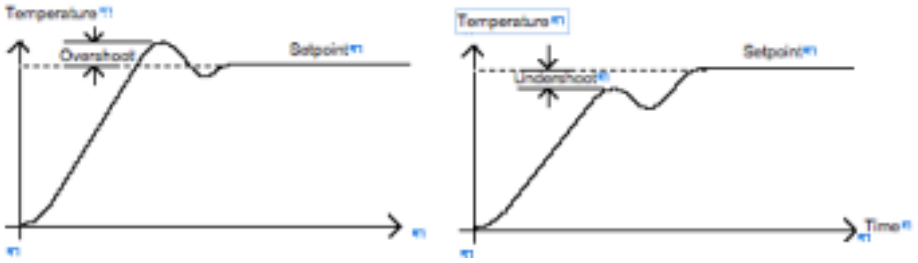
The above procedure sets up the parameters for optimum steady state control. If unacceptable levels of overshoot or undershoot occur during start-up, or for large step changes in temperature, then manually set the cutback parameters ‘Lcb’ and ‘Hcb’.

Proceed as follows:

1. Set the low and high cutback values to three proportional bandwidths (that is to say, Lcb = Hcb = 3 x Pb).
2. Note the level of overshoot, or undershoot, that occurs for large temperature changes (see the diagrams below).

In example (a) increase ‘Lcb’ by the overshoot value. In example (b) reduce ‘Lcb’ by the undershoot value.

Example (a) **Example (b)**



Where the temperature approaches the set point from above, you can set ‘Hcb’ in a similar manner.

Integral action and manual reset

In a full three term controller (that is, a PID controller), the integral term ‘ti’ automatically removes steady state errors from the set point. If the controller is set up to work in two term mode (that is, PD mode), the integral term will be set to ‘OFF’. Under these conditions the measured value may not settle precisely at a set point. When the integral term is set to ‘OFF’ the parameter *manual reset* (code ‘rES’) appears in the ‘Pid LiSt’ in ‘FuLL’ level. This parameter represents the value of the power output that will be delivered when the error is zero. You must set this value manually in order to remove the steady state error.

Automatic droop compensation (Adc)

The steady state error from the set point, which occurs when the integral term is set to ‘OFF’ is sometimes referred to as ‘droop’. ‘Adc’ automatically calculates the manual reset value in order to remove this droop. To use this facility, you must first allow the temperature to stabilize. Then, in the auto tune parameter list, you must set ‘Adc’ to ‘on’. The controller will then calculate a new value

for manual reset, and switch ‘Adc’ to ‘OFF’. ‘Adc’ can be repeated as often as you require, but between each adjustment you must allow time for the temperature to stabilize.

Safety Thermostat (if fitted)
The chamber is fitted with an overheat safety protection thermostat. It must be set to slightly above the desired set point temperature and will prevent overheating. It will maintain the set value only and will not switch off the chamber. Change the thermostat value to slightly above the set point temperature once the temperature has stabilized at the set value on the controller, then turn back the thermostat until it “clicks” at this point it will switch off the heaters. Turn it clockwise again until it “clicks” on again and then continues turning so it is around 5°C above the set value on the controller. The safety thermostat is now set to turn off the heaters should it overheat. Setting the thermostat simply by using the numbers on the dial may cause the thermostat to interfere with the operation of the chamber. To be sure, set it using the “click” method outlined above.

Eurotherm Controller Instructions for Manual Calibration

Indicator and Button Functions
The Eurotherm controller has the following buttons and indicators:

Indicator or button	Name	Function
	Page button	Press to select a new list of parameters. (Left most key)
	Scroll button	Press to select a new parameter in a list.(2nd key from left)
	Down button	Press and release to view the set point or a selected parameter. Keep pressed to decrease the value.
	Up button	Press and release to view the set point or a selected parameter. Keep pressed to increase the value

1. Press and hold in the Menu (left most key) until LVL3 appears on the screen.
2. The controller will then ask for the COD (password) enter 3 using the up arrow.
3. If successful push Menu once to display INPUT.
4. Press (not hold) the Scroll buttons (2nd key from left) until it displays PV.OFS. Change this value using up and down keys only to calibrate the temperature on your external logger.
5. Then press the Menu key until ACCES is displayed. Press the Scroll button once to display LVL3 and GOTO. Use the down arrow to change to LVL1.
6. Controller will flash and return to the main user screen.