

# HBC-4301A Hot Bonding Controller

## Operators Manual





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**NOTE:** Throughout this manual, several important keys have been referred to by an abbreviation.

i.e.	↵	Refers to the Enter key
	[ESC]	Refers to the Escape key
	↓, ↑, ← & →	Refers to the Cursor keys

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and the control case software version 2.13, released 26 May 2016

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# 1. PRODUCT DESCRIPTION

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The Novatech Controls HBC-4301A Hot Bonding Controller is a feature-rich composite bonding controller system designed to suit the varied requirements of today's composite bonding industries.

The device consists of an electronic / vacuum control case which is configured and monitored via a computer interface. The control case is designed with storage space beneath the lid to accommodate a notebook computer, although non-portable computers may also be used.

Communication between the bonder control case and computer is done via a supplied serial cable. The standard cable supplied is approximately 5 metres in length, although cable extensions can be supplied to extend this distance up to 100 metres.

Each bonder control case has three programmable heater outputs that are individually configured and controlled, 16 thermocouple inputs to measure temperature, two vacuum ejector pumps and two vacuum transducer inputs to provide vacuum control.

For tasks requiring additional heater zones and thermocouple inputs two separate control cases can be networked together increasing the capacity for a cure cycle to 6 heater zones, 32 thermocouple inputs and four vacuum pumps.

A small display and keypad is located on the front panel of the control case. This is used for the calibration of the device, and if desired can display other bonder related process variables such as thermocouple temperatures, zone power output and vacuum levels.

The HBC-4301A Control Case is configured and monitored via a Microsoft Windows computer interface. This approach is used to take advantage of the familiar user input methods, real-time monitoring and detailed logging capabilities of a computer. The interface also offers several options for storing and producing physical documentation of cure cycle task data during and after the completion of a task on the screen, or in the form of a printed document.

Prior to starting a cure, thermocouples are assigned to the heater output zones using the 'Thermocouple and Heater Zone Setup' screen. The temperature for each heater zone is determined by finding the hottest thermocouple assigned to each heater zone. During operation this temperature is plotted on the zone Temperature Graph screen, as well as being used to control the temperature of the zone.

The HBC-4301A bonder also has the ability to regulate vacuum using its two vacuum ejector pumps, and to adjust the vacuum level to pre-defined levels at key stages during the cure cycle.

Please refer to the appropriate chapters in this manual for further details on temperature and vacuum control.

## 1. Product Description

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### 2.1 Hardware Specifications

#### **NATO Stock Number: 6685-66-145-0064**

The central or main component of the HBC-4300 series is the HBC-4301A control case. The case contains the notebook computer for transportation, and also:

- The main microcomputer
- Thermocouple reading circuitry
- Heater control
- Backup keypad / display
- Automatic vacuum control pumps and circuitry

Number of T/C Inputs	16 (expandable to 32 using two control cases)
Thermocouple Type	Type K or J
Temperature Range	Up to 300°C (570°F)
Accuracy	+/- 1°C
Number of Heater Zones Inputs	3 (expandable to 6 zones using two control cases)
Type of Controlled Output	Phase angle and burst fired SCRs to operate infra-red heater lamps or mats
Heater Current (Max Load)	10 Amps
Heater Power	7.2kW total at 240vac supply (2.4kW per zone) 3.3kW total at 110vac supply (1.1kW per zone)
Power Supply Safety Protection	Earth leakage circuit protection on each heater
Vacuum Sources	2 Air operated ejectors, down to -80 kPa
Vacuum Control	Automatic, programmable
Air Supply	400 to 650 kPa (Normal operation 500kPa) 200 l/m (both pumps running at 100%)
Mains Voltage Supply	Single phase or 3 phase 100 to 240VAC 50/60 Hz (phase to neutral)
Power	10Watts for controller plus heater power
Safety Switch	Earth leakage detector on each zone (30mA)
Environmental Rating	Operating Temperature -25°C to 55°C Relative Humidity 5% to 95% (non-condensing)
Degree of Protection	IP65 with the case closed IP30 with the case open
Case Dimensions, HBC-4301A	520 mm wide by 425 mm deep by 220 mm high
Case Weight, HBC-4301A	14 kg plus notebook computer (approx 2.8kg)

## 2.2 Operational Specifications

Temperature Control

0 to 300°C

Real-time Display

### Thermocouple Table

During operation, an all inclusive table grouping the thermocouples by heater zone output. Thermocouples within the table are colour-coded to indicate actual temperature relative to the controller set-point, as well as indicate which thermocouple is the hottest in each zone and which thermocouple is the coldest acceptance enabled thermocouple

### Graph Display

A graph showing the set-point temperature for each zone for the duration of each run, as well as the actual control temperature during operation. Overlaid onto this graph is the coldest acceptance enabled thermocouple.

During operation the graph also overlays information regarding the different stage numbers, adhesive flow temperature, bond failure area

Zone Heater Temperature Control

The heater outputs for each zone are controlled so that the highest thermocouple in each zone is controlled to the profile set-point.

Selection of Acceptance Thermocouples

Any thermocouple can be nominated as an ‘acceptance thermocouple’.

The lowest temperature for all thermocouples selected acceptance thermocouples is called the Accept Temperature. This temperature is then used for guaranteed soak time automatic adjustments when an adhesive profile is selected.

Zone Stage Progression Control

All zones within a task begin the ramp phase of each stage simultaneously, and will control to the same temperature set-point. The bonder will also not progress to the next stage until all active zones have completed the soak phase of the current stage.

Display Units of Measurement

The PC Interface can be configured to display in several units of measurement

Temperature: Celsius / Fahrenheit

Vacuum: kilopascals (kPa) / Atmospheres (Atm) / Inches of Mercury (InHg) / Bars

Pressure: kilopascals (kPa) / Pounds per Square Inch (PSI) / Bars

---

Heater Cycle Profile	<p>Up to 6 stages, each stage consisting of a controlled temperature ramp phase followed by a timed soak phase.</p> <p>The ramp phase increases or decreases the set-point temperature at a controlled rate between 0.5°C per minute to 10°C per minute. The soak phase holds the set-point temperature constant from 0 to 999 minutes.</p>
Pre-Programmed Heater Cycle	<p>The PC Interface has the ability to save up to 100 pre-programmed heater cycles.</p>
Storage and Retrieval of Job Data	<p>All jobs are constantly stored to the PC during operation and archived at completion. In the event of a computer power failure the program can be resumed from the point at which it stopped. At the completion of a job, whether through premature termination or the end of the final stage the job is immediately archived to local storage where it remains until it is deleted by someone with manager access.</p>
Hard Copies of Job Data	<p>Available anytime during operation, at the completion, or by retrieval from the Previous Jobs Database. All information can be printed including Configuration, Temperature Tables, Graphs and Process Logs</p> <p>Printing is handled via the Windows print spooler, so any Windows compatible printer is supported. Page sizes supported are A4 and Letter, orientation is handled by the program</p>
Import and Export of Previous Jobs	<p>All documents relating to a completed job are stored as a single ZIP archive which can be exported and accessed using standard computer programs. Run-time data is stored in comma-separated values (CSV) formatted files the can easily be opened in spreadsheet programs for external reporting. Log files are stored as text.</p>
Alarms and Information During Operation	<p>A loud buzzer and a large red flashing LED on the control case alert the operator of any alarms during operation.</p> <p>On-screen display using Process Log, which is stored with the job data files for later review, or printed in hard form.</p>

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## 3. INSTALLATION OF THE PC INTERFACE

### 3.1 Installing the PC Interface Software

Insert the Novatech Controls HBC-4301A Installation CD in the CD drive in the PC. Launch the installer by double-clicking the CD icon in the Windows Explorer.

Follow the installer prompts by clicking the 'next' button as requested.

#### Select Components

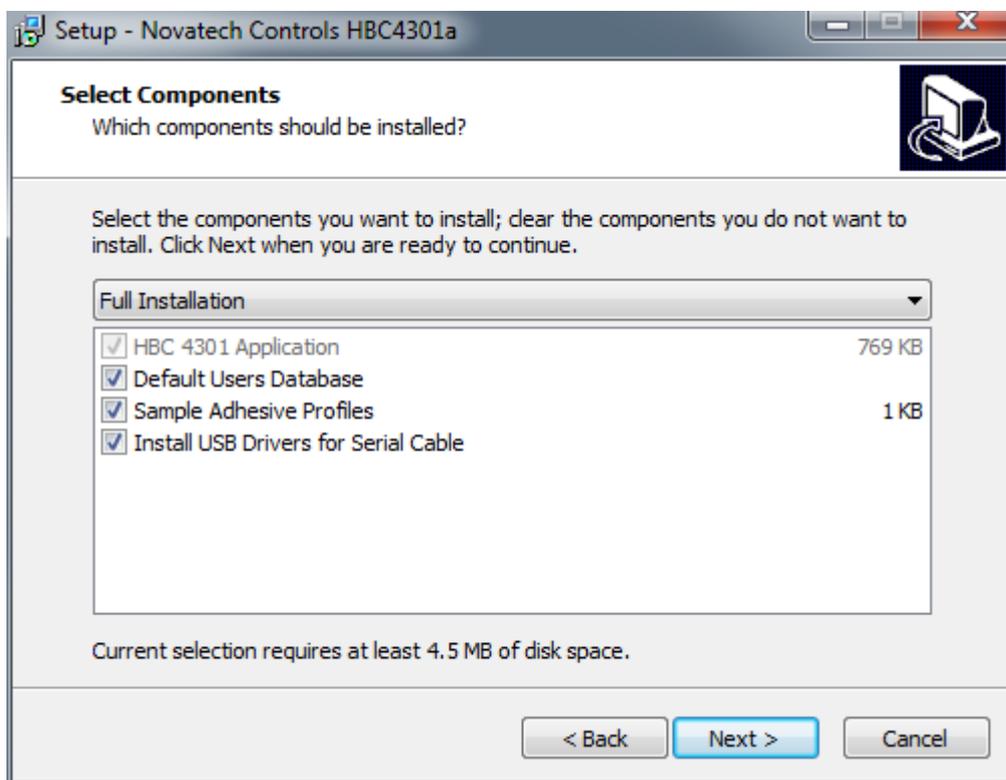
The drop down box gives the operator two options:

- **Full Installation**

This option installs the HBC-4301A PC Interface program, sample adhesives and USB serial cable drivers.

