

**Spinline**

# **OPERATION MANUAL**

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p/n 30900

**DACA**  
instruments

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# WARNINGS



High operating temperatures and moving parts of DACA Instruments' processing instruments are potentially dangerous; therefore the user should observe the following safety precautions and be aware of the possible dangers at all times.

**OPERATOR SAFETY** Users who are to install and operate the equipment should study this Operation Manual and all referenced documentation prior to installation and/or operation of the equipment. Carefully read installation instructions and operating instructions; observe all WARNINGS and CAUTIONS.

Ensure that the equipment setup and the actual use does not present a hazard to personnel. Common sense and good judgment are the best safety precautions.

**GENERAL SAFETY** The following statements apply to all users of DACA Instruments' processing instruments.

## **1. HIGH SPEEDS AND FORCES**

Be aware at all times of moving components which are potentially dangerous due to high speeds and forces. Do not permit anyone to operate a processing system who is unaware of its function or unskilled in its use.

## **2. SUPPLY VOLTAGES EXCEEDING 50V**

DACA Instruments designs do not permit the operator to be exposed to voltages exceeding 50V under normal operation of the instrument. However, if any covers are removed from the instrument, all safety precautions should be strictly observed when carrying out servicing procedures. Also, always disconnect the instrument from the main power source whenever performing any service including checking or changing fuses.

## **3. ROTATING MACHINERY**

The source of power for rotating machinery is electrical. Always disconnect the test instrument or equipment from the power source before removing any cover which gives access to rotating machinery, (e.g., belts, gears, screws or shafts).

## **4. HIGH TEMPERATURE COMPONENTS**

It is essential to display a WARNING notice concerning high temperature operation whenever high temperature equipment is in use; always use special handling gear and protective clothing under these conditions. High temperature refers to all equipment with a temperature exceeding 60°C (165°F). Note that the hazard from high temperature can extend beyond the immediate area of the instrument.

## **5. HIGH PRESSURE COMPRESSED AIR**

The Piston Extruder uses compressed air for cooling. High pressure compressed air is potentially dangerous. Always follow the operating instructions. Before releasing a air connection, disconnect the air supply and reduce to zero any system pressure and stored pressure.

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# INTRODUCTION

## **GENERAL DESCRIPTION**

### **SPINLINE**

The SpinLine is a multipurpose tool designed to process small quantities of polymer fibers in a precise and controlled way. The equipment employs computer controlled supply and take up rolls, heating elements, and winders, to accurately control fiber drawing speed, draw ratio, and processing temperature. This equipment is designed to be used in conjunction with the Piston Extruder to serve as a small fiber production facility.

### **HIGH-PRESSURE PISTON EXTRUDER**

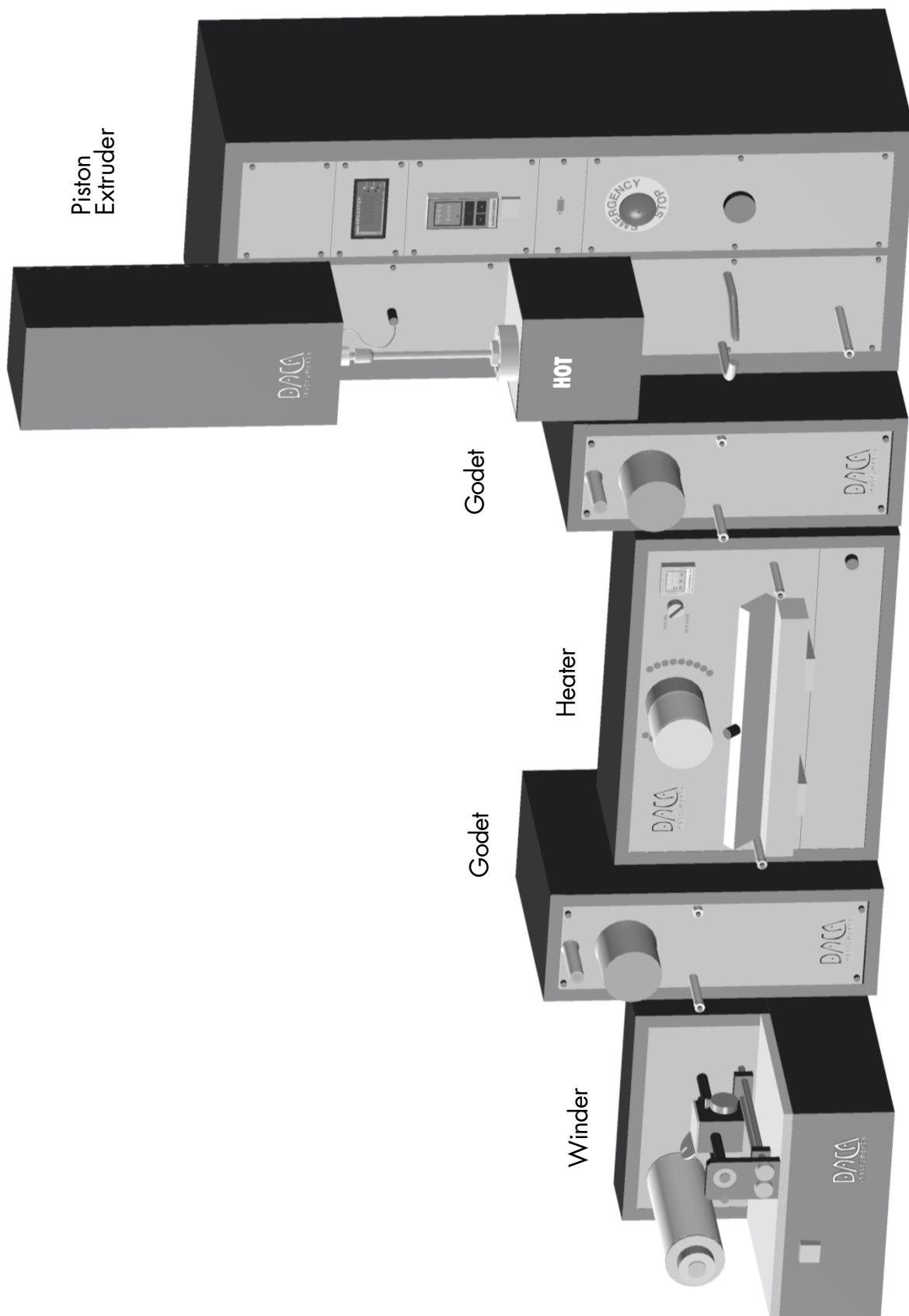
This instrument is a computer controlled, piston-driven extruder for polymer melts, polymer solutions, or more generally, any kind of highly viscous fluid. The apparatus is particularly useful for the production of miniature size samples of fibers, without the need for optimization of continuous extrusion parameters.

# SPECIFICATIONS

	Piston Extruder	Godet	Winder	Heater
Electrical Volts Amps Freq. (Hz) Phase	120 220 10 7 50/60 1	120 220 5 3 50/60 1	120 220 5 3 50/60 1	120 220 5 3 50/60 1
Motor Torque Nm oz.in.	2.8 400	7.1 1000	2.14 300	—
Gear Reduction	15:1	—	—	—
Temp. Controller	Eurotherm 94 Digital AutoTune PID, Closed loop			Eurotherm 91c Digital AutoTune PID, Closed loop
Thermocouple	K Type	—	—	Pin: K Type Shoe: K Type
Heater	2x350W	—	—	Pin: 225W Shoe: 150W
Physical Dimensions cm inches	W x D x H 39 51 123 15.5 20 48.5	W x D x H 19 43 48 7.5 17 19	W x D x H 35.5 38 34 14 15 13.5	W x D x H 53 33 38 21 13 15
Weight Kg lb	70 154.3	30 66	24 53	18 40
Other Sensors	Load Sensor 5000 N Limit Alarm	—	—	—



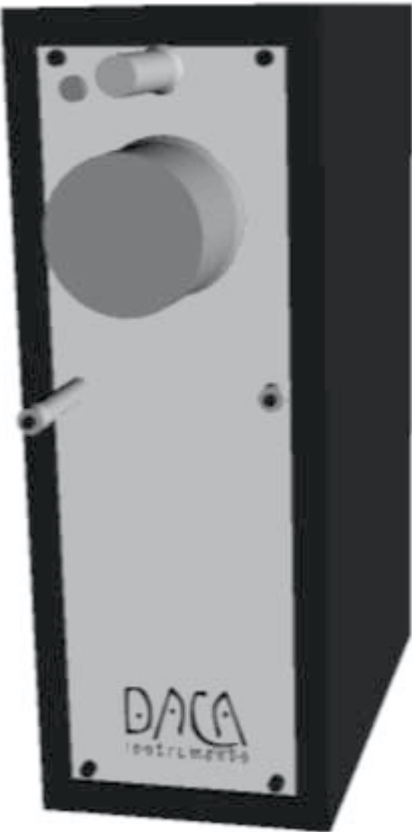
# ILLUSTRATION OF COMPLETE SYSTEM IN STANDARD CONFIGURATION



# ILLUSTRATION OF PISTON EXTRUDER



**ILLUSTRATION OF GODET**



**ILLUSTRATION OF WINDER**



# ILLUSTRATION OF FIBER HEATER



# INSTALLATION

## UNPACKING

### SHIPMENT DAMAGE

Merchandise shipped is carefully packed in compliance with carrier requirements. Claims for loss or damage in transit must be made with the carrier by the customer. All shipments should be unpacked and inspected immediately upon receipt. If damage is concealed and does not become apparent until shipment is unpacked, the customer must make a request for inspection by the carrier's agent and file a claim with the carrier. Any external evidence of loss or damage must be noted on the freight bill or carrier's receipt and signed by the carrier's agent. Failure to do this will result in the carrier refusing to honor the claim. For the customer's protection, DACA Instruments' billings include insurance for damage or loss in transit.

The SpinLine is shipped in two crates

Crate 1 should contain the following items:

- 1 Piston Extruder
  - 1 Controller
  - 1 Bag containing
    - 5 power cords
    - 3 interconnect data cables
    - Cleaning brush, cleaning tool, charging tool
    - A piece of cotton fabric for the cleaning tool
    - Set of English Hex wrenches
    - Set of Metric Hex wrenches
    - Open end wrench for top of barrel
    - Funnel to load the barrel
  - 1 Bag with 10 spools for the winder
  - 1 Small plastic box containing:
    - Additional O-rings for the barrel
    - Additional O-rings for the piston
    - Extra spinnerets if ordered
  - 1 Bag containing:
    - This Manual
    - Registration Card
- Any other optional accessories ordered

Crate 2 should contain the following items:

- 2 Godets
- 1 Heater module
- 1 Winder

If any of these items is missing, please contact DACA Instruments immediately so that we may ship replacements.

## INSTALLATION

### LOCATION

The SpinLine should be set up on a leveled, sturdy table or bench. The SpinLine is a modular system that can take a significant amount of bench space depending on how it is configured. The table should be well supported to accommodate the weight of the complete system (172 Kg/380 lb).

### ELECTRICAL

The SpinLine modules require electrical connections. The modules operate with 120 or 220VAC, 50/60Hz, 3-10Amp, single phase. For proper operations outside the U.S., the plug on the power cord might have to be replaced with a different one. Consult your local electrical code for the appropriate cable and plug.

## OPERATOR INTERFACE

A separate control console is provided. The unit connects to the front of the piston extruder with the cable provided.