- **Custom Installation**

This allows the operator to enable or disable specific components within the installation process.



**Figure 1: Start of the Installation Screens**

#### Select Start Menu Folder

This screen allows the operator to select a different location for shortcuts to the program to be located in the Start Menu. It is recommended you leave this as default and click next.

#### Select Additional Tasks

This screen allows the operator to place an icon on the computer desktop to launch the program. It is recommended you leave this box checked and click next.

#### Ready to Install

This screen confirms the installation details. Click Install to complete the installation.

### USB Adapter

Drivers for the supplied USB serial cable are installed by default with the HBC-4301A PC Interface and should not need to be installed separately.

**NOTE:** Ensure that the USB cable is not unplugged from the PC while the HBC-4301 program is running. Doing so will cause the program to lose communications with the control case, and may potentially cause Windows system errors.

Remove the HBC-4301 CD from the computer and store it in a safe place.

## 3.2 Starting the PC Interface

When the program is started for the first time the factory default login to gain access to the program is:

**Username:** Default

**Password:** password

**Note:** both username and password are case sensitive.

This will log the user on with the access level of a **Manager**. For further details of the password system see Chapter 12. Operators and Passwords.



**Figure 2: Login Screen and Splash Screen**

After login the program will continue loading while displaying a start-up splash screen showing the software version in the top left corner.

During this time the program will load settings, detecting USB serial cables and commence looking for connected HBC-4301A Control Cases. If the program was improperly shutdown due to a system error or power failure and it detects that an incomplete cycle was already running it will also commence the procedure for resuming this task.

### 3.3 Using the PC Interface

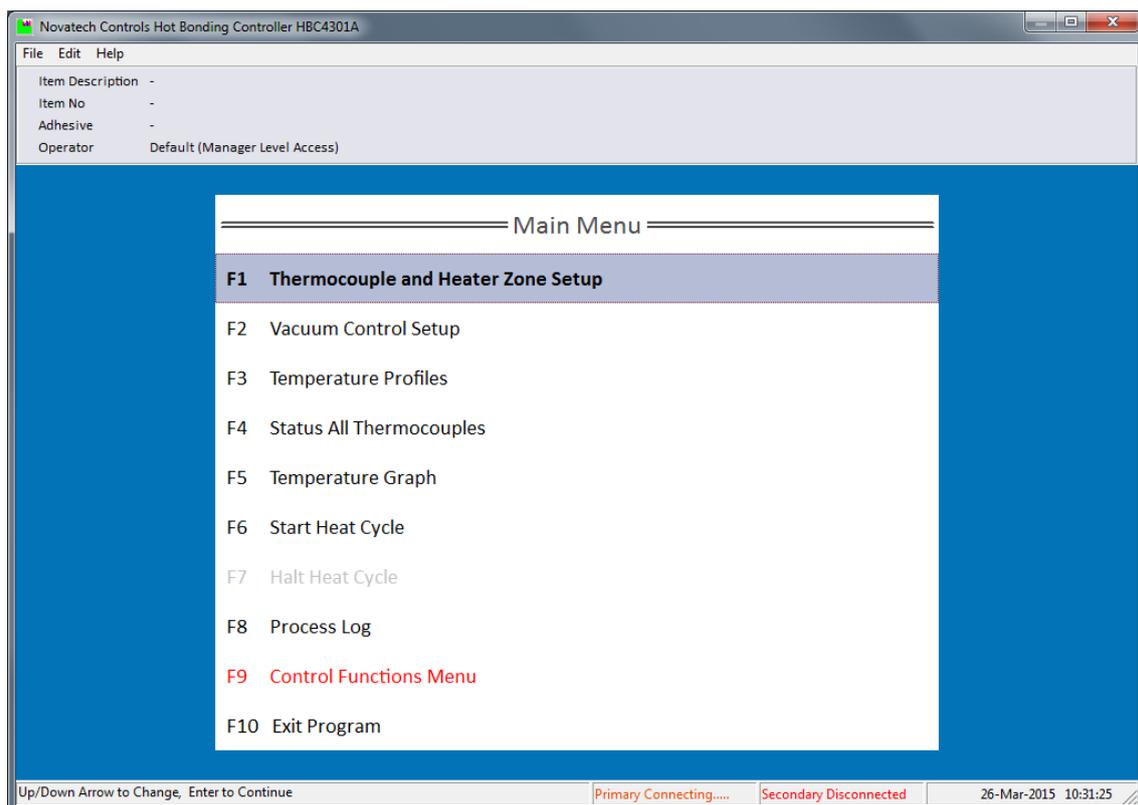
The HBC-4301A PC Interface is made up of a series of screens that are navigated via a menu system. The interface is designed in such a way that it can be interacted with using either the mouse or the keyboard, or a combination of both. There are however several options, such as data entry that will require a keyboard, and some other aspects, such as zooming in on the graphs that can only be done using the mouse.

The PC Interface has several consistent features throughout. First of all the escape key [ESC] is always used to return to the previous screen. Along the bottom of each screen is a toolbar containing buttons for common commands such as save, print, toggle views or return to the previous screen. Along the top of each of the screens related to monitoring tasks in progress is an information bar that will contain information such as item description and the duration of the task.

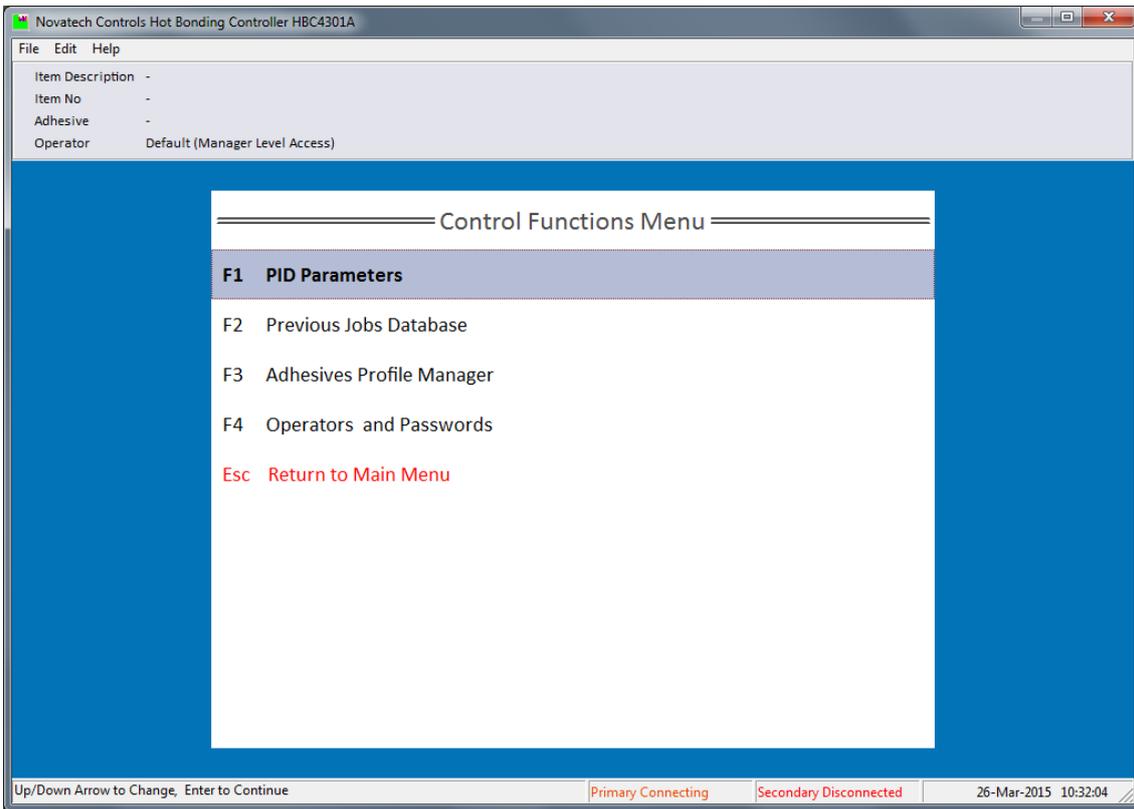
### 3.4 The Main Menu

The program has two menus accessible via the menu system have been split into two groups the **Main Menu** and the **Control Functions Menu**.

When the program first starts, the Main Menu is displayed and provides access to the most common of the functions that are required to configure and run a repair cycle.



**Figure 3: Main Menu Screen**



**Figure 4: Control Functions Menu**

The **Control Functions Menu**, which is displayed when F9 is pressed in the Main Menu. This menu provides access to functions used to configure more advanced aspects of the bonder such as PID control, adhesives profiles, operator accounts or to recall completed cycles.

To select a function either -

- a) Press the corresponding function key shown to the left of the description in the Menu. (i.e. In the **Main Menu**, Function key F1 will select Thermocouple and Heater Zone Setup)
- b) Use the up/down cursor keys to highlight the required function.  
Press the Enter key.
- c) Double-click with the pointing device, either an external mouse or the built in touch pad.

The keyboard function keys access different screens in the Control Functions Menu and the Main Menu. To return to the Main Menu from the Control Functions Menu either double-click on the item highlighted in red or press [ESC]

## 4. THERMOCOUPLES AND HEATER ZONE SETUP

To assign thermocouple inputs to specific heater zones press F1 from the Main Menu to enter the **Thermocouple and Heater Zone Setup** screen

Novatech Controls Hot Bonding Controller HBC4301A

File Edit Help

Primary Controller - Thermocouple Setup

TC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Enabled	Yes															
Zone	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3
Accept	Yes															

Secondary Controller - Thermocouple Setup

TC	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Enabled	No															
Zone	None															
Accept	No															

Primary Controller - Heater Zone Setup

Zone	1	2	3
Enabled	Yes	Yes	Yes
PID Ctrl	Normal	Normal	Normal

Secondary Controller - Heater Zone Setup

Zone	4	5	6
Enabled	No	No	No
PID Ctrl	Normal	Normal	Normal

Temperature Alarm Threshold

Above Setpoint: 5.0 °C  
Below Setpoint: 5.0 °C

Temperature Units: Celsius  
Vacuum Units: KiloPascals  
Pressure Units: KiloPascals

Serial Devices Detected on System:  
Communications Port (COM1) - Looking for Devices...

Save Configuration Esc Return to Menu

Spacebar to Change Enabled, Arrows/Tab to Navigate Fields Primary Connecting Secondary Disconnected 26-Mar-2015 10:32:28

**Figure 5: Thermocouple and Heater Zone Setup Screen**

This screen is used to configure several of the most basic aspects of the device and user interface, including the allocation of thermocouples to each heater output zone, thermocouple temperature alarm thresholds and units of display for temperature, vacuum and pressure. It also has some additional information for checking the connection status of the HBC-4301A Control Case which may be useful for troubleshooting.

Any changes made to the thermocouple and zone configuration, alarm thresholds or units of display will become active once the 'Save Configuration' button in the bottom left corner is pressed, or if the operator selects 'Save' when prompted when leaving this screen.

### 4.1 Quick Summary of the Thermocouple and Zone Tables

- The tables are colour-coding to quickly identify the active and inactive thermocouples and zones. Active thermocouples and zones are highlighted in red, inactive thermocouples and zones are greyed out.
- To place a thermocouple in a zone toggle (using the space bar) the **Zone** cell in the appropriate thermocouple column and make sure that the zone selected for the thermocouple is in the correct task. A zone is automatically enabled when a thermocouple is assigned to it, and likewise automatically disabled once all thermocouples in the zone are removed.
- The PID control parameters for each heater zone can be set individually.

**NOTE:** During operation it is not possible to change the thermocouple / zone configuration except to change the:

- PID values
- Acceptance status of a thermocouple
- Remove a thermocouple

Use the tab and the cursor keys to navigate around the screen, and the space bar to change a selection. The prompt line shows the available keys for each cell.

### 4.2 Thermocouple Configuration

The table shows which thermocouples are enabled, to which heater zone they are allocated and whether the thermocouple has been assigned the status of an acceptance thermocouple.

A thermocouple can also be enabled but not assigned to any heater zone by setting the zone to 'none'. In this case the thermocouple will be used for monitoring only and not for controlling temperature. Thermocouples not assigned to a zone can still be assigned as an acceptance thermocouple, however this is not advised.

### 4.3 Zone Configuration

This table allows the operator to assign PID parameters to each heater zone individually. The three different PID options are described as 'Normal', 'Thick' and 'Thin', as a convenient way to allow for different thicknesses of the structure being patched

The actual PID numbers are set in the PID Parameters screen in the Control Functions Menu, see Chapter 13. PID Parameters

**NOTE:** The PC Interface will attempt to connect to the Primary or Secondary Control Cases only as required. If for example only thermocouples 1-16 or heater zones 1-3 are enabled then the PC Interface will only look for a Primary Control Case. If however any thermocouples 17-32 or heater zones 4-6 are enabled it will immediately start trying to connect to a Secondary Control Case

### 4.4 Temperature Alarm Threshold

The values set in the Above Set-Point and Below Set-Point boxes determine the levels at which the Thermocouple High Temperature and Thermocouple Low Temperature alarms are triggered during operation.

These values also affect the background colour of the thermocouples in the Status All Thermocouples screen. See Chapter 8.1 Status All Thermocouples

## 4.5 Temperature, Vacuum, Pressure Units of Display

The HBC-4301A PC Interface is able to display units for temperature, vacuum and pressure in a number of standard formats. The actual display units do not affect the operation of the device and can be changed to suit the operator. The units of display selected here will alter the displayed values in the tables, graphs, heater cycle setup as well as process log.

As the process log is generated during operation, if the operator changes the units of display mid task then the process log will display any new log items in the new units, but any previous entries in the log will remain as they were.

### Options for units of Display

Temperature: Celsius / Fahrenheit

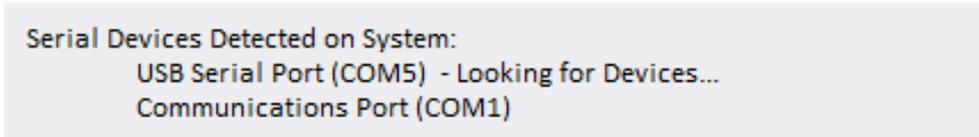
Vacuum: kilopascals (kPa) / Atmospheres (Atm) / Inches of Mercury (InHg) / Bars

Pressure: kilopascals (kPa) / Pounds per Square Inch (PSI) / Bars

## 4.6 Serial Device Detection

The last option on this screen is for information purposes only and cannot be altered using the keyboard or mouse. It is provided as a point of reference for the operator to identify the status of the connection between the HBC-4301A Control Case and the PC.

The first item lists the serial devices detected on the system. If the USB serial cable is plugged in and the drivers installed it should appear as an item at the top of the list as 'USB Serial Port', with some identifier listed next to it in brackets, as shown in example 1 below.



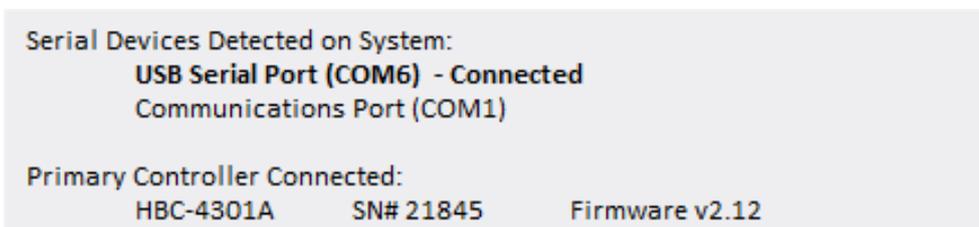
### Example 1

If the USB serial cable is connected to the PC and you do not see an item listed such as this, it either means the Windows drivers for the cable are not properly installed, or potentially the cable or USB port are damaged.

Once the serial ports on the PC have been detected the PC Interface then tries to establish a connection with a HBC-4301A Control Case with each device in turn. You will see the status 'Looking for devices' next to each device in sequence.

This will continue indefinitely until the PC Interface is able to establish communications with a Control Case. At this point the device will be highlighted in bold and the status will change to 'Connected'

Beneath this is a description of the connected Control Case listing the device serial number, and the locally installed firmware version, as shown in example 2 below.



### Example 2

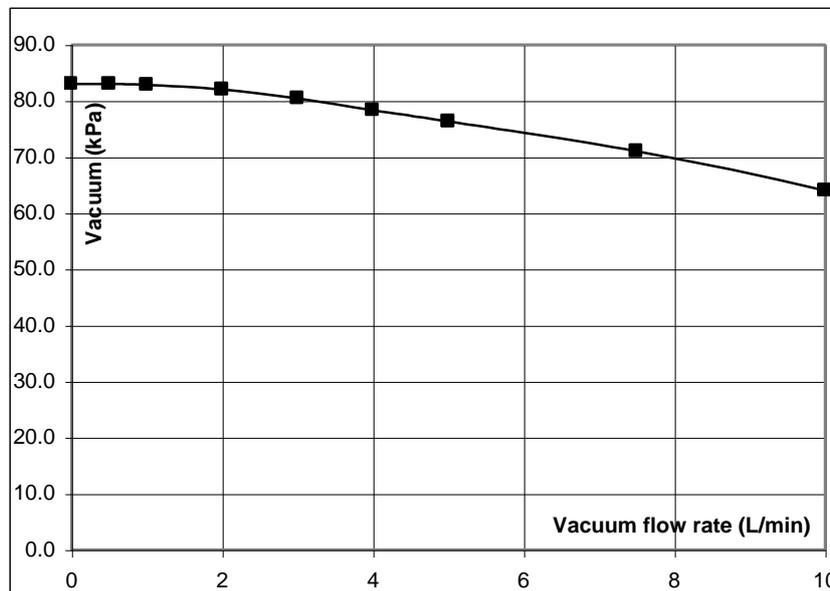
## 5. VACUUM CONTROL SETUP

### 5.1 Vacuum Pumps

The HBC-4301A Control Case is supplied with **two** vacuum ejector pumps, both of which are independently configured and controlled using the two respective external vacuum inputs.

The two vacuum pumps require a pressurised air supply between 400kPa and 600kPa to operate, as well as external 4-20mA vacuum transducers for control feedback. The vacuum levels are logged during operation and there are both low and high vacuum alarms that can be enabled to alert the operator of any problems.

Both vacuum pumps are capable of sustaining a vacuum of approximately -80kPa with a leak rate of <2 litres per minute, dropping off to -60kPa with higher leak rates up to 10 litres per minute. Exceeding this level of leak rate it would be impractical to try to maintain a steady vacuum level.