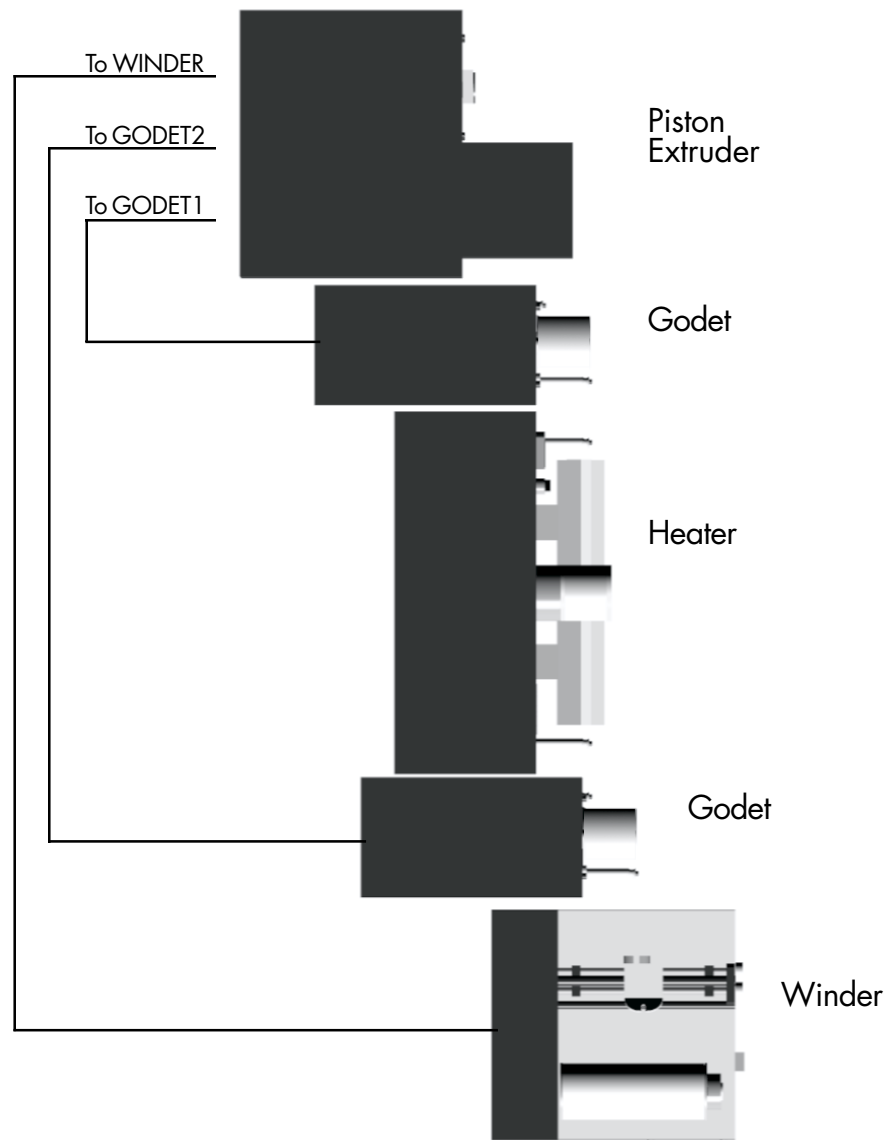
## INTERCONNECT DATA CABLES

Three data cables are provided to connect the Godets and Winder module to the Piston Extruder. The cables are interchangeable. The connectors on the back of the extruder are labeled to indicate the proper connection. It is important that the Godet which receives the fibers from the extruder be connected to the GODET1 port. The Godet placed before the winder must be connected to the GODET2 port (see diagram below).

## COOLING AIR SUPPLY

A fixture is provided on the back of the Piston Extruder to connect a compressed air line used for cooling the fiber as it comes out of the extruder. The normal operating pressure should be 2.8 BAR (40 PSIG) or less. Lower pressures provide better flow control of the air. Excessive pressure will cause damage to the gas lines inside the instrument.

## TOP VIEW SHOWING THE DATA CABLE CONNECTIONS AND THE OVERALL ALIGNMENT OF THE COMPONENTS



# OPERATION

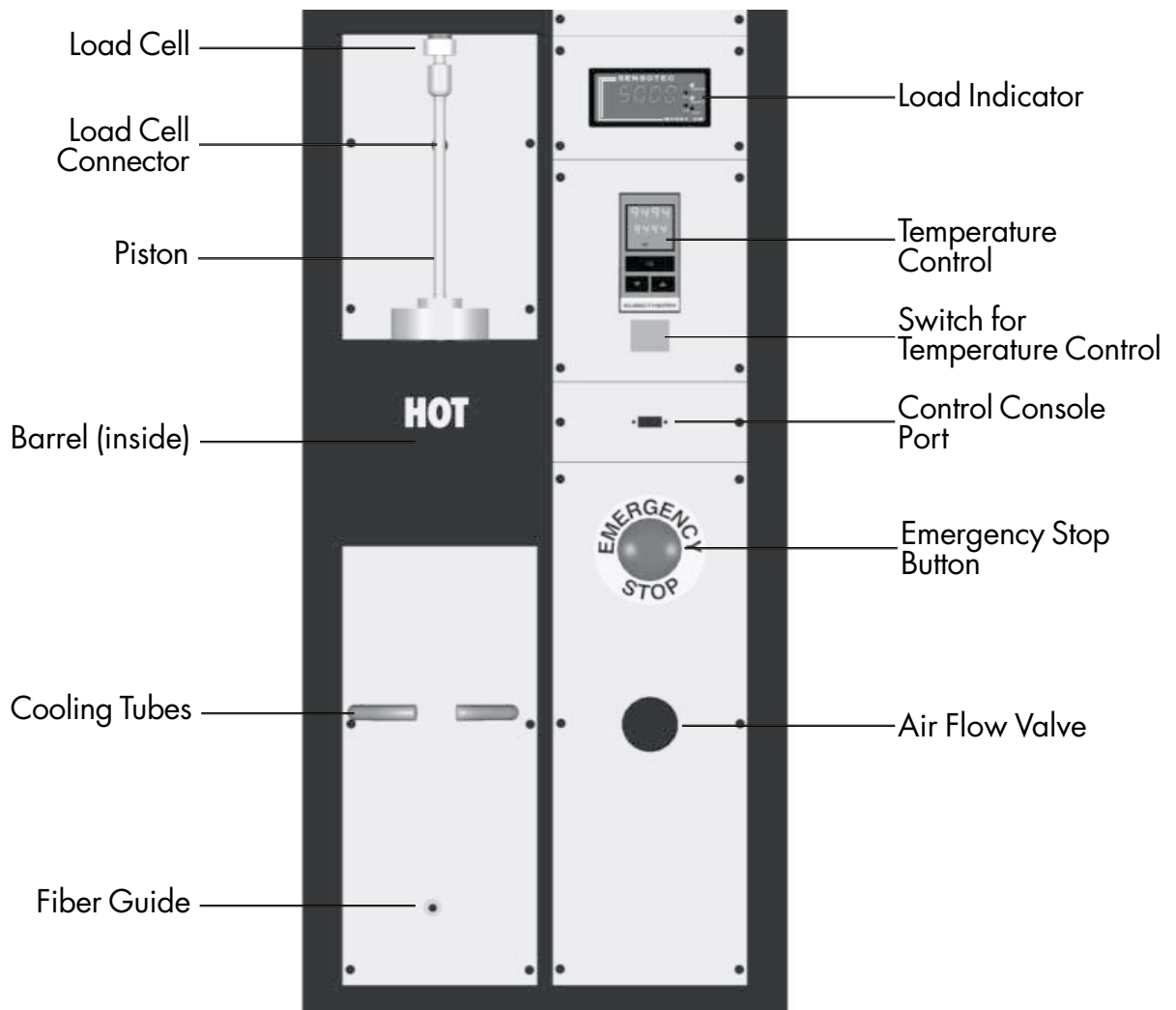
## PISTON EXTRUDER

The Piston Extruder is a batch extruder for polymers or high viscosity fluids. The instrument consists of a heated barrel and a computer controlled piston that pushes the molten polymer in the barrel through a small orifice (spinneret) at a very precisely controlled rate. The instrument can generate over 5000 N of force on the polymer to extrude it out of the spinneret. This unit is also the heart of the system since it contains the computer that also controls the Godets and the Winder. Consequently this unit must be turned ON even if only the Winder is going to be used.

### SET UP

The Piston Extruder requires only a connection to electrical power and a connection to high pressure air (< 2.8 BAR/40 psig) to supply air to the cooling Tubes. In addition the control console must be connected to the front panel connector in order to control the instrument. If the other components (Godets and Winder) will be used they must be connected to the back of the Piston Extruder using the data cables provided. These units should be turned ON before turning ON the Piston Extruder.

### COMPONENTS OF THE HIGH PRESSURE PISTON EXTRUDER

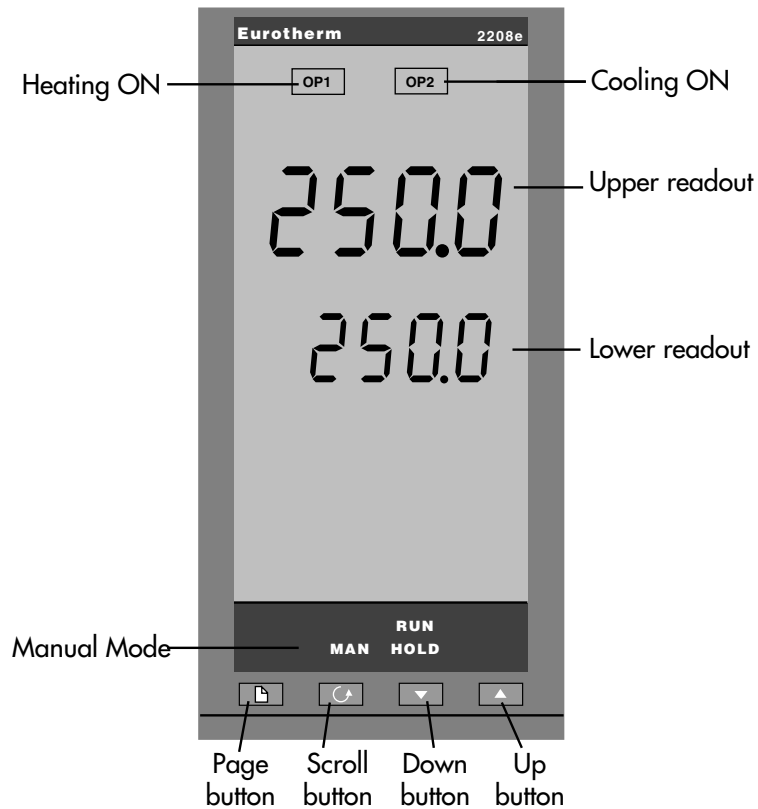


# TEMPERATURE CONTROL FOR EXTRUDER

Portions © EUROTHERM CONTROLS Inc.

## FRONT PANEL LAYOUT

Temperature of the barrel is controlled by a EUROTHERM model 2208 temperature controller.







Button or Indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that heating output is on.
OP2	Output 2	When lit, it indicates that cooling output is on.
REM	Remote Setpoint	When lit, this indicates that the PDS remote Setpoint input has been selected. 'REM' is also used to indicate that user comms is active.
MAN	Manual light	When lit, it indicates that manual mode has been selected
RUN	Run light	When lit, it indicates that Setpoint rate limit is active.
	Page button	Press to select a new list of parameters.
	Scroll button	Press to select a new parameter in a list.
	Down button	Press to decrease a value in the lower readout.
	Up button	Press to increase a value in lower readout.



Table T1. Controller buttons and indicators




Switch on the power to the controller. It runs through a self-test sequence for about three seconds and then shows the temperature, or process value, in the upper readout and the setpoint in the lower readout. This is called the Home display. It is the one that you will use most often.

## BASIC OPERATION


On this display you can adjust the setpoint by pressing the ▲ or ▼ buttons. Two seconds after releasing either button, the display blinks to show that the controller has accepted the new value.

**NOTE:** You can get back to the Home display at any time by pressing  and  together. Alternatively you will always be returned to the Home display if no button is pressed for 45 seconds, or whenever the power is turned on. If, however, a flashing alarm message is present the controller reverts to the Home display after 10 seconds.



### DISPLAY UNITS



A single press of the  button will flash the display units for 0.5 seconds, after which you will be returned to the **Home** display.

Flashing of the display units may have been disabled in configuration, in which case a single press will take you straight to the display shown below.

Press  twice to show the

### % OUTPUT POWER DEMAND

The % output power demand is displayed in the lower readout. This is a read-only value. You cannot adjust it. Press  and  together to return to the Home display.

Pressing  from the Output Power display may access further parameters if the access level of the controller has been changed (see Appendix B). When you reach the end of this scroll list, pressing  will return you to the Home display.



## ALARMS

If the controller detects an alarm condition, it flashes an alarm message in the Home display. For a list of all the alarm messages, their meaning and what to do about them, see *Alarms* at the end of this chapter.

### ALARM ANNUNCIATION

Alarms are flashed as messages in the Home display. A new alarm is displayed as a double flash followed by a pause, old (acknowledged) alarms as a single flash followed by a pause. If there is more than one alarm condition, the display cycles through all the relevant alarm messages. Table T-1 and Table T-2 list all of the possible alarm messages and their meanings.

### ALARM ACKNOWLEDGEMENT AND RESETTING

Pressing both  and  at the same time will acknowledge any new alarms and reset any latched alarms.

### ALARM MODES

Alarms have been set up to operate as:

- **Non-latching**, which means that the alarm will reset automatically when the Process Value is no longer in the alarm condition.

## ALARM TYPES

There are two types of alarm: Process alarms and Diagnostic alarms.

### PROCESS ALARMS

These warn that there is a problem with the process which the controller is trying to control.

Alarm Display*	What it means
_FSL	PV Full Scale Low alarm
_FSH	PV Full Scale High alarm
_DEV	PV Deviation Band alarm
_dHi	PV Deviation High alarm
_dLo	PV Deviation Low alarm
_LCr	Load Current Low alarm
_HCr	Load Current High alarm
tUEr	Tune Error. Press page and Re-tune

*\* In place of the dash, the first character will indicate the alarm number.*

Table T-2 Process alarms

### DIAGNOSTIC ALARMS

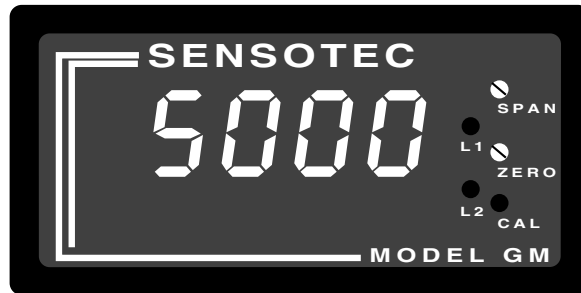
These indicate that a fault exists in either the controller or the connected devices. See following page.

Display shows	What it means	What to do about it
<i>EE.Er</i>	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 Eurotherm Controls.
<i>S.br</i>	Sensor Break: Input sensor is unreliable or the input signal is out of range.	Check that the sensor is correctly connected.
<i>L.br</i>	Loop Break The feedback loop is open	Check that the heating and cooling circuits are working properly.
<i>Ld.F</i>	Load failure Indication that there is a fault in the heating circuit or the solid state relay.	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO mode 1 It indicates either an open or short circuit SSR, blown fuse, missing supply or open circuit heater.
<i>SSr.F</i>	Solid state relay failure Indication that there is a fault in the solid state relay.	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO mode 2 It indicates either an open or short circuit condition in the SSR.
<i>Htr.F</i>	Heater failure Indication that there is a fault in heating circuit.	This is an alarm generated by feedback from a Eurotherm TE10S solid state relay (SSR) operating in PDSIO mode 2 It indicates a blown fuse, missing supply, or open circuit heater.
<i>Hw.Er</i>	Hardware error Indication that a module is of the wrong type, missing, or faulty.	Check that the correct modules are fitted.
<i>no.i0</i>	No I/O None of the expected I/O modules are fitted.	This error message normally occurs when pre-configuring a controller without installing any of the required I/O modules.
<i>rmE.F</i>	Remote input failure. Either the PDSIO input, or remote DC input, is open or short circuit	Check for open, or short circuit wiring on the PDSIO, or remote DC, input.
<i>LLLL</i>	Out of range low reading	Check the value of the input.
<i>HHHH</i>	Out of range high reading	Check the value of the input.
<i>Err1</i>	Error 1: ROM self-test fail	Return the controller for repair.
<i>Err2</i>	Error 2: RAM self-test fail	Return the controller for repair.
<i>Err3</i>	Error 3: Watchdog fail	Return the controller for repair.
<i>Err4</i>	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.
<i>Err5</i>	Error 5: Faulty internal communications.	Check printed circuit board interconnections. If the fault cannot be cleared, return the controller for repair.

Table T-3 Diagnostic alarms

## LOAD INDICATOR

The load sensor and indicator are provided to monitor the load that the piston applies on the polymer during extrusion. The load sensor also acts as a limit to prevent excessive loads from damaging the instrument. For a constant volume of material extruded, the load generated will be proportional to the viscosity of the material and to the extrusion speed, and inversely proportional to the spinneret diameter. This load is monitored using a load sensor placed above the piston on the lead screw and is displayed in the load indicator. The force is measured and displayed in Newtons and it has a range of 0–5000 N. The load sensor is also a safety device which monitors the process load and cuts power to the motor if the load exceeds 5000 N. The main purpose of this limit is to protect the instrument, particularly the piston and barrel, against damage.



### SAFETY LIMITS

Two limits are pre-programmed into the indicator.

L1 (Low limit):

This limit has been programmed to activate at 4500 N. Once activated, a light will turn on below the L1 as a warning of excess load.

L2 (High limit):

This limit has been programmed to activate at 5000 N. Once activated, the **entire system will stop**, thus ending the process. In addition to the warning light below the L2 reset button the program will also display a message that the limit has been reached. Please read the Software Control section for the correct procedure to follow in such an emergency.

Two conditions will cause the load to exceed the allowed setting:

- the viscosity of the material being compounded is too high
- the spinneret is blocked preventing proper flow of the material out of the barrel

In either case, the barrel should be opened and manually emptied before continuing with other tests. Do NOT continue to extrude the material which triggered the alarm since damage to the Piston Extruder will occur.

Some adjustments might be necessary from time to time to maintain the load indicator working within the proper parameters. These include adjusting the FINE ZERO and FINE SPAN if they have changed. Allow the instrument to warm up for 15 minutes before making any adjustments.

### FINE ZERO ADJUSTMENT

The load transducer usually has a small amount of zero drift as a result of temperature change at the transducer itself. If the indicator does not read zero when the barrel is open and no load is placed on the load pin, the transducer can be readjusted to zero by changing the position of the ZERO adjustment screw with a small screwdriver.

### FINE SPAN ADJUSTMENT

After the FINE ZERO is readjusted, press the CAL button to determine if the span is correct. With the CAL button pressed, the indicator should read\_\_\_\_\_. If the reading is different change the position of the SPAN adjustment screw with a small screwdriver until the display reads\_\_\_\_\_. Release the CAL button and verify that the display returns to zero. Repeat both steps if necessary.

## COOLING AIR VALVE

A precision needle valve is provided to control the flow of cooling air out of the repositionable hoses. These hoses have come prefitted with the wide tip to broaden the cooling area. Additional round nozzles are provided to change the pattern of the air flow. The pressure of the incoming air should be low to achieve the best flow control of the air.

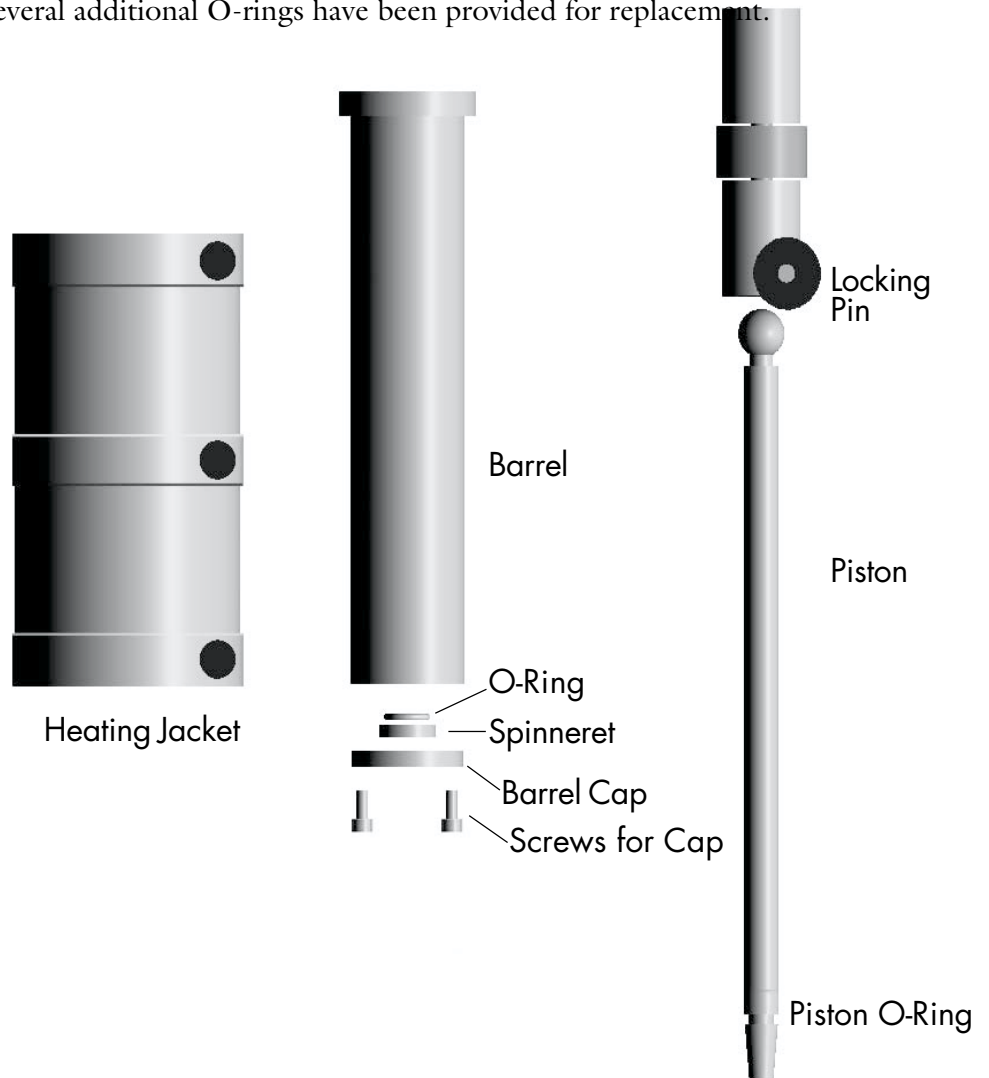
## BARREL AND HEATING JACKET



**WARNING** Assembly and disassembly of the barrel should be performed when the unit is at room temperature.

To remove the barrel and heating jacket from the Piston Extruder disconnect the electrical connector from the front panel. To separate the heating jacket from the barrel, loosen the six screws that tighten the jacket. It is not necessary to fully remove the screws or to loosen the screws for the heating bands. Once the heating jacket is removed, the barrel can be lifted from the top of the support structure.

The spinneret on the barrel can be changed by removing the barrel cap at the end of the barrel. This can be accomplished while the barrel is in place. Use the open end wrench and the cap removal tool to change the spinneret. A PTFE (Teflon®) O-ring is used to provide a seal between the barrel and the spinneret. Several additional O-rings have been provided for replacement.



## **OPERATION OF PISTON EXTRUDER**

A smaller PTFE O-ring is used at the tip of the piston to provide a seal between the piston and the barrel. The ring is slightly oversized and will compress after a few times of use. After this compression it becomes easier to push the piston in slightly into the barrel to load it on to the ball assembly. The locking pin is provided to maintain the piston attached to the ball assembly when extrusion is finished and the piston is withdrawn from the barrel, since it could become stuck to the bottom of the barrel due to polymer friction.