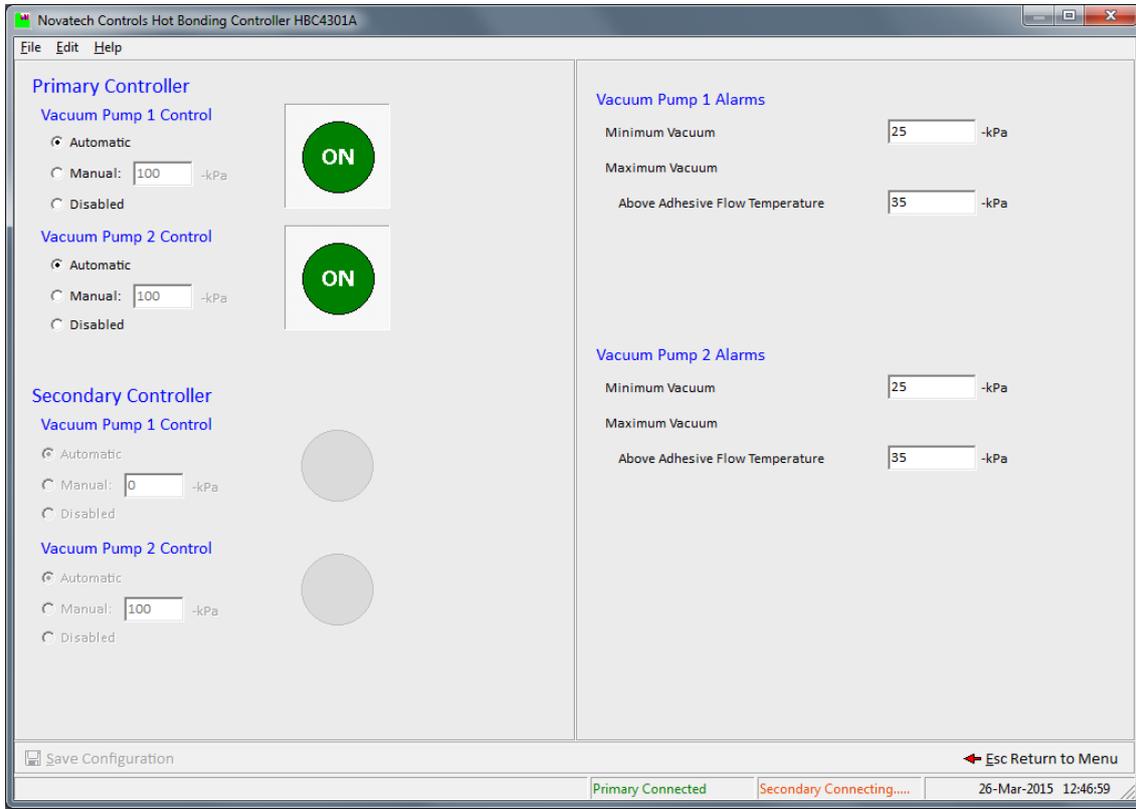
**Figure 6: Vacuum Pump Maximum Vacuum vs Leak Rate**

**NOTE:** In order for the vacuum pumps to work, the vacuum transducer must be present to enable controlled feedback.

The two vacuum pumps are provided to allow automatic vacuum control and monitoring during operation to compliment the temperature controller.

## 5.2 Vacuum Control Configuration

To configure the two vacuum pumps, press F2 from the Main Menu screen to enter the Vacuum Control Setup screen



**Figure 7: Vacuum Control Setup Screen**

In order to control vacuum, the output from each vacuum pump must be fed back to the Control Case via a vacuum transducer connected to the appropriate external vacuum input. The vacuum pumps will not operate until a vacuum transducer with a valid signal is detected.

## 5.3 Vacuum Control Modes of Operation

### Automatic

This option allows the PC Interface to adjust the vacuum level for ‘smart’ vacuum control used for curing adhesives. In this mode the PC Interface controls the vacuum level based on the temperature of the heater zones and the flow temperature of the selected adhesive.

The Temperature Profile screen has an option to configure two vacuum levels; one level for vacuum below adhesive flow temperature and a second for above adhesive flow temperature.

In Automatic Control mode the vacuum will initially be controlled to the first vacuum level. Once any of the heater zones reaches the adhesive flow temperature the vacuum level will immediately be adjusted to the second vacuum level, where it will remain for the duration of the cure cycle.

**Manual**

This option allows the operator to manually set a vacuum level that the Control Case will maintain control at regardless of whether the bonder is operating, or what temperature the bonder is operating at. Setting this to 100kPa has the same effect as turning the pump on full, and setting this to 0kPa is the same as setting the vacuum pump to disabled (see below)

**Disabled**

This option has the same effect as setting the control to Manual 0kPa. It disables the vacuum pump output and suppresses any vacuum related alarms.

The two vacuum pumps can also be switched on or off by clicking the two large buttons next to the control settings. Buttons for switching the vacuum pumps on and off are also located in the Status All Thermocouples and Temperature Graph screens.

Vacuum levels can be set and displayed in several units of measurement, see Chapter 4.5 Temperature, Vacuum, Pressure Units of Display for details.

## 5.4 Vacuum Pump Alarms

When the vacuum pump control is set to Automatic to enable smart vacuum control for adhesive curing there are two additional alarms with alarm thresholds that are enabled.

**Minimum Vacuum**

This sets the alarm threshold for the minimum allowable vacuum for the cure cycle. If the vacuum level dips beneath this level at any time during the task the operator is notified and the alarm is logged to the Process Log.

**Maximum Vacuum above Adhesive Flow Temperature**

This is the alarm threshold for the maximum allowable vacuum once the temperature reaches the adhesive flow temperature.

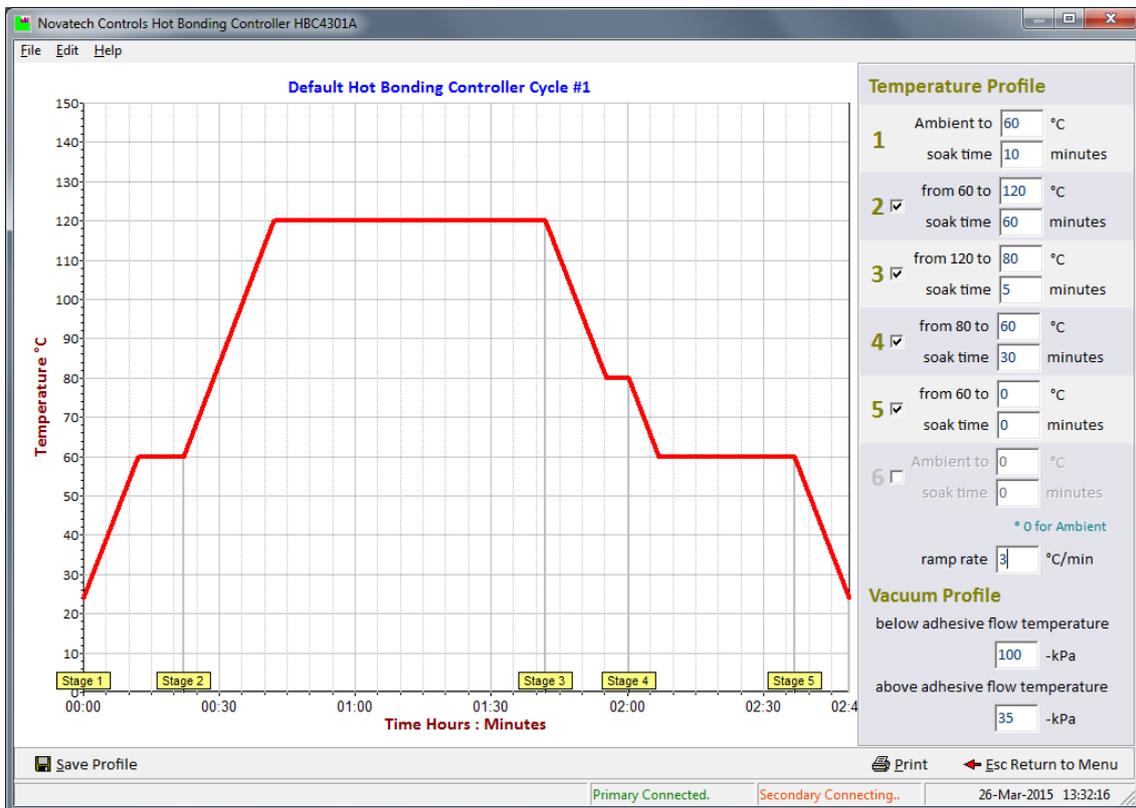
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## 6. EDITING A TEMPERATURE PROFILE

There are 100 heat cycles profiles stored in the HBC-4301A PC Interface that can be edited and renamed before starting a cycle. Each temperature profile has up to 6 stages each comprising of a controlled ramp phase followed by a timed soak phase. Additionally the temperature profile also contains information defining the ramp rate and vacuum control information used for adhesive cure cycles.

To create or edit a temperature profile press F3 or select Temperature Profiles from the Main Menu and select the profile to be edited. The select profile dialog is also used to edit the name of the cycle to be edited.

The table on the right of the screen shows the stage soak temperatures and times while the graph on the left gives a visual representation of the cycle temperature over time.



**Figure 8: Temperature Profile Screen**

The six stages can be enabled or disabled in consecutive order using the checkboxes to limit the cycle to the desired number of controlled ramp and timed soak phases. Each stage starts with the ramp phase, moving the temperature set point from the current temperature to the new temperature at specified rate of change. Once at this temperature the soak phase commences which holds this temperature for the defined length of time.

The Vacuum Profile set points are used to set the automatic vacuum level for adhesive cure cycles. The 'below adhesive flow temperature' is the vacuum level that the vacuum pump will control to while the zone temperatures are less than the adhesive flow temperature. Once the heater zones temperature reaches the adhesive flow temperature the vacuum pump will then control the vacuum to the 'above adhesive flow temperature' vacuum level for the remainder of the cure cycle.

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## 7. STARTING AND STOPPING A HEAT CYCLE

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Once the thermocouples, heaters and vacuum have been configured the bonder can begin a heat cycle.