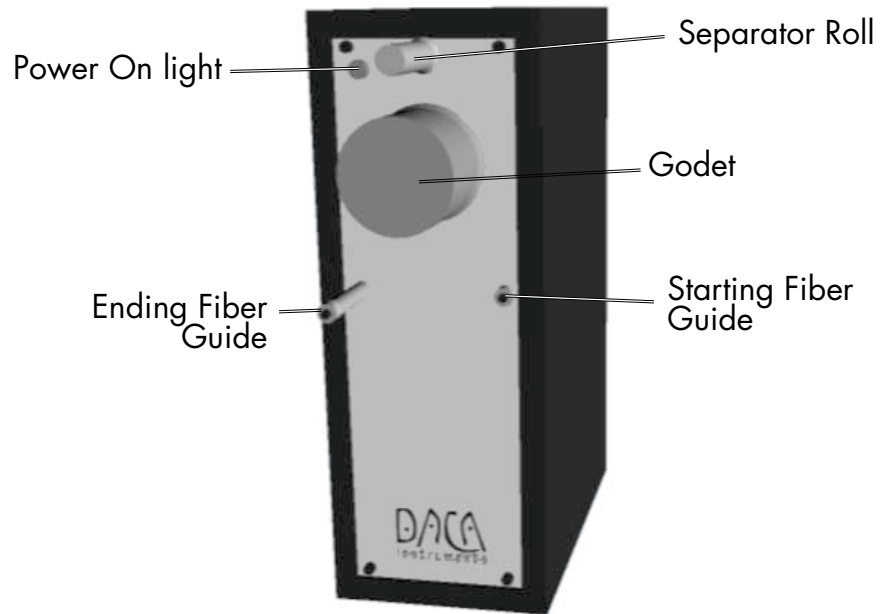
Once the barrel is put back on the Piston Extruder and the heating jacket is reassembled, the system is ready to be heated and loaded with polymer. Turn on the temperature controller and set the desired temperature as described in the Temperature Control section on pp 16. Polymer can be loaded into the barrel at any point during the heating cycle but it is easier to load the maximum amount of polymer when the barrel is heated since the molten polymer can be manually pushed down the barrel with the piston. A funnel is provided to facilitate loading of the polymer onto the barrel.

Once the polymer is loaded, the piston is installed in place by first inserting the tip slightly into the barrel holder and then moving up onto the ball assembly. After the piston is in place, install the locking pin in the hole provided.

Once the barrel temperature is stable and the piston is in place proceed with the program using the control panel to operate the Piston Extruder, Godets and the Winder. The Fiber Heater unit should be turned on and the temperature stable before running fibers over either heater.

# GODET UNIT

This component is used to pull the filament from the piston extruder and to stretch the filament either through the heater unit or cold from one Godet to the other. The speed of the high torque stepper motor in the Godet unit is computer controlled from 0.05 to 300 m/min.



## SET UP

There are two Godets units in the system. The two units are identical and are only differentiated when they are connected to the ports on the back of the piston extruder. On the back of each Godet there are two ports, one for electrical power and the other (labeled To Controller) is for the data cable. The Godet connected to the GODET 1 port on the Piston Extruder, becomes the Main Godet. This Godet is intended to pull the filament from the Piston Extruder or another fiber source. The unit connected to the GODET 2 port on the Piston Extruder, becomes the secondary or stretch Godet. This Godet stretches the filament by rotating faster than the first Godet. For correct positioning, GODET 1 should be placed on the left side of the Piston Extruder (see figure on page 14)

## OPERATION OF GODETS

The main parts of each Godet unit are the actual rotating Godet and the separator roll. In addition there are two filament guides to control the starting and ending position of the filament over the Godet. The path of the filament should start on the inside of the Godet, wrap a number of times around the Godet and the separator roll ending on the outside of the Godet. Usually 8 to 10 wraps over the Godet and separator roll are necessary to build enough friction on the filament to prevent sliding during stretching.



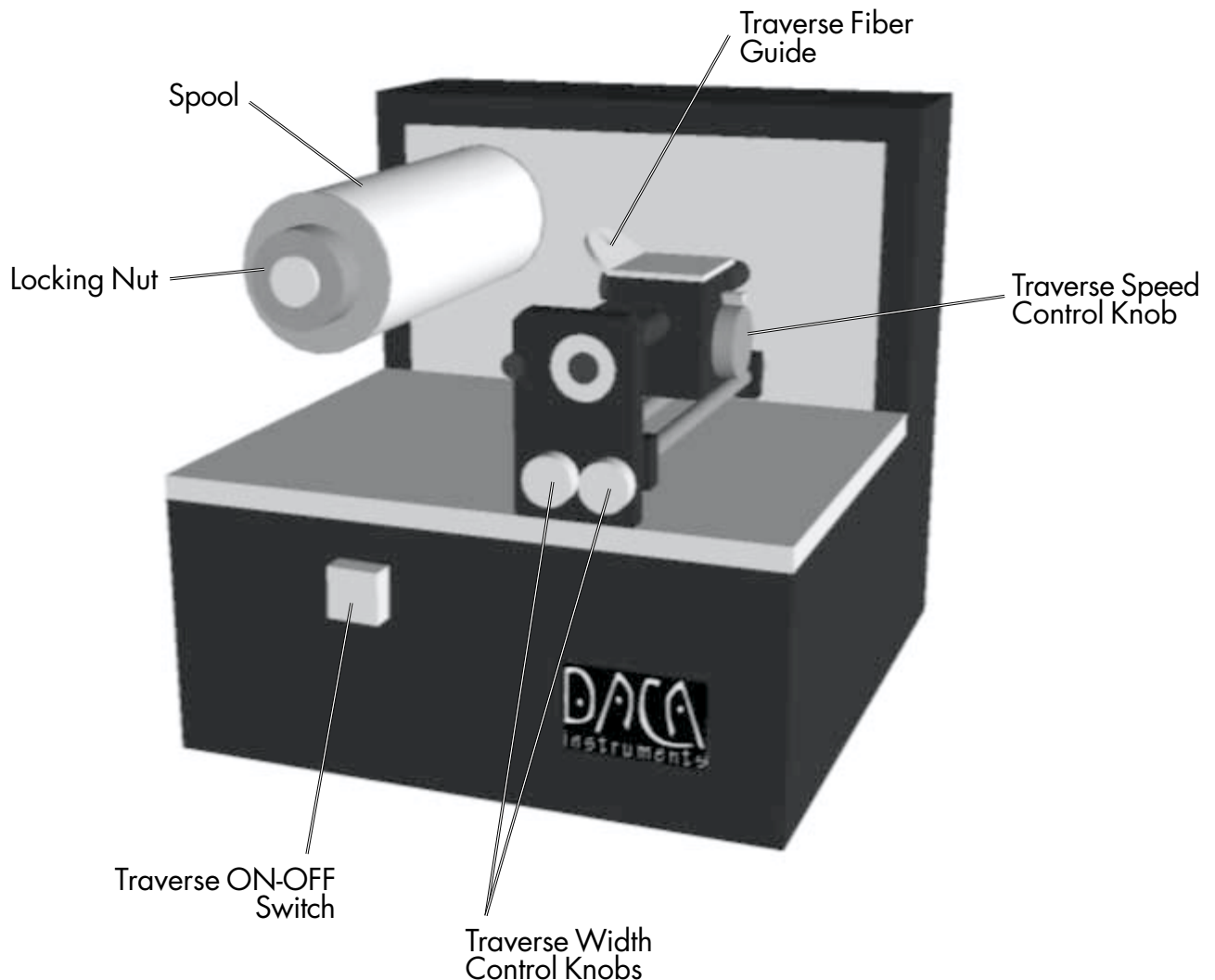
# WINDER

The Winder is the last unit on the SpinLine. There are two connections for the Winder, an electrical power connection and a data/control connector which must be plugged into the back of the Piston Extruder. When assembling the SpinLine, the Winder will be the unit at the left end of the assembly. As mentioned before, the normal travel of the filament is right to left along the assembly.

## OPERATION OF WINDER

The Winder uses standard 80 mm diam. spools for collecting the processed fibers. The speed of the spool is proportional to the speed of the second Godet and calibrated to take up the filament with a small amount of tension. The filament must travel over the traverse guide and under the spool. During operation the spool rotates counterclockwise while the two Godets rotate clockwise. Once the filament reaches the spool, it can either be taped to the spool or held onto the spool for several turns until the filament remains on the spool without slipping.

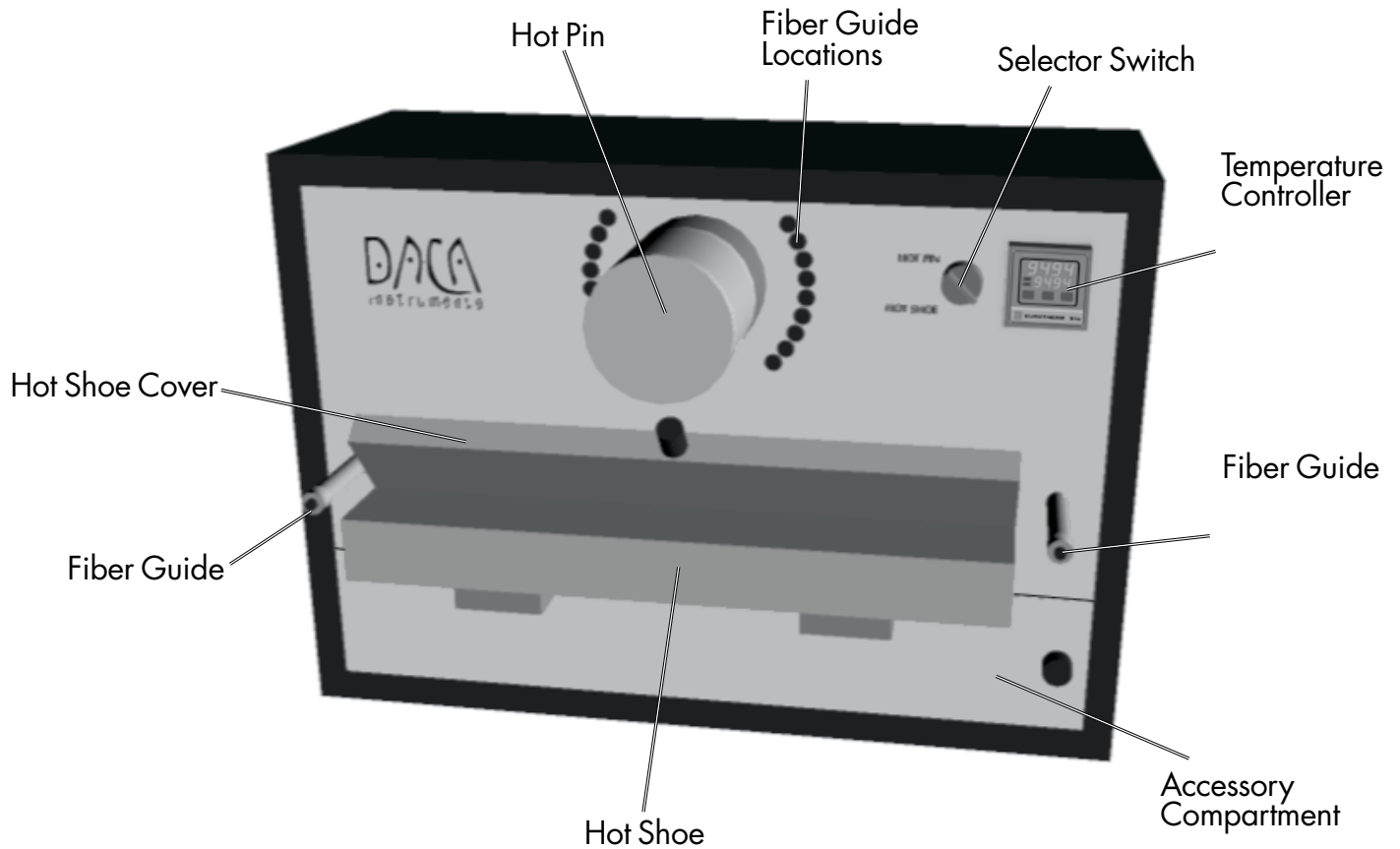
The movement of the traverse guide is activated by the square ON-OFF switch located in front of the Winder unit. The speed of the traverse guide relative to the spool is independently controlled by the speed selector knob located on the traverse unit. This controller permits a variety of overlap patterns from 0.5 mm to 27 mm between filament windings. The width of the movement of the traverse guide is also controllable by adjusting the two knobs in front of the traverse guide.