### 7.1 Start Cycle Overview

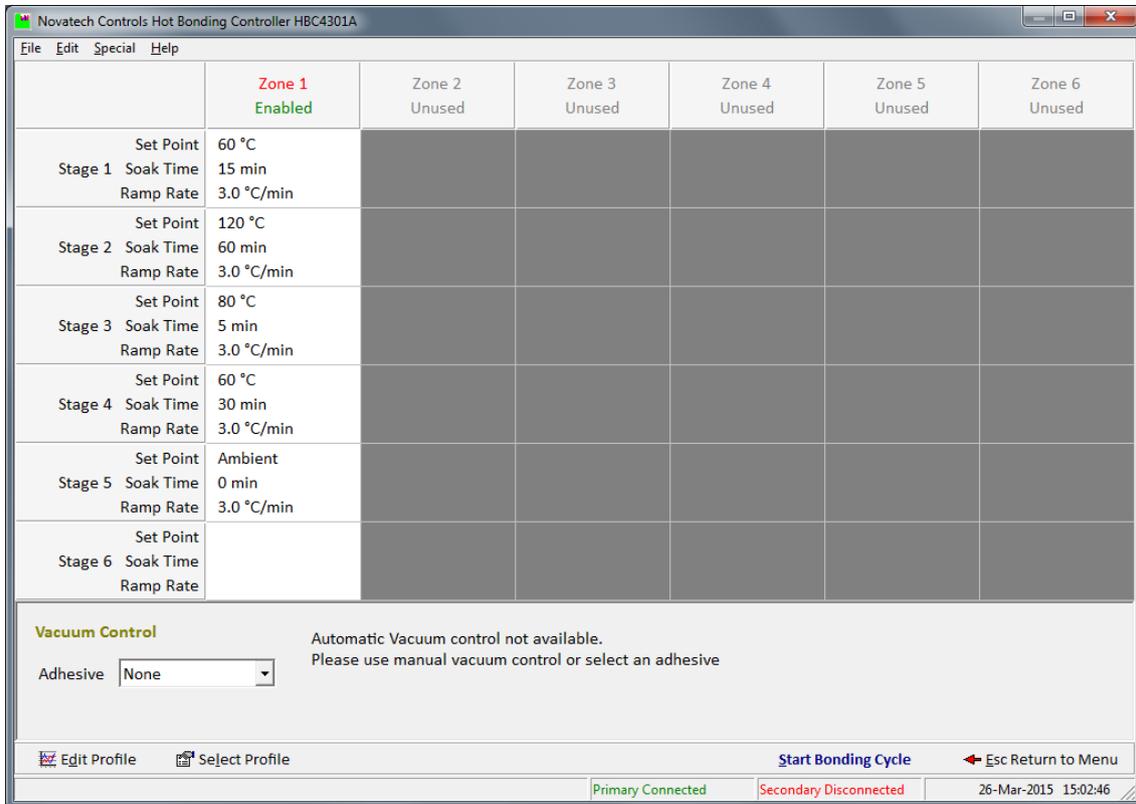
Below is a quick start guide to starting a cure cycle task. The following sections of this chapter will describe the options for each step in further detail.

- a) Select **Start Heat Cycle (F6)** from the Main Menu.
- b) From the table screen, press the Select Profile, to select a pre-recorded temperature cycle, or Edit Profile to edit the currently loaded profile. Once the correct profile has been selected and entered, press [ESC] to return to the Start Heat Cycle screen.
- c) Select an adhesive to enable automatic vacuum control if desired
- d) Press the 'Start Bonding Cycle' button at the bottom right of the screen
- e) Enter the Item Description, Item Number, check the adhesive information is correct and the vacuum pump control is set properly
- f) Press the 'Start Bonding Cycle' button in the Start Task Dialog to start the temperature cycle.

After pressing the button in step 6 above a new cure cycle task will be started. The program will automatically switch over to the 'Status All Thermocouples' table screen to monitor the running task.

## 7.2 Starting a Heat Cycle

The Start Heat Cycle screen shown below provides a summary in table form of the cycles last used for each of the heater zones. It provides a quick reference to see which zones have been enabled, lists the details of the Current Temperature Profile to be started, and provides a selection box to select an adhesive profile for temperature and vacuum control.



**Figure 9: Start Heat Cycle Screen**

The functional keys available on the **Start Heat Cycle screen** are;

### 7.2.1 Edit Profile

(Shortcut Key 'D')

Pressing this button loads the Current Temperature Profile edit screen for the profile to be edited prior to starting the cycle. For details on editing heater profiles see Chapter 6. Editing a Temperature Profile

### 7.2.2 Select Profile

(Shortcut Key 'L')

Pressing this button opens the Select Heat Cycle dialog where the operator can then select one of the pre-programmed Heater Profiles. On selecting a profile it is loaded into the Current Temperature Profile which is then loaded for editing.

**NOTE:** At this stage you are not actually editing the pre-programmed heater profile, but you are editing the Current Temperature Profile, which is a copy of this profile that was previously selected in the previous dialog box.

### 7.2.3 Start Bonding Cycle

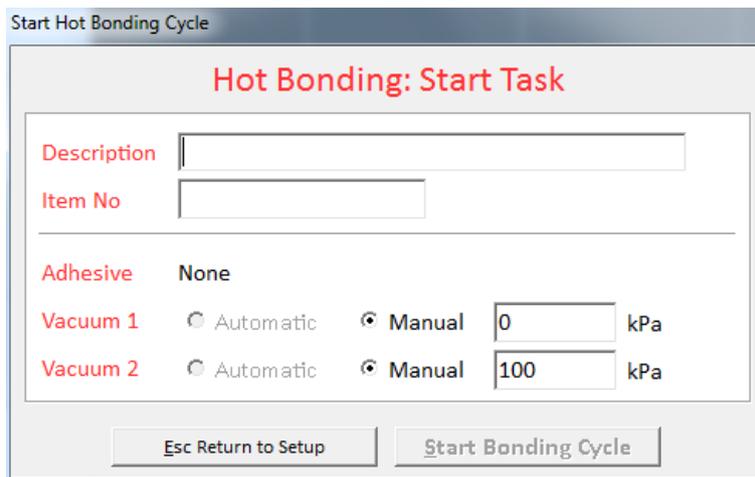
(Shortcut Key 'S')

Press this button to start the bonder using the loaded configuration.

This button will not be enabled unless the bonder is properly configured. There are several reasons why this button might be greyed out and disabled; the text on the button itself gives directions on what is preventing it from starting a bonding cycle.

<b>Text on the Button</b>	<b>Description of the Problem and possible Solutions</b>
Primary Not Connected	<p>The PC is not communicating with the Primary HBC-4301A Control Case.</p> <p>Check that the connected HBC-4301A has been set to <b>Primary</b>. See Chapter 7.4.2 Setting the Control Case to Primary or Secondary.</p>
Secondary Not Connected	<p>The PC is not communicating with the Secondary HBC-4301A Control Case.</p> <p>The PC Interface will attempt to connect to the Secondary Controller if thermocouples 17-32 or zones 4-6 are enabled.</p> <p>Check that the connected HBC-4301A has been set to <b>Secondary</b>. See Chapter 7.4.2 Setting the Control Case to Primary or Secondary.</p>
Zone x Not Ready	<p>One of the nominated zones does not have any thermocouples associated with the zone, or does not have a valid temperature reading due to open-circuit thermocouples.</p> <p>Check the Status All Thermocouples screen to see what might be affecting this zone.</p>
No Enabled Zones	<p>No zones have been associated with the task.</p> <p>Return to the Thermocouple and Heater Zone Setup screen and enable some thermocouples and assign them to zones. See Chapter 4. Thermocouples and Heater Zone Setup</p>
Task Active	<p>The task is running already.</p> <p>Use the Halt Heat Cycle function from the Main Menu to stop the heat cycle.</p>

If the bonder is properly configured and there are no problems, the button should be enabled and the text should say Start Bonding Cycle. Pressing this button brings up the Start Cycle dialog

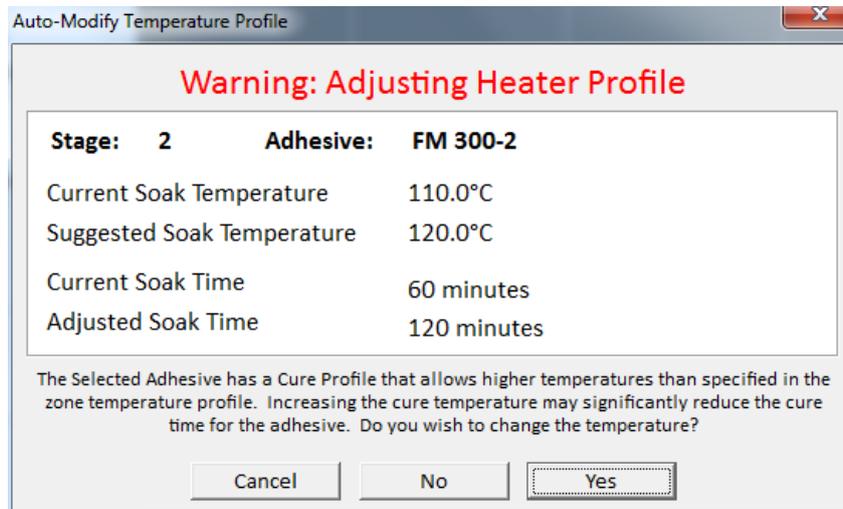


**Figure 10: Start Cycle Dialog**

The Start Cycle Dialog requires the operator to enter information for the description and item number before continuing. This information is added to the log files and printouts for identification.

#### 7.2.4 Automatic Adhesive Heater Profile Adjustment

If an adhesive was selected in the Start Heat Cycle screen then the program will do some basic checks to ensure that the Current Temperature Profile is compatible with the selected adhesive. If the profile is compatible, but not ideal it will prompt the operator to adjust the soak temperature or time to allow optimal conditions for the quickest possible soak time.