# HEATERS MODULE

The Heaters Module is an independent unit which only requires electrical power. As such it is optional and can be left out of the set up if the filament drawing (stretching) process requires no heating.



## OPERATION OF HEATERS MODULE

There are two independent heaters in the heater unit: a small round Hot Pin and a long Hot Shoe. The selection of the heater is made by the switch next to the temperature controller. There are two filament guides provided with the unit and they can be placed in any of the threaded positions found on the unit. There is one position at each end of the Hot Shoe and eight positions on each side of the Hot Pin. The different positions around the Hot Pin permit control of the length of filament in contact with the hot surface during stretching.

## TEMPERATURE CONTROL FOR HEATER MODULE

The temperature of the heaters is controlled by a Eurotherm 2216 temperature controller. The operation instructions are the same as those for the 2208 used in the Piston Extruder. Please refer to page 16 and 37 for instructions.

# SOFTWARE CONTROL

The software is the main component of the SpinLine. The software was carefully written to give the user the most control over all the operations of the entire SpinLine. There are four programs built into the SpinLine: one to control the Piston Extruder only, one to control the Winder only, one to control the Godets and Winder without affecting the extruder and the last program controls all four components simultaneously. The following description will cover this last program.

After all the cables are properly connected, turn on the Winder, the two Godets then turn on the Piston Extruder. On the controller the following text will appear

```
DACA INSTRUMENTS 2000
CONTINUE                               QUIT
```

## QUIT

Causes the program to end. The new screen is the starting point for programming the SpinLine controller using the front panel display or to upload and download new programs from a computer. To change the existing programs contact DACA Instruments. If this button is pressed, the only way to return to the start up screen is to turn off the piston extrude and then turn it back on.

## CONTINUE

Presents you with a new screen which has the four programs available for the SpinLine

## PROGRAM SELECTION

```
SELECT THE PROGRAM TO USE
```

```
EXTRD  WINDR  GODET  EXTRD  FULL
ONLY   ONLY   WINDR  WINDR  SYS   QUIT
```

## EXTRD ONLY

This option operates only the Piston Extruder. The Godets and the winder should be turned OFF if this option is chosen. This option is useful if the material extruded does not have to be processed into fibers or if the filament is spun into a coagulating bath (wet spinning).

## WINDR ONLY

This option operates only the final winder. The Piston Extruder and the GODETS will not operate with this program. This option is useful to collect fibers created with an instrument other than the piston extruder (i.e. Micro-Com-pounder).

## GODET+WINDR

This option operates the two Godets and the Winder. The Piston Extruder will NOT operate if this option is selected. This option is useful to perform tensile deformation on filaments already on a spool or if the filaments are being produced by a different extruder.

### EXTRD+WINDR

This option operates the PistonExtruder and the Winder. This option is useful for quick spinning of fibers without using the Godets.

### FULL SYS

This option operates all four components of the SpinLine. Only this program will be described in detail since the other two are subsets of this main program.

When F5 is pressed the following screen is displayed,

```
THIS PROGRAM CONTROLS ALL MODULES
EXTRUDER, GOSETS, AND WINDER
```

### CONTINUE

The program first searches for the upper hardware limit and then asks a series of questions regarding the choice of barrel and the initial speeds of the piston and Godets. Once the data is entered and motion is started, the main screen offers control of all the speeds individually and as a unit.

## HARDWARE LIMIT

```
PRESS F1 TO FIND HARDWARE LIMIT
```

```
HW LIMIT
```

```
QUIT
```

### QUIT

Ends the program.

### HW LIMIT

Finds the starting (upper or home) position of the piston. The piston will move upwards until it finds the upper limit switch then come down 3 mm and stop at the home position. If the instrument was turned OFF properly during the previous experiment, the piston will be at the starting position and will only move a short distance.

During the movement the following screen is displayed:

```
SEARCHING FOR LIMIT SWITCH
STOP
```

Once the limit is found, the following screen is displayed:

## BARREL SELECTION

```
PRESS F1-F3 TO SELECT BARREL IN USE
```

```
NORM-JECT PISTON^
```

```
5ML 10ML &CYL.
```

```
QUIT
```

Here you need to tell the program which of the three cylinders is attached to the piston extruder.



### WARNING

It is important that the correct choice is made at this point. The stop point for the piston is controlled programmatically. If the choice made does not match the barrel attached to the instrument, the piston could crash against the bottom of the barrel damaging the unit.

The choices are:

NORM-JECT 5ML

This is used for the 5 ml syringe barrel.

NORM-JECT 10ML

This is used for the 10 ml syringe barrel.

PISTON & CYL.

This is used for the stainless cylinder and piston.

After the choice is made, the following screen appears.

## LOADING MATERIAL INTO BARREL

```
WHEN SYRINGE/CYLINDER IS LOADED, PRESS  
F1 TO PLACE PISTON AT START POSITION
```

```
ST. POS.
```

```
QUIT
```

The barrel/or syringe must be filled with material and in place before proceeding. At the starting position, the tip of the piston is 3-5 cm into the barrel. The only way to remove the piston at this point is to quit the experiment. Pressing F1 will lower the piston to the starting position. During this motion, the following screen is shown which allows you to stop the process should it be necessary.

```
MOVING PISTON TO START POSITION
```

```
STOP
```

```
QUIT
```

When the starting position is reached, the program asks for the initial speed of the piston,

## INITIAL SETTINGS

```
INITIAL SETTINGS FOR PISTON EXTRUDER
```

```
ENTER INITIAL PISTON SPEED (MM/MIN):
```

The piston speed is the vertical downward velocity of the piston. Type the speed using the numerical key pad and press the enter key. Fractional numbers (x.xx) are allowed. To calculate the extrusion speed of the filament use the following equation,

piston speed by the ratio  $x$  (barrel internal radius<sup>2</sup> ÷ spinneret internal radius<sup>2</sup>)

For example, if the piston is moving at 0.1 mm/min and the 0.5 mm spinneret is used (barrel ID 9.53 mm), the filament speed would be

$$0.1 \times ((4.76)^2 / (0.25)^2) = 36.25 \text{ mm/min}$$

```
ENTER ADJUSTMENT INCREMENT (MM/MIN):
```

Adjustment increment is the change of speed the piston will have when the velocity is increased or decreased. For example, if the initial speed is 1.5 mm/min and the adjustment is 0.1 mm/min, when the increase button is pressed (later), the new speed will be 1.6 mm/min.

After these two numbers are entered the program asks for similar data for the speed of the main Godet.:

```
INITIAL SETTINGS FOR MAIN GODET
ENTER INITIAL SPEED (M/MIN):
```

```
ENTER ADJUSTMENT INCREMENT (M/MIN):
```

Next the program asks for the stretch factor

```
INITIAL SETTINGS FOR STRETCH
ENTER INITIAL STRETCH FACTOR:
```

This data refers to how much faster the second Godet rotates with respect to the first one. For example, if the main Godet speed is set to 93 m/min and the STRETCH FACTOR is set to 1.3, the second Godet will rotate at (93 x 1.3) 121 m/min.

```
ENTER ADJUSTMENT INCREMENT:
```

## **MAIN SOFTWARE MENU**

After the requested data is entered, the main screen is displayed:

```
MAIN MENU
```

```
PISTON MAIN STRETCH          START/  
EXTR  GODET FACTOR WINDER STOPALL QUIT
```

## **MAIN -> PISTON EXTR**

PISTON EXTR

Adjusts the speed of the piston extruder. A new screen is displayed to make the changes:

```
PISTON EXTRUDER MENU
CURRENT SPEED SETTING (MM/MIN):
          ADJ          START   MAIN
INC    DEC    INC    HOME /STOP  MENU
```

INC

Increases the speed by the amount specified in Adjustment Increment

DEC

Decreases the speed by the amount specified in Adjustment Increment

ADJ INC

Shows a new screen to change the Adjustment Increment. The following screen comes up:

## PISTON EXTRUDER

CURRENT ADJ. INCREMENT (MM/MIN) = x.xx  
ENTER NEW ADJ. INCREMENT (MM/MIN):  
Type the new value at the prompt and press ENTER.

### HOME

Returns the piston to the upper (home) position.

### START/STOP

Starts or stops the piston independently of the other units.

### MAIN MENU

Returns to the main menu

## MAIN -> MAIN GODET

### MAIN GODET

Adjusts the speed of the main Godet. A new screen is displayed to make the changes:

```
                MAIN GODET MENU
CURRENT SPEED SETTING (M/MIN):
      INC      DEC      ADJ      DATA      MAIN
                INC                MENU
```

The main advantage of the SpinLine is the precise control it offers over all the speeds. In addition, once the spinning process has been stabilized at a certain extrusion and drawing speed, changing the speed of the Main Godet will change the speed of the rest of the system proportionally.

See MAIN -> PISTON EXTR for the explanation of INC, DEC, ADJ INC, and MAIN MENU

### DATA

Displays the current values of the speeds for all the axes. See DATA DISPLAY for a sample screen output.

## MAIN -> STRETCH FACTOR

### STRETCH FACTOR

Adjusts how much faster the second Godet is with respect to the first one. A new screen is displayed to make the changes:

```
                STRETCH FACTOR MENU
CURRENT STRETCH FACTOR:
      INC      DEC      ADJ      DATA      MAIN
                INC                MENU
```

See MAIN -> PISTON EXTR for the explanation of INC, DEC, ADJ INC, and MAIN MENU

## MAIN -> WINDER

### WINDER

Because of small fluctuations in diameters of the spools, the tension of the fiber might vary from spool to spool at the winder. This variation can also be noticeable if there is enough filament wound on the bobbin to change its diameter. The WINDER selection will enable you to make small adjustments to the winder velocity with respect to the velocity of the second Godet. A small amount of tension must be maintained on the fiber at the winder to prevent the fiber from slipping from the spool.

### WINDER MENU

CURRENT WINDER FACTOR:

				MAIN
INC	DEC		DATA	MENU

The standard winder factor is 1.009. This means that the winder is spinning 1.009 times faster than the Godet. When the INC or DEC buttons are pressed this factor is changed by  $\pm 0.001$  respectively.

## MAIN -> START/STOP ALL

### START/STOP ALL

Starts or stops the motion of all axes. The motors accelerate slowly from zero to full speed. Stopping is instantaneous.

## MAIN -> QUIT

### QUIT

Stops all axes, returns the piston to the top position and ends the program.

When quit is pressed, all the motors are stopped and the piston of the extruder is returned to the starting position.

### RETURNING TO HOME POSITION

### STOP

#### STOP

Allows the user to stop the piston travel in case of a problem.

## DATA DISPLAY

When the piston is at the starting position, the final settings for all the axes are displayed

DATA: EXTRUDR	GODET 1	GODET 2	WINDER
SET Q:	1.23	78	5.5
M/MIN:		78	429
MM/MIN:	1.23		433
			F6-DONE

When the F-6 key is pressed, the program returns to the starting screen:

### DACA INSTRUMENTS 1998

CONTINUE

QUIT

## **EMERGENCY CONDITIONS**

There are two emergency conditions that will stop the normal flow of the program:

### **EMERGENCY STOP BUTTON**

When the emergency stop button is pressed, all the units will immediately stop moving and the following screen is displayed

```
EMERGENCY STOP PRESSED  
PROGRAM WILL QUIT
```

The program will wait until the emergency stop button is released and will proceed to quit. The piston will then move to the Home (top) position while all other units will not move. If the emergency button is not released, a screen will remind you to do so before returning the piston to the starting position.

```
IF CONDITIONS ARE SAFE  
PLEASE RELEASE THE EMERGENCY STOP
```

This screen will also be displayed if the instrument is turned on while the emergency stop button is still depressed.