**Figure 11: Automatic Adhesive Adjust Dialog**

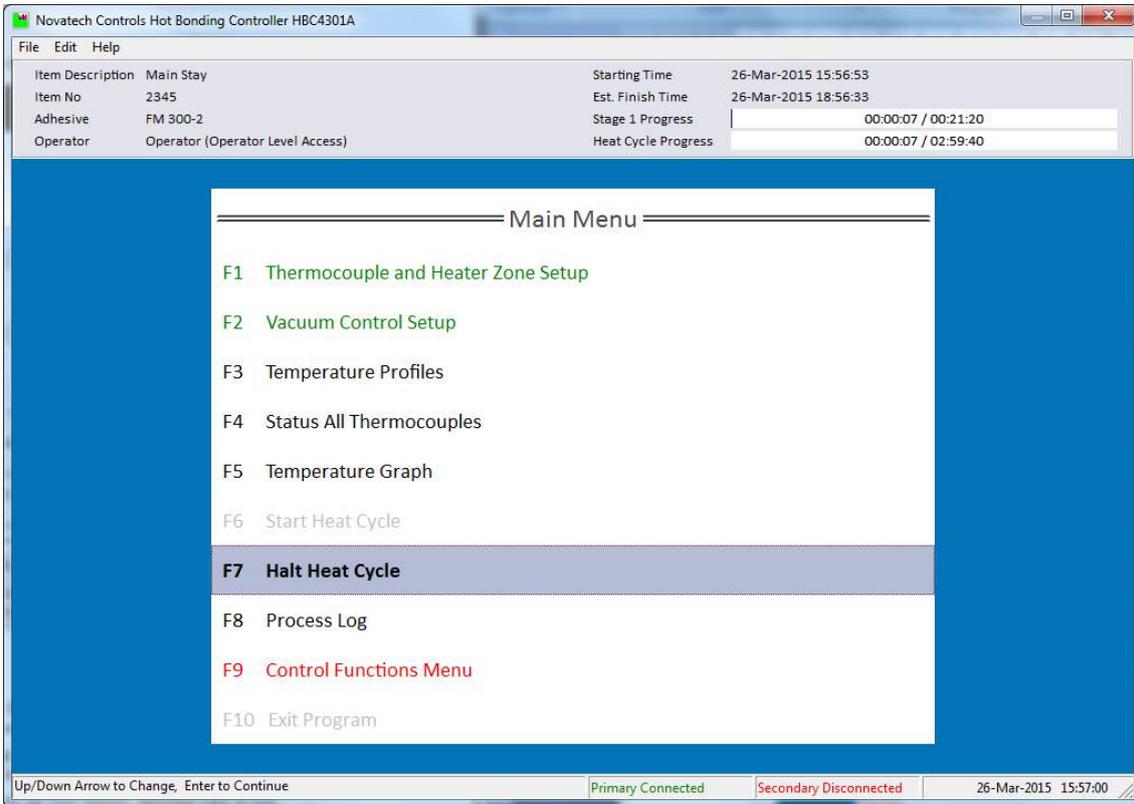
**NOTE:** It may not be the intention of the operator to run the cure cycle and the optimal temperature for the shortest possible soak time. It should be at the discretion of the operator whether to adjust the cycle or not.

If the Current Temperature Profile is wholly incompatible with the selected adhesive then the interface will refuse to allow the task to commence. In this case the operator will be presented with an error message saying ‘Please check the zone temperature profiles are correct for the selected adhesive’

At this stage, if the interface has no other problems, the heater cycle will commence and the program will automatically load the Status All Thermocouples to commence monitoring.

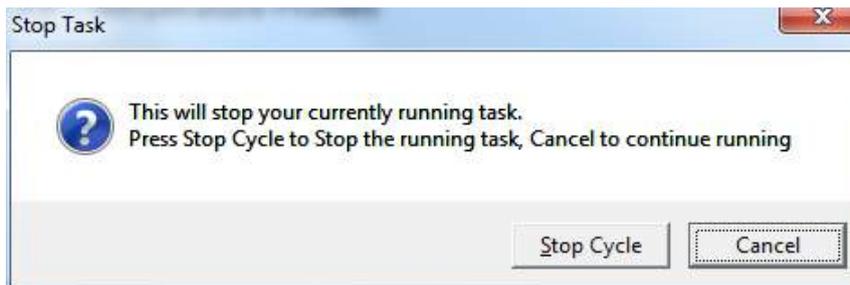
### 7.3 Stopping an Active Heat Cycle

The Heat Cycle will automatically stop once it has completed, however if the operator wishes to halt the cycle early this can be done by selecting Halt Heat Cycle from The Main Menu.



**Figure 12: Halt Heat Cycle on the Main Menu**

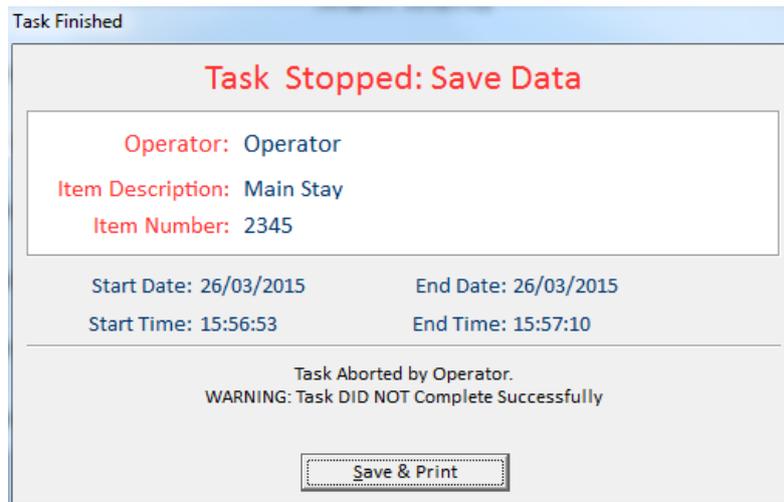
If no task is running this option is greyed out and trying to select this option results in an error message. If a task is active the below confirmation dialog will be shown to confirm the cycle should be prematurely stopped.



**Figure 13: Halt Task Dialog**

By clicking Stop Cycle the task is then stopped and cannot be re-commenced from where it was. All heater outputs are immediately disabled

On the completion of a job the Task Finished Dialog appears again reiterating the job details, duration and status.



**Figure 14: Task Finished Dialog**

Clicking the ‘Save and Print’ button stores all configuration, profile data and process logs to the jobs database. See Chapter 11. Previous Jobs Database for details on accessing and managing previous jobs.

A Print dialog box will open and attempt to send the print job files to the selected printer. Files printed include all active zone graphs and the process log.

## 7.4 Operating with Two Control Cases

It is possible to connect two HBC-4301A Control Cases together to allow the PC Interface to control both cases simultaneously and at the same time double the number of thermocouple inputs and heater zone outputs. This is achieved using a second serial cable connected between the two control cases.

**Before two control cases can be used together they must be configured so that one of the cases is designated as the ‘Primary’ and the other as ‘Secondary’.**

While both cases remain operationally identical, the control case that is set as Primary will control thermocouples 1-16 and zones 1-3, while the control case set as Secondary will control thermocouples 17-32 and zones 4-6.

**NOTE:** It is important to ensure that one case is set as Primary and one case is set as Secondary otherwise neither will work.

### 7.4.1 Checking Whether a Control Case is Configured as Primary or Secondary

To check whether a Control Case is configured as a Primary or Secondary, before connecting the USB serial cable, connect the power cable to the Control Case and switch it on. After initialisation which should take no more than a few seconds it will display which mode it is currently set to.

The control case will display one of the following messages:

Primary Controller	Secondary Controller
Thermocouples 1-16	Thermocouples 17-32
Heater Outputs 1-3	Heater Outputs 4-6

### 7.4.2 Setting the Control Case to Primary or Secondary

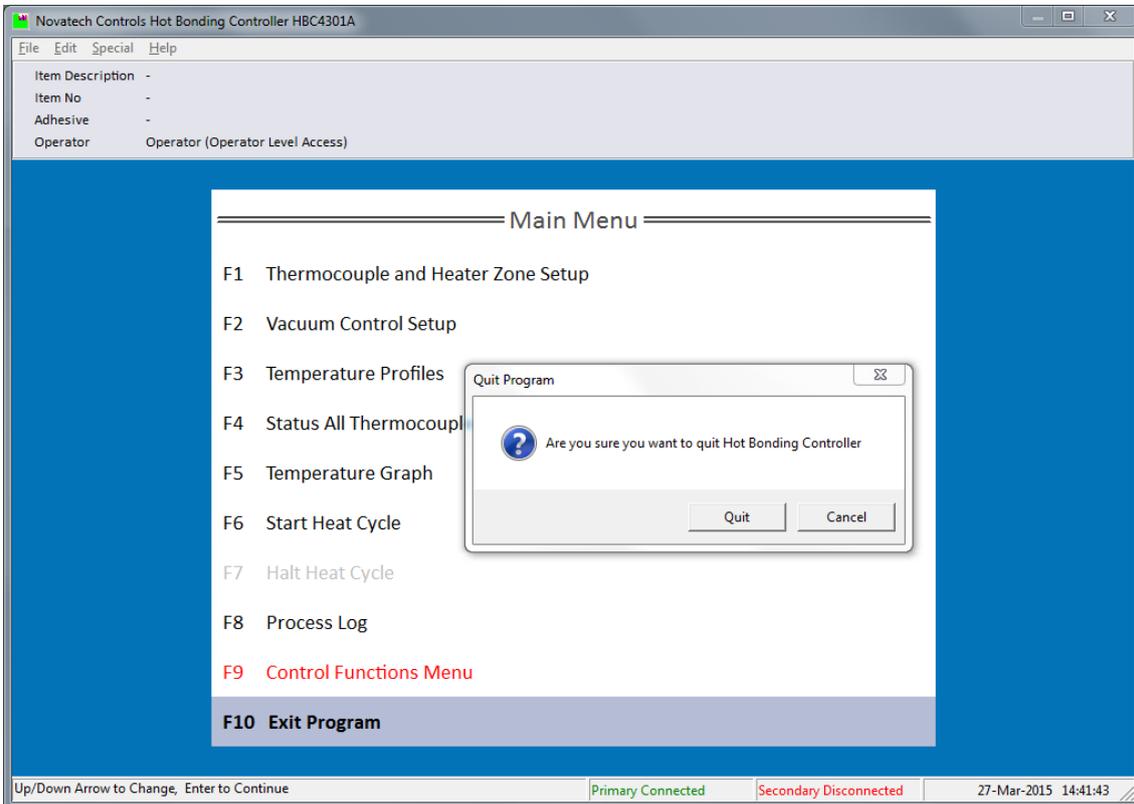
The process of changing a control case from Primary to Secondary must be done from the control case itself using the local keypad. It is the only time the operator will be required to press any buttons on the Control Case itself in standard operation, and once this mode is set it will remain this way even after power is lost.

To change the control case from Primary to Secondary or vice-versa, press and hold any key on the Control Case keypad and watch the LCD display for instructions. After 5 seconds the Control Case will toggle between Primary and Secondary. The control case will then remain either Primary, or Secondary until manually changed.