### **OVERLOAD**

If the load on the piston exceeds 5000 N the system will stop all units and quit the program. At the overload condition the following screen is displayed:

```
OVERLOAD CONDITION  
PROGRAM WILL QUIT
```

```
QUIT
```

The piston will slowly back away a few mm to release the load and wait for the user to press F1 to proceed with QUIT.



# TYPICAL RUN

This example is presented as a starting point in the operation of the complete SpinLine. The parameters were developed for fiber grade Polypropylene.

- Turn ON all 5 modules.
- Attach the Ø0.5mm spinnerets to the Piston barrel
- Set the temperature of the piston extruder to 200°C
- Set the Temperature of the Hot Shoe to 140°C
- Wait until the barrel and hot shoe are heated
- Add polymer to the Piston barrel. Pack the material by pushing it down as it softens with the "pink" Garolite loading tool
- Select the FULL SYS program
- Select the Piston & Cyl setting
- Select the following parameters:
  - Piston initial speed 1.0 mm/min
  - Piston increment 1mm/min
  - Main Gotet speed 10m/min
  - Main godet increment 1m/min
  - Stretch factor 1.2
  - Stretch increment 0.1
- Press the START/STOP key (F5)
- Once the polymer begins to be extruded, pick it up with a set of tweezers.
- Pulling down of the extrudate, guide it around the low pulley in the piston extruder.
- Guide it under the 1st pulley of the main godet
- Make about 10-15 turns around the godet and separator roll (see page 35)
- Guide it under the pulleys and over the shoe of the heater module.
- Guide it under the 1st pulley of the second godet
- Make about 10-15 turns around the godet and separator roll (see page 35)
- Guide the fiber over the traverse guide of the winder.
- Make a few turns on the bobbin and secure in place with a small piece of tape.
- Once the system has stabilized at this speed, the speed of the main godet can be increased slowly to 30m/min or more.
- Once this has stabilized the stretch factor can be increased to 4x

Again, this are just guidelines for an optimal system. Feel free to experiment with different settings for your particular polymer.

# MAINTENANCE

Maintenance of the SpinLine is relatively simple. The Godets require no maintenance. The other units require only minimum maintenance.

## WINDER

The winder requires periodic lubrication of the main shaft of the traverse guide. Use a few drops of a light machine oil such as WD-40® or TriFlo™ directly on the shaft while it is rotating.

## HEATER MODULE

If the surface of the heaters become contaminated with polymer, they should be cleaned with a brass brush or steel wool. Take special care not to scratch the surface of the heaters since it would impair smooth passage of the fibers over the heaters.

## PISTON EXTRUDER

The piston extruder requires periodic lubrication to assure optimal operation of the moving components.

- Lubrication of the lead screw

The screw should be lubricated every twelve months or more often depending on use. Use a high temperature grease such as Lubriplate™. For complete lubrication the cover of the lead screw should be removed to access the top section of the screw.

- Lubrication of barrel bearing

The bearing that supports the barrel should be lubricated every three months. Use a high temperature grease such as Lubriplate™ for best protection. Remove the barrel and pivot the bearing until the rounded surface of the bearing is visible. Use a small amount of grease and rotate the bearing in order to coat the entire rounded surface. Pivot the bearing back to its original position.

## CLEANING

Periodically the barrel should be cleaned thoroughly to remove all polymer particles attached to any of the surfaces. Use the brass brushes provided to aid with the cleaning. Steel tools (except brushes) may be used, but take extreme care not to scratch the surfaces.

A cleaning tool has been provided to easily clean the barrel while the polymer residue still molten. The tool tip looks like:



Cut a small 2x2 inch (4x4cm) square of the cotton fabric that was supplied with the instrument. Place the fabric over the inlet hole of the barrel. Push the fabric into the barrel with the cleaning tool. The fabric can be pushed up and down several times and then removed. Repeat the process with a clean piece of cotton until the barrel is clean.

# TROUBLESHOOTING

If you experience any problem with the SpinLine or Piston Extruder, please contact DACA Instruments for assistance.

DACA Instruments  
P.O. Box 991  
Goleta, CA 93116  
Phone: +1 (805) 967-6959  
FAX: +1 (805) 967-4331  
e-mail: [daca@daca.com](mailto:daca@daca.com)

## HARDWARE PROBLEMS

### FUSES

If any of the units fails to turn ON, check the fuse located in the fuse drawer of the power entry module of the unit. The small drawer can be pulled open with a small screwdriver. If the fuse is damaged, replace it with a fuse of the same rating. The fuse rating is printed above the power entry module.

### E-STOP

If the emergency stop button is locked in the depressed position the following message will appear on the control console upon start-up.

IF CONDITIONS ARE SAFE  
PLEASE RELEASE THE EMERGENCY STOP

Release the emergency stop button in order to proceed with testing.

### CABLES

If one of the Godets or the Winder is not moving (when they are supposed to) check that the power is ON and its data cable is properly connected into the back of the unit and in the proper location on the Piston Extruder.  
Load Cell Connector: If the load display makes noise when the Piston Extruder is turned ON, the Load Cell is not properly connected. Make sure that the Load Cell connector is properly inserted in the receptacle and locked in place. The load cell should be connected whenever the Piston Extruder is turned ON.

## PISTON EXTRUDER HEATER MODULE

### HEATERS

The message **LP.br** should be displayed on the temperature controller if one of the heaters is faulty or if they are not properly connected to the port on the Piston Extruder.

The temperature controllers can detect if there is a break in the control loop due to a fuse burnout, heater burnout, faulty output device or loose wiring. The operator is warned by the message **LP.br**. The message is latching, resettable by touching any button on the front panel. The controller assumes a break in the control loop if the output to the heaters remains at 0% or 100% and the measured value moves less than 1/2 of the **ProP** setting (proportional band) towards the setpoint within the setting of **LP.br** (loop break time). These two values are determined during the autotune procedure.

- Verify first that the connection is properly made.
- If heater damage is suspected, contact DACA instruments for replacement heaters.

## SOFTWARE PROBLEMS

### THERMOCOUPLE

The message **Sn Sr Fail** will appear on the temperature controller if the thermocouple is disconnected or the sensor is malfunctioning.

- Verify first that the connection is properly made.
- Is thermocouple damage is suspected, contact DACA instruments for a replacement.

### TEMPERATURE CONTROLLER

Please refer to the tables in the temperature control section (pp.16) for descriptions of the messages that might show up on the temperature controller during faulty operation.

### E-STOP

If the emergency stop button is locked in the depressed position the following message will appear on the control console upon start-up.

```
IF CONDITIONS ARE SAFE  
PLEASE RELEASE THE EMERGENCY STOP
```

Release the emergency stop button in order to proceed with testing.

### PROGRAM ERASED

If upon start up the following screen does not appear

```
DACA INSTRUMENTS 1998
```

```
CONTINUE
```

```
QUIT
```

the programs were erased from the memory of the controller. Please contact DACA Instruments for replacement software.

# TEMP. CONTROL TUNING & SET UP

## TUNING

### WHAT IS TUNING?

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

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

Tuning involves calculating and setting the value of the parameters listed in Table T4. These parameters appear in the ‘Pi d’, list.

Parameter	Code	Meaning of Function
Proportional band	$P_b$	The bandwidth, in display units, over which the output power is proportioned between minimum and maximum.
Integral time	$t_i$	Determines the time taken by the controller to remove steady state error signals.
Derivative time	$t_d$	Determines how strongly the controller will react to the rate-of change of the measured value.
High Cutback	$H_{cb}$	The number of display units, above setpoint, at which the controller will increase the output power, in order to prevent undershoot on cool down.
Low cutback	$L_{cb}$	The number of display units, below setpoint, at which the controller will cutback the output power, in order to prevent overshoot on heat up.
Relative cool gain	$r_{EL}$	Only present if cooling has been configured and a module is fitted. Sets the cooling proportional band, which equals the $P_b$ value divided by the $r_{EL}$ value.

Table T4. Tuning parameters

## AUTOMATIC TUNING

The ‘one-shot’ 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 One-shot 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 re-tune again for the new conditions.

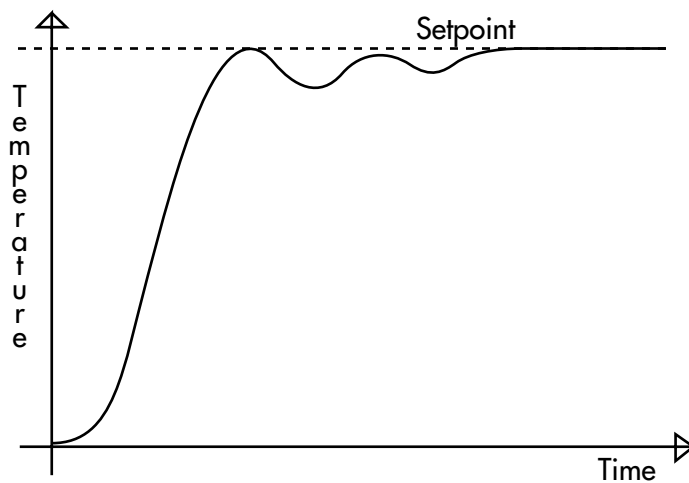
It is best to start tuning with the process at ambient temperature. This allows the tuner to calculate more accurately the low cutback and high cutback values which restrict the amount of overshoot, or undershoot.

## HOW TO TUNE

1. Set the setpoint to the value at which you will normally operate the process.
2. In the 'MENU' 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 setpoint.
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 4-1 and resumes normal control action.

If you want 'Proportional only', 'PD', or 'PI' control, you should set the 'I' or 'I D' 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.

## ACCESS LEVELS

This section describes the different levels of access to the operating parameters within the controller.

## THE DIFFERENT ACCESS LEVELS

There are four access levels:

- **Operator level**, which you will normally use to operate the controller.
- **Full level**, which is used to commission the controller and the process being controlled.
- **Edit level**, which is used to set up the parameters that you want an operator to be able to see and adjust when in Operator level.
- **Configuration level**, which is used to set up the fundamental characteristics of the controller.


Access level	Display shows	What you can do	Password Protection
Operator	<i>OPER</i>	In this level, operators can view and adjust the value of parameters defined in Edit level (see below).	No
Full	<i>FULL</i>	In this level, all the parameters relevant to a particular configuration are visible. All alterable parameters may be adjusted.	Yes
Edit	<i>Edit</i>	In this level, you can determine which parameters an operator is able to view and adjust in Operator level. You can hide, or reveal, complete lists, individual parameters within each list and you can make parameters read-only or alterable. (See Edit level at the end of this chapter).	Yes
Configuration	<i>CONF</i>	This special level allows access to set up the fundamental characteristics of the controller.	Yes

Table T5. Access levels list

## SELECTING AN ACCESS LEVEL

Access to Full, Edit or Configuration levels is protected by a password to prevent unauthorised access.

### ACCESS LIST HEADER

Press  until you reach the access list header 'ACCESS'.


Press .


### PASSWORD ENTRY

The password is entered from the 'codE' display. Enter the password using ▲ or ▼. Once the correct password has been entered, there is a two second delay after which the lower readout will change to show 'PASS' indicating that access is now unlocked.



The pass number is set to '1' when the controller is shipped from the factory.

*Note;* A special case exists if the password has been set to '0'. In this case access will be permanently unlocked and the lower readout will always show 'PASS'.

Press  to proceed to the *CODE* page.

(If an *incorrect* password has been entered and the controller is still 'locked' then pressing  returns you to the 'ACCESS' list header.)

### ACCESS TO READ-ONLY CONFIGURATION


From this display, pressing ▲ and ▼ together will take you into Read-Only Configuration without entering a password. This will allow you to view all of the configuration parameters, but not adjust them. If no button is pressed for ten seconds, you will be returned to the Home display. Alternatively, pressing  and  together takes you immediately back to the Home display.

### LEVEL SELECTION

The *CODE* display allows you to select the required access level.

Use ▲ and ▼ to select from the following display


codes: *OPER*: Operator level  
*FULL*: Full level  
*Edit*: Edit level  
*CONF*: Configuration level

Press .