## 7.5 Closing the PC Interface

The HBC-4301A PC Interface will not allow the operator to exit the program while a cycle is running. If there is an active heat cycle either wait until the task is complete or manually stop the heat cycle in progress. See Chapter 7.3 Stopping an Active Heat Cycle

To close the HBC-4301A PC Interface, from the Main Menu select Exit Program, or press F10. The program will present a confirmation message asking if the operator wishes to Quit.



**Figure 15: Exit Program Confirmation**

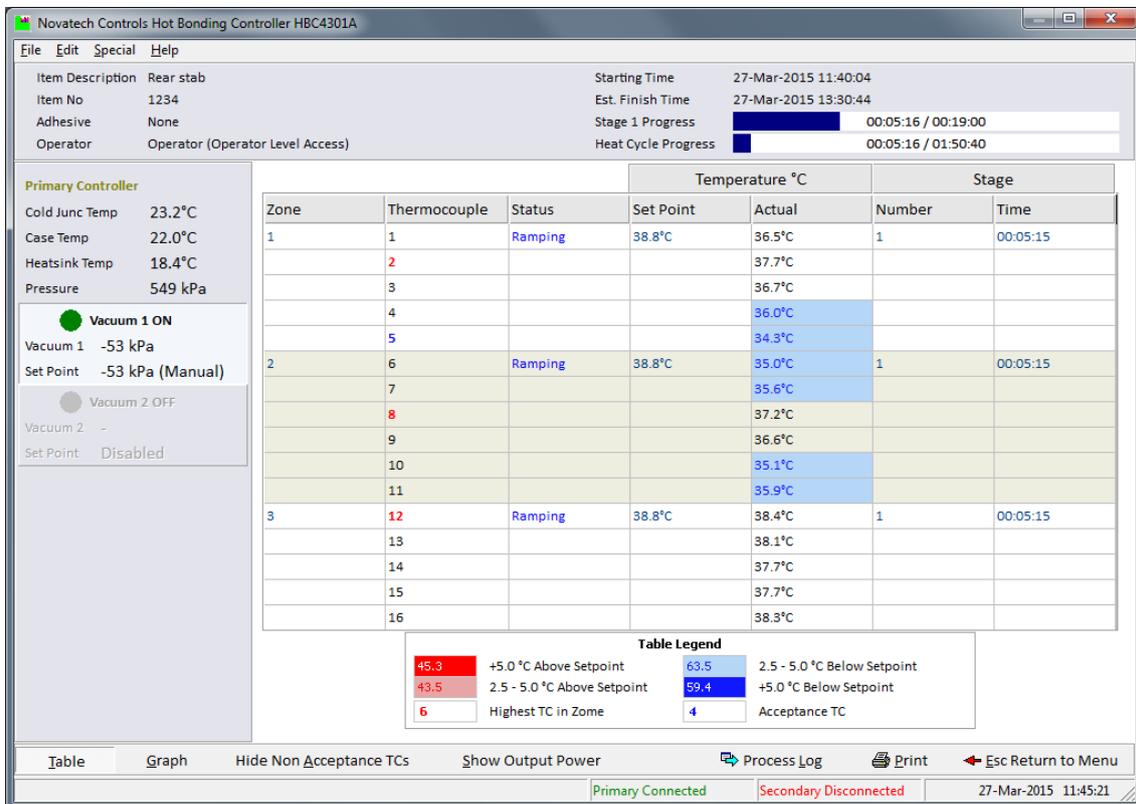
## 8. MONITORING A RUNNING CYCLE

While a temperature cycle is running the status of the task can be monitored from several screens. The temperature of an individual zone can be shown as a graph or all the thermocouples can be shown grouped in numerical order and grouped in zones.

### 8.1 Status All Thermocouples

This screen displays:

- Operator, Item Description and adhesive information
- The current operating status of all of the thermocouples and zones
- Start time, estimated finish time and cycle progress indicators
- Vacuum levels for all vacuum transducers
- Supply air pressure
- The cold junction, case temperature and heatsink temperatures



**Figure 16: Status All Thermocouples Screen - During a Heat Cycle**

From this graph it should be able to see at a quick glance in which zone each thermocouple is located, the current status of the cycle in progress, time elapsed since the task started and the time remaining. The graph uses a system of colour codes to highlight any thermocouples that have deviated from the set point by different amounts. Refer to the Legend beneath the table for details.

The hottest thermocouple in each zone is quickly identifiable by looking in the Thermocouple column for the numbers highlighted in red. The acceptance thermocouple, which is the coldest thermocouple from the group nominated as acceptance thermocouples can also be quickly identified by looking in the Thermocouple column for the number highlighted in blue.

### 8.1.1 Hide Non-Acceptance TCs

(Shortcut Key ‘A’)

This toggle button can be used to quickly hide in the table any thermocouples that are not nominated as acceptance thermocouples in the Thermocouple and Heater Zone Setup screen.

### 8.1.2 Show Output Power

(Shortcut Key ‘S’)

This toggle button controls an additional column at the right side of the table which shows the power output level for each of the zones. This has been included as it allows the operator to monitor both the inputs and outputs for all active zones from the one screen.

The button bar along the bottom of the screen also has links to quickly access the Temperature Graph screen (shortcut key ‘G’), the Process Log screen (shortcut key ‘L’).

The information bar to the left side of the table shows the vital information for each of the connected Control Cases and has buttons to switch on or off the vacuum pumps.

## 8.2 Temperature Graph

The Temperature Graph screen shows a graph for each active heater zones in the current task, and when a task is active the operator can also see the progress of the cycle as it progresses from left to right. In this screen the entire temperature cycle can be seen as a function of time, along with the actual progress of the selected zone. It allows the operator to visualise the progress of the cycle and to identify any time base fault such as temperature lag or oscillations.

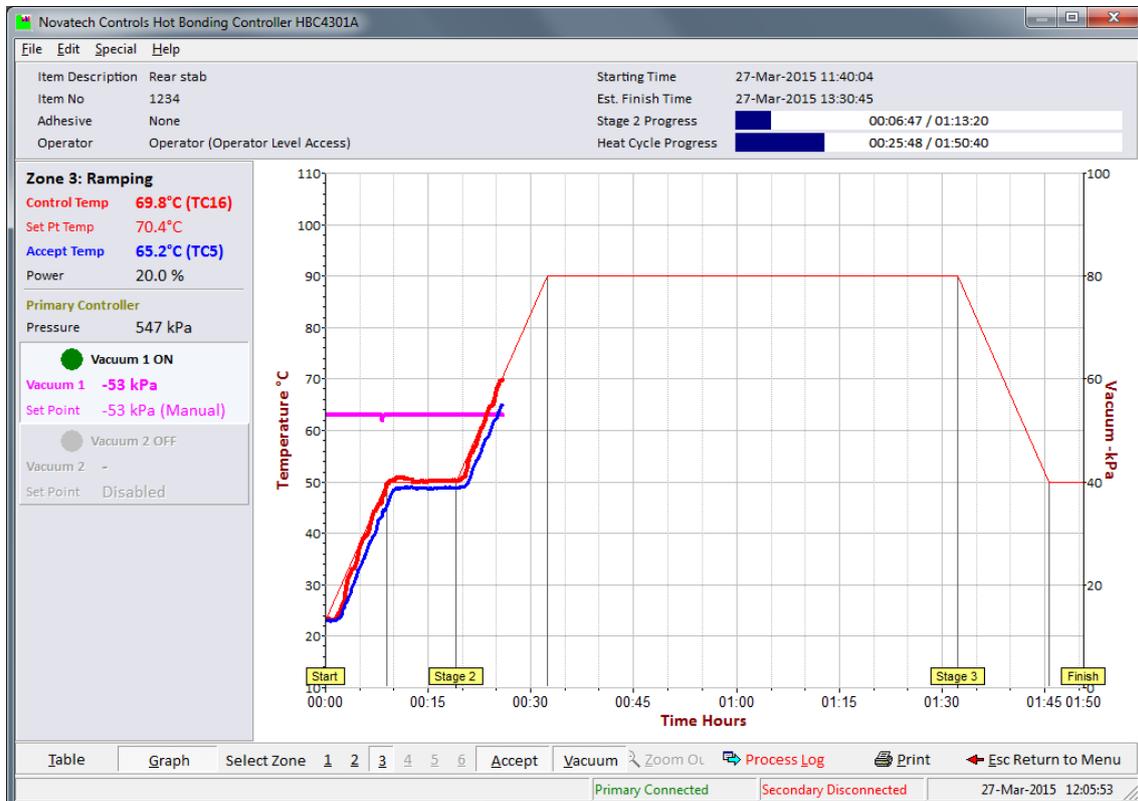


Figure 17: Temperature Graph Screen During a Heat Cycle

Details of any part of the graph can be examined by zooming up on the graph. To zoom in on the graph press and hold the left mouse button while pointing to the top-left corner of the area you want to zoom in on. Drag the mouse to the bottom-right corner of the area and release the mouse button. The graph will be redrawn to fit the zoom area. Pressing the Z key or clicking the Zoom Out button will return the graph to the full screen.

### 8.2.1 Select Zone

(Shortcut key '1' through '6')

These shortcut keys select the zone to display on the graph above. Active zones can be selected, inactive zones are greyed out.

### 8.2.2 Accept

(Shortcut key 'A')

This toggle key shows and hides the acceptance temperature on the graph.

### 8.2.3 Vacuum

(Shortcut key 'V')

This toggle key shows and hides the vacuum on the graph above. The vacuum scale is shown on the right vertical axis on the graph.

The button bar along the bottom of the screen also has links to quickly access the Status All Zones screen (shortcut key 'T'), the Process Log screen (shortcut key 'L').

The information bar to the side of the graph shows vital information for the active Control Cases, specific to the displayed zone. This includes the control temperature along with the control thermocouple number, the set point temperature calculated from the heater cycle, acceptance temperature and power output level as a percentage of full power.

There are also buttons on the left information bar to switch on or off the vacuum pumps.