If you selected *OPER*, *FULL*, or *Edit* level you will be returned to the *ACCESS* list header in the level that you chose. If you selected *CONF*, you will get a display showing '*CONF*' in the upper readout (see below).

### CONFIGURATION PASSWORD

When the *CONF* display appears, you must enter the Configuration password in order to gain access to this level. Do this by repeating the password entry procedure described in the previous section. The configuration password is set to *2* when the controller is shipped from the factory.

Press 

### CONFIGURATION LEVEL

Contact DACA Instruments about changing the configuration of the controller.

### RETURNING TO OPERATOR LEVEL

To return to operator level from either *FULL* or *Edit* level, repeat entry of the password and select *OPER* on the *CONF* display.



In *Edit* level, the controller will automatically return to operator level if no button is pressed for 45 seconds.

## EDIT LEVEL



Edit level is used to set which parameters you can view and adjust in Operator level. It also gives access to the 'Promote' feature, which allows you to select and add ('Promote') up to twelve parameters into the Home display list, thereby giving simple access to commonly used parameters.

### SETTING OPERATOR ACCESS TO A PARAMETER

First you must select *Edit* level, as shown on the previous page.

Once in *Edit* level, you select a list, or a parameter within a list, in the same way as you would in Operator, or Full, level - that is to say, you move from list header to list header by pressing , and from parameter to parameter within each list using .

However, in Edit level what is displayed is not the value of a selected parameter, but a code representing that parameter's availability in Operator level.

When you have selected the required parameter, use  and  buttons to set its availability in Operator level.

There are four codes:

*ALTER* Makes a parameter alterable in Operator level.

*PROM* Promotes a parameter into the Home display list.

*READ* Makes a parameter, or list header, read-only (it can be viewed but not altered).

*HIDE* Hides a parameter, or list header.

### HIDING OR REVEALING A COMPLETE LIST

To hide a complete list of parameters, all you have to do is hide the list header. If a list header is selected, only two selections are available: *READ* and *HIDE*. (it is not possible to hide the *ACCESS* list, which always displays the code: *to LIST*.)

### PROMOTING A PARAMETER

Scroll through the lists to the required parameter and choose the *PROM* code. The parameter is then automatically added (promoted) into the Home display list. (The parameter will also be accessible, as normal, from the standard lists.) A maximum of twelve parameters can be promoted. Promoted parameters are automatically 'alterable'. Please note, in the *PROM LIST* the parameters from segment number (*SEG.N*) onwards *cannot* be promoted.



For additional information on calibration and configuration of the temperature controller, please contact DACA Instruments.

## PARAMETERS AND HOW TO ACCESS THEM

Parameters are settings within the controller that determine how it will operate. For example, alarm setpoints are parameters that set the points at which alarms will occur. For ease of access, the parameters are arranged in lists as shown in the navigation diagram on the following page. The names of these lists are called the *list headers*. The lists are:

Home list	Input list
Alarm list	Output list
Autotune list	Communications list
PID list	Access list.
Setpoint list	

Each list has a ‘List Header’ display.

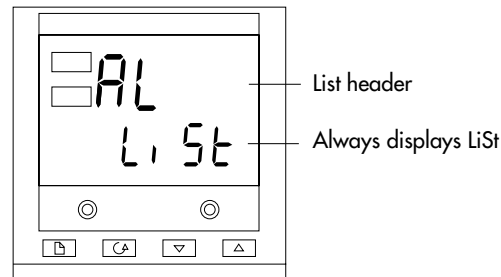


Figure T6. Typical list header display

A list header can be recognized by the fact that it always shows ‘Li St’ in the lower readout. The upper readout is the name of the list. In the above example, AL indicates that it is the Alarm list header. List header displays are read-only.

**To step through the list headers** press . Depending upon how your controller has been configured, a single press may momentarily flash the display units. In this case, a double press will be necessary to take you to the first list header. Continued pressing of will step through the list headers eventually returning you to the **Home** display.

**To step through the parameters** within a particular list, press . When you reach the end of the list, you will return to the list header. From within a list you can return to the list header at any time can by pressing . To step to the next list header, press once again.

### PARAMETER NAMES

In the navigation diagram, each box depicts the display for a selected parameter. The upper readout shows the name of the parameter and the lower readout its value. The Operator parameter tables later in this chapter list all the parameter names and their meaning.

The navigation diagram shows all the parameters that can, *potentially*, be present in the controller. In practice, only those associated with a particular configuration will appear.

The shaded boxes in the diagram indicate parameters that are hidden in normal operation. To see all the available parameters, you must select Full access level. For more information about this read section 7.1.3, *Access Levels*.

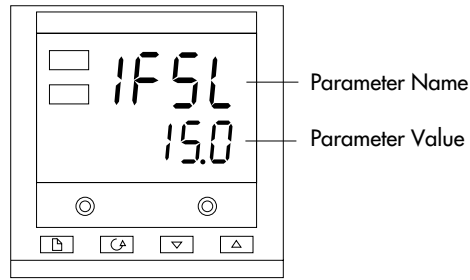


Figure T7. Typical parameter display

Parameter displays show the controller's current settings. The layout of parameter displays is always the same: the upper readout shows the parameter name and the lower readout its value. Alterable parameters can be changed using ▲ or ▼. In the above example, the parameter mnemonic is IFSL (indicating *Alarm 1, full scale low*), and the parameter value is 10.0.

**TO CHANGE THE VALUE OF A PARAMETER**

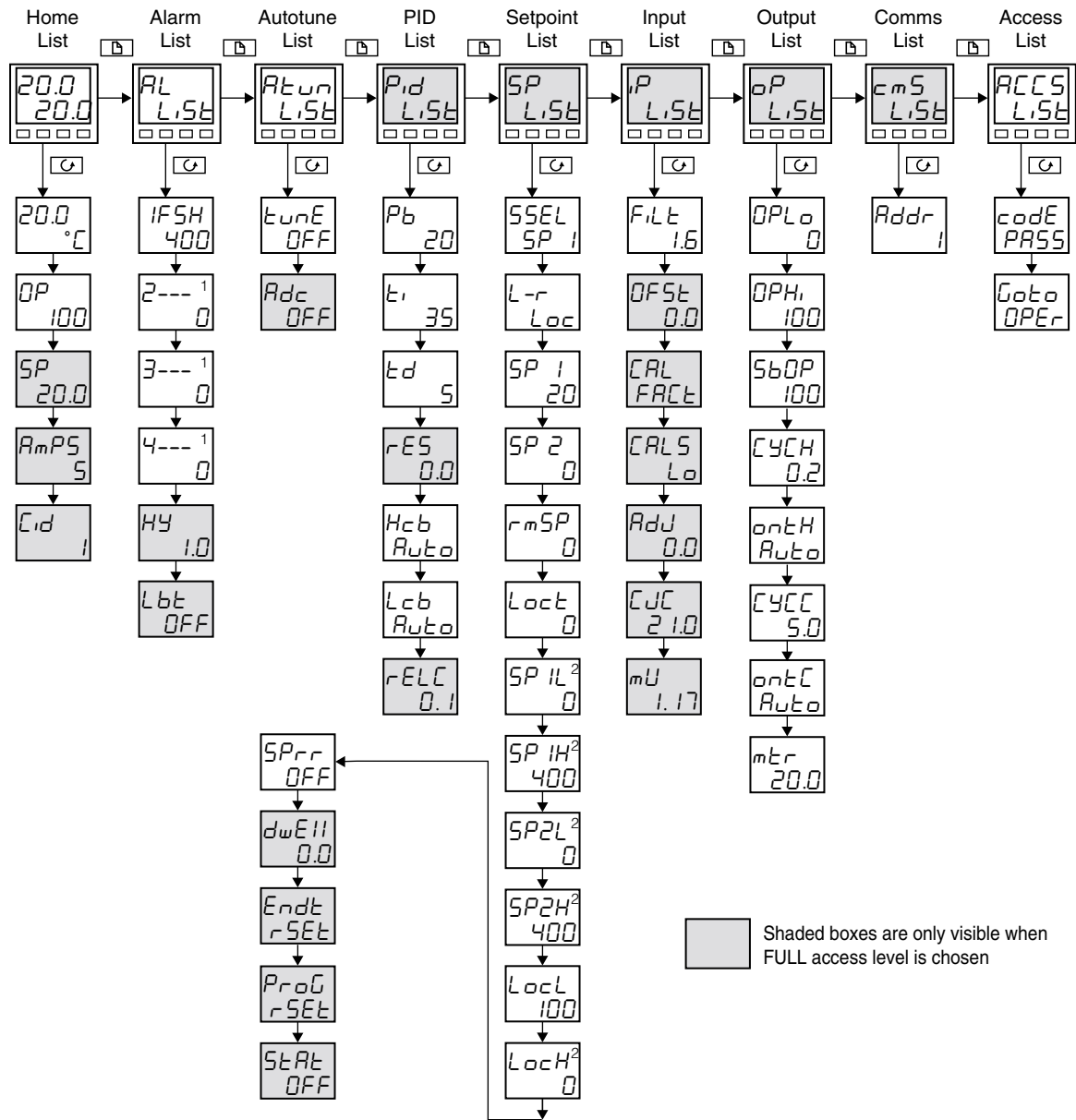
First, select the required parameter. The parameter name is shown in the upper readout and the parameter value in the lower readout.

To change the parameter value, press either ▲ or ▼. During adjustment, single presses change the value by one digit.

Keeping the button pressed speeds up the rate of change.

Two seconds after releasing either button, the display blinks to show that the controller has accepted the new value.

# NAVIGATION DIAGRAM



## PARAMETER TABLES

The tables which follow list all parameters that are available in full operator level. The controller comes preconfigured from DACA Instruments. This tables are provided for information pupose only.

### HOME DISPLAY

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
Home	Measured Value and Setpoint	SP=25°C			as display
<i>uPOS</i>	Valve positioner output power		0.0	100.0	% of mtr
<i>OP</i>	% Output Level		-100.0	100.0	%
<i>wSP</i>	Working setpoint				as display
<i>SP</i>	Setpoint		-999	9999	as display
<i>AmPS</i>	Heater current (PDS modes 2 and 5)		0	100	AmPS
<i>m-R</i>	Auto/manual select	Auto			
<i>disP</i>	Configure lower readout of home	Std			
<i>cid</i>	Customer ID	0	0	9999	

### AUTOTUNE LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
Atun	Autotune List				
<i>TunE</i>	Self tune enable	<i>OFF</i>	<i>OFF</i>	<i>On</i>	
<i>Rdc</i>	Automatic droop compensation (Manual Reset) enable (only present if <i>b</i> set to OFF)	<i>mRn</i>	<i>mRn</i>	<i>CALLC</i>	

### ACCESS LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
ACCS	Access list				
<i>codE</i>	Full and Edit level password	1	0	9999	
<i>Goto</i>	Goto level <i>OPERFULL</i> <i>Edit</i> or <i>conf</i>	<i>OPER</i>	<i>OPER</i>	<i>conf</i>	
<i>CONF</i>	Configuration level password	2	0	9999	

## ALARM LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
AL	Alarm List				
1---	Alarm 1 set point value	0			as display
2---	Alarm 2 set point value	0			as display
3---	Alarm 3 set point value	0			as display
4---	Alarm 4 set point value	0			as display
In place of dashes, the last three characters indicate the alarm type, as follows:					
-F5H	Full Scale High alarm		-999	9999	as display
-F5L	Full Scale Low alarm		-999	9999	as display
-dE0	Deviation band alarm		0	9999	as display
-dHi	Deviation High alarm		0	9999	as display
-dLo	Deviation Low alarm		0	9999	as display
-Lcr	Low current alarm		0	100	AmPS
-Hcr	High current alarm		-0	100	AmPS
Hy	Hysteresis		0	9999	as display
Lbt	Loop break time	OFF	0	9999	secs

## OUTPUT LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
oP	Optput List				
OPLo	Low (power) output limit	-100.0	-100.0	100.0	%
OPHi	High (power) output limit	100.0	-100.0	100.0	%
SbOP	output setting when in sensor break	0.0	-100.0	100.0	%
CYCH	Heat cycle time	1.0	0.2	999.9	secs
onEH	Heat output min on time	0.1	Auto	999.9	
CYCC	Cool cycle time	1.0	0.2	999.9	secs
onEC	Cool output min. on time	0.1	Auto	999.9	
mtr	VP motor travel time		0.0	999.9	secs

## PID LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
Pid	PID List				
<i>Pb</i>	Proportional band	20.0	1	9999	as display
<i>t<sub>i</sub></i>	Integral time	360	OFF	9999	seconds
<i>t<sub>d</sub></i>	Derivative time	60	OFF	9999	seconds
<i>rES</i>	Manual reset (appears when <i>t<sub>i</sub></i> set to OFF)	0.0	0.00	100.0	%
<i>Lcb</i>	Cutback low	Auto	0	9999	as display
<i>Hcb</i>	Cutback high	Auto	0	9999	as display
<i>rELC</i>	Relative cool gain (set 1)	1.00	0.01	9.99	

## INPUT LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
IP	Input list				
<i>FILE</i>	Input filter time constant	1.6	oFF	999.9	secs
<i>OFFSE</i>	PV Offset		-999	9999	as display
The next 5 parameters will appear if User calibration has been enabled in configuration level					
<i>CAL</i>	<i>FACT</i> will re-instate factory settings and disable User Calibration. <i>USER</i> will re-instate any previously set User Calibration offsets and make available User Calibration parameters as follows:				
<i>CALS</i>	User calibration select	nonE			
<i>ADJ</i>	Adjust calibrated reference source				
The following parameters are allways present in Full Access but not in Operator level.					
<i>CJC</i>	Cold Junction compensation temperature				
<i>mU</i>	Millivolt input				

## SETPOINT LIST

NAME	DESCRIPTION	DEFAULT	MIN VALUE	MAX VALUE	UNITS
SP	Set Point List				
<i>SEL</i>	Select	SP1	SP 1	SP2	
<i>L-r</i>	Local or remote setpoint select	Loc	Loc	rmt	
<i>SP 1</i>	Setpoint 1 value	25	As display range		
<i>SP 2</i>	Setpoint 2 value	25	As display range		
<i>rm.SP</i>	Remote setpoint	0	As display range		
<i>Loc.t</i>	Local trim	0	As display range		
<i>SP 1L</i>	Setpoint 1 low limit	0	As display range		
<i>SP 1H</i>	Setpoint 1 high limit	1000	As display range		
<i>SP 2.L</i>	Setpoint 2 low limit	0	As display range		
<i>SP 2.H</i>	Setpoint 2 high limit	1000	As display range		
<i>Loc.L</i>	Local setpoint trim low limit	-210	As display range		
<i>Loc.H</i>	Local setpoint trim high limit	1200	As display range		
<i>SPrr</i>	Setpoint rate limit	OFF	As display range		
<i>dwEll</i>	Dwell time	OFF	0.1 to 999.9 minutes		
<i>End.t</i>	End type	<i>rSEt</i>	<i>rSEt</i> <i>hold</i> <i>Stby</i> <i>dwEll</i>		
<i>Prog</i>	Program control	<i>rES</i>	<i>run</i> <i>rSEt</i>		
<i>Stat</i>	Status of program	<i>OFF</i>	<i>rmP</i> <i>dwEll</i> <i>End</i> <i>OFF</i>		

# APPENDICES

## APPENDIX A: BARRELS FOR PLASTICS SYRINGES

Two optional barrels are available for the Piston Extruder. These barrels are designed to support 5cc and 10cc all-plastic syringes respectively. The use of plastic syringes is useful to process highly corrosive fluids or very small amounts of solution at low temperatures.

If the syringe barrels have been ordered they are supplied with 100 non-sterile, specially modified syringes and with a piston tip. The piston tip is pressed onto the end of the metal piston and enlarges its end surface area. This enlarged area provides even pressure to the syringe plunger.

Additional syringes can be obtained from DACA Instruments.

The barrels are loaded on the Piston Extruder as described on page 20. The 10cc barrel is long enough to accept the heating jacket during operation, however do not operate this barrel at temperatures above 60°C since the syringe will begin to soften and operate improperly.

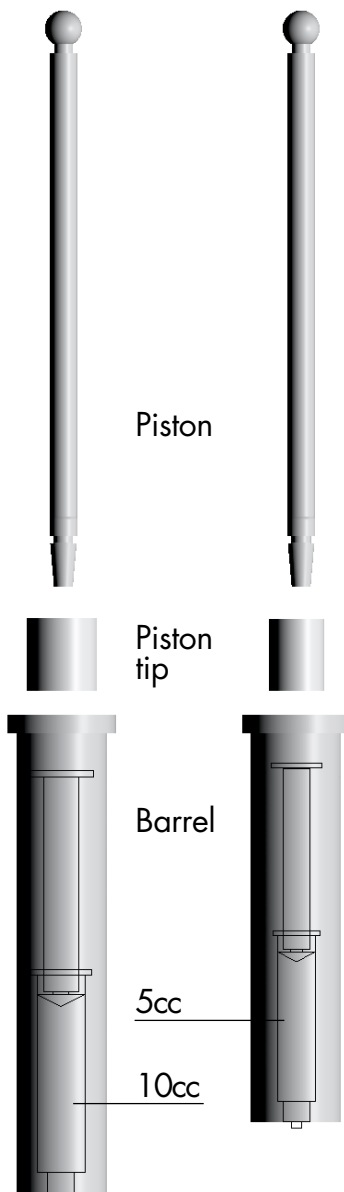
The filled syringes are loaded into the barrel through the top opening. The starting position for the piston (pp. 29) accommodates a fully loaded syringe.

Use only blunt-cut needles for fiber spinning. Standard, sharp point needles will yield very poor fibers. These needles can be obtained from DACA Instruments or directly from:

Newark Electronics

Phone: (800) 4-NEWARK

FAX: (800) 718-1998



Catalog No	Description	ID Inches (mm)	Hub Color	~cost \$/50
52F9944	18 GA 1/2' long	.033 (.84)	green	7.62
52F9947	20 GA 1/2' long	.024 (.61)	pink	7.62
52F9948	21 GA 1/2' long	.024 (.50)	purple	7.62
52F9949	22 GA 1/2' long	.016 (.40)	blue	7.62
52F9950	23 GA 1/2' long	.013 (.33)	orange	6.24
52F9951	25 GA 1/2' long	.010 (.25)	red	7.62
16F8269	27 GA 1/4' long	.008 (.20)	clear	7.22
52F9954	30 GA 1/4' long	.006 (.15)	lavender	8.81



# LIMITED WARRANTY

## **Our Pledge**

It is the goal of DACA Instruments to have every article bearing the DACA name give you, the Customer, complete satisfaction. To achieve this end, we maintain the highest standards for our workmanship and materials, and for the inspection of our products. If the article you have purchased should experience any problem during its lifetime, contact us and we will do all we can to fix the problem. (We will fix it almost for free during the first year.) However, if you abuse the article or accidentally “drop it on your foot,” it’s your problem!

PLEASE COMPLETE AND RETURN THE WARRANTY CARD WHICH IS INCLUDED WITH YOUR INSTRUMENT SHIPMENT. Although it is not a requirement to validate the warranty, it will allow us to send you (and not the purchasing department) information about new products, as well as modifications to the product you purchased.

## **LIMITED WARRANTY**

DACA Instruments warrants this equipment to be free of defects in materials and workmanship for a period of thirteen (13) months from date of shipment. DACA’s Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling, shipping and setup time. This ensures that our customers receive maximum coverage on each product. Our liability under this warranty is limited to the repair and replacement, at our expense, of any defective item or part thereof with a similar item or part thereof free from defect. This warranty does not apply to any equipment altered by Customer or which malfunctions because of Customer’s fault or negligence or to components which experience normal wear. If during the warranty period the equipment malfunctions and the Customer contacts DACA Instruments, describing the problem being encountered, DACA Instruments will analyze the problem to the extent possible and either advise of corrective action that the Customer can perform or request the return of the equipment to DACA Instruments for factory repair. If factory repair is required, Customer will return the equipment in accordance with DACA Instruments’ instructions at Customer’s expense. Upon receipt, DACA Instruments shall either repair the equipment or replace it with an equivalent unit(s), and return such equipment to Customer at DACA Instruments’ expense. THE WARRANTIES CONTAINED IN THIS PARAGRAPH ARE IN LIEU OF ALL OTHER WARRANTIES, AND NO OTHER WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY OR FITNESS, APPLY TO THIS EQUIPMENT, AND NO EXPRESS WARRANTY OR GUARANTY, EXCEPT AS MENTIONED ABOVE, GIVEN BY ANY PERSON, FIRM OR CORPORATION WITH RESPECT TO THIS EQUIPMENT, SHALL BIND DACA INSTRUMENTS.

This warranty gives the Customer specific legal rights, and the Customer may also have other rights that vary from state to state, province to province, or country to country.

## **LIABILITY**

These units are inherently dangerous and are intended to be installed and used only by qualified personnel. Our liability is conditioned upon the installation, operation, maintenance, storage, service and repair of the item in accordance with written plans and instructions prepared or approved by us. In no event will DACA Instruments be liable for any damages, including any lost revenue or other indirect, incidental, special, consequential, punitive or exemplary damages arising out of the use or inability to use equipment purchased from DACA Instruments. By accepting this equipment, the Customer will assume all liability for any damages which may result from its use or misuse by the

purchaser, his/hers/its employees or by others. No warranty extended herein will apply if such unit is installed or used by unqualified personnel. Further, the customer agrees that any liability of DACA Instruments for all claims if any shall not exceed the amount actually paid by customer.

Further, the Customer and/or its End Users shall indemnify and hold harmless DACA Instruments from all loss, damage, costs and expenses of whatever nature, including attorney's fees, arising from or in any way connected with any injury to person or damage to property resulting from an unauthorized modification or alteration of the Product.

**PATENTS:** The sale of any product or products by DACA Instruments pursuant to this order does not convey to the Purchaser any license, by implication, estoppel, or otherwise, respecting any patent, trademark or trade name claims or rights of DACA Instruments covering said product or products or any combination thereof with or without other devices or elements.

**MODIFICATIONS TO THE TERMS OF SALE:** No addition to, deletion from, nor modification of any of the provisions of the Terms & Conditions of Sale of this order shall be binding upon DACA Instruments unless acknowledged and accepted in writing by DACA Instruments. Any change made by DACA Instruments will be deemed accepted by Customer unless, within ten (10) days from written notice of such change, Customer notifies DACA Instruments. Any waiver of the Terms & Conditions of Sale shall not be deemed to be a continuing waiver or a waiver of any other default or of any other of these Terms & Conditions of Sale, but shall apply solely to the instance to which the waiver is directed. Any agreed upon modifications shall be specified on both the Customer's purchase order and DACA's order acknowledgment document.

**MISCELLANEOUS PROVISIONS:** This Agreement is entered into, shall be governed by, and is to be construed according to the laws of the State of California. Any dispute, controversy, or claim arising out of or relating to the enforcement, interpretation, or alleged breach of this Agreement shall be submitted to and resolved by binding arbitration in the Santa Barbara County, California before one (1) neutral arbitrator appointed in accordance with the Commercial Arbitration Rules of the American Arbitration Association and judgment upon the award may be entered in and enforceable by any court having jurisdiction. In the event that any matter respecting this Agreement is submitted to arbitration or if either party hereto files suit to enforce and/or interpret this Agreement, the prevailing party in such proceedings shall be entitled to reasonable attorney's fees and costs. In addition, jurisdiction and venue of any claim filed to enforce and/or interpret this Agreement shall lie with the appropriate State of California court in the County of Santa Barbara

The parties hereto agree that if any provision of this Agreement or the application thereof is held to be invalid, then such invalidity shall not effect any other provisions of this Agreement or the application thereof and to this end the provisions of this Agreement are declared severable.

This Agreement contains the entire agreement of the parties concerning any and all matters described herein, and supersedes any prior or contemporaneous agreements with respect thereto.



**NOTES**