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## 9. PROCESS LOG, ALARMS

The Process Log screen shows a chronological log of all information, events and alarms from the start to the end of a cycle. Whenever an alarm is triggered during the running of a cycle both the PC Interface and the Control Case will emit a loud beeping noise which is stopped once the operator acknowledges the alarm by entering the Process Log screen. If the operator is already on the Process Log screen they can acknowledge any new alarms by pressing the Accept Active Alarms button in the button bar at the bottom of the screen.

The Process Log screen is accessed by selecting Process Log (shortcut key F8) from the Main Menu screen, or from the button bar in either the Status All Thermocouples or Temperature Graph screens.

Items in the Process Log are colour-coded to quickly identify items that are information based and those that are alarms triggered during a cycle. Information based items will have headings in colours that are green, blue or grey depending on their purpose, while alarms which are intended to alert the operator of potential problems have red headings.

Time	Description
11:40:04 00:00:00	<b>Heat Cycle Setup</b> Stage 1: Set Point: 50°C, Soak Time: 10 min(s), Heat Rate: 3.0°C/min Stage 2: Set Point: 90°C, Soak Time: 60 min(s), Heat Rate: 3.0°C/min Stage 3: Set Point: 50°C, Soak Time: 5 min(s), Heat Rate: 3.0°C/min Stage 4: Skipped Stage 5: Skipped Stage 6: Skipped Vacuum Pump 1: Disabled Vacuum Pump 2: Disabled
11:40:04 00:00:00	<b>PID Settings</b> Zone 0: Normal {P=75, I=18, D=60} Zone 1: Normal {P=75, I=18, D=60} Zone 2: Normal {P=75, I=18, D=60}
11:40:04 00:00:00	<b>Vacuum Alarm Settings</b> No Adhesive Selected Vacuum 1: Low Vacuum Alarm: -25 kPa Vacuum 2: Low Vacuum Alarm: -25 kPa
11:40:04 00:00:00	<b>Information Report</b> TC Temperatures: 1: 23.2°C 2: 23.2°C 3: 23.2°C 4: 23.2°C 5: 23.2°C 6: 23.2°C 7: 23.2°C 8: 23.2°C 9: 23.2°C 10: 23.3°C 11: 23.2°C 12: 23.3°C 13: 23.3°C 14: 23.3°C 15: 23.3°C 16: 23.3°C Zone Temperatures: 1: 23.2°C 2: 23.3°C 3: 23.3°C Acceptance Temperature: 23.2°C Primary Controller: Ambient: 21.3°C Cold Junction: 23.2°C Heatsink: 18.4°C Vacuum 1: -53 kPa Vacuum 2: - Pressure: 549 kPa
11:41:56 00:01:51	<b>Thermocouple 6 &gt;5.0°C Below Temperature</b> Current Temperature: 23.4°C, Set Point Temperature: 28.6°C
11:41:57 00:01:52	<b>Thermocouple 7 &gt;5.0°C Below Temperature</b> Current Temperature: 23.5°C, Set Point Temperature: 28.6°C

**Figure 18: Process Log Screen During a Cycle**

At the commencement of a cycle the configuration of the device is added to the Process Log under a series of headings including Heat Cycle Setup, PID Settings and Vacuum Alarm Settings. There are also information reports at the commencement of the cycle showing item description, adhesive, operator and control case related information.

The Process Log also has the ability to log periodic information reports at set intervals. These periodic information reports are configured to log vital information for the Control Case including status of all thermocouples, vacuum inputs, temperatures and supply air pressure.

At the completion of a task the contents of this log are stored along with the rest of the task data in the database of previous jobs and can be recalled and printed at any stage during the running of the task or after the task has completed.

## 9.1 Critical Temperature Alarm

**NOTE:** A critical temperature alarm is triggered when the PC interface detects that any of the thermocouples within a zone exceeds the zone set point by more than 25°C. The alarm exists as a safety system to prevent serious damage to the structure being heated in the event of a catastrophic failure.

There are several potential scenarios that may lead to this alarm being triggered, which may include, but not be limited to thermocouples being assigned to incorrect heater zone outputs, intermittent thermocouple behaviour or various hardware failures. Each individual case should be investigated thoroughly to understand why this alarm has been triggered.

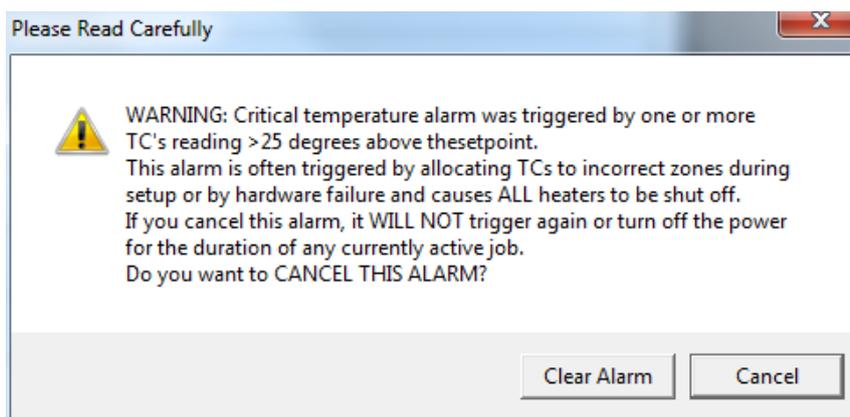
When this alarm is triggered **all zones are immediately and indefinitely disabled** to minimise thermal damage to the area being heated. The critical temperature alarm is logged to the Process Log along with specific information regarding the thermocouple's temperature and set-point.

It is possible to override this critical temperature alarm, although once this has been done the PC interface makes no further attempts to prevent thermal damage by disabling heater outputs.

If the operator wishes to re-enable the heater outputs after this alarm has been triggered there is a button on the Process Log screen to cancel the critical alarm. Once re-enabled the critical temperature alarm will then be disabled and remain so for the remainder of the job.

### 9.1.1 Cancel Critical Temperature Alarm

This button on the Process Log screen becomes active once the critical temperature alarm has triggered disabling all heater zone outputs. Pressing this button prompts the operator to acknowledge that they know what they are doing and that the software will now re-enable the heaters risking potential damage to the structure being heated.



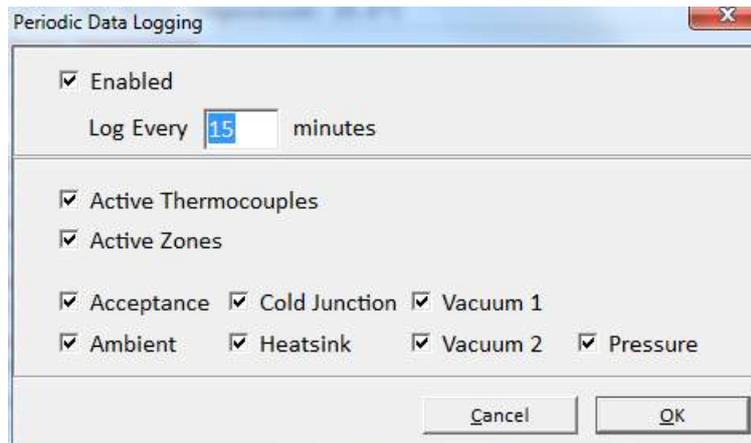
**Figure 19: Cancel Critical Temperature Alarm Confirmation**

By pressing the Clear Alarm button on the confirmation message the alarm is then disabled and power to the zones will be reinstated.

## 9.2 Periodic Log

The Process Log is designed to allow information both critical and informative relating to the cycle in operation to be logged in a chronological order. In addition to alarm information which is logged as it occurs, the Periodic Log system generates reports at fixed intervals listing the vital information relating to the active cycle.

The Periodic Log is user-configurable allowing the operator to choose which vital information is logged, and how often. Configuration of the Periodic Log is accessed by pressing the Periodic Log Setup button on the Process Log screen.



**Figure 20: Periodic Log Setup Dialog**

Pressing OK on this dialog updates the information to be logged and the log period. The changes are made effective immediately although any Periodic Log information reports already in the Process Log remain unchanged.

## 9.3 Process Log Items Summary

The HBC-4301A PC Interface will record all events that occur during a repair. The following is a list of some of the possible process messages that are saved to the log file:

### 9.3.1 Heat Cycle Started

This information report shows information relating to the operator, item description, adhesive, PC Interface version and Control Case serial number. This is the first item that appears in the Process Log when a cycle starts.

### 9.3.2 Heat Cycle Stopped / Finished

This information report marks the end of a heat cycle, whether through completion or through operator intervention. This is the last item that appears in the Process Log at the end of a cycle.

### 9.3.3 Information Report

This is the heading given to the automatically generated Periodic Log. See Chapter 9.2 Periodic Log

### 9.3.4 Heat Cycle Setup / PID Settings / Vacuum Alarm Settings

These information items are added to the Process Log at the commencement of a cure cycle, or when the settings described are altered by the operator during the course of an active cycle.

### **9.3.5 Heat Cycle Resumed**

This information is logged when a heat cycle is resumed after the PC Interface has been closed unexpectedly.

Similar to the starting of a new heat cycle, this marks the moment when a heat cycle resumes from a state of inactivity and continues running a cycle that was already in progress. The process of resuming an incomplete task will load all previous data including the Process Log, so this item will appear in the log when a task has been resumed somewhere between Heat Cycle Start and Heat Cycle Stopped

### **9.3.6 Adhesive Flow Temperature Reached**

For cure cycles using an adhesive this information report marks the time at which the hottest zone temperature is within 5°C of the adhesive flow temperature.

If automatic vacuum control is enabled this is also the point at which the vacuum level is decreased to the vacuum level defined in the Heater Profile for above adhesive flow temperature. See Chapter 5.4 Vacuum Pump Alarms

### **9.3.7 Adhesive Soak Finished**

For cure cycles using an adhesive this information report marks the time for each zone when the guaranteed soak for the provided adhesive has been met.

When using adhesive profiles to automatically adjust the soak time based on temperature, the final soak time can vary from that originally set in the Heater Profile.

### **9.3.8 Communications Reset / Communications Re-Established**

During operation the PC Interface is constantly communicating with the Control Case via the USB serial cable. It is possible that the communications may get interrupted, either due to the cable being physically disconnected, electromagnetic interference, or sometimes just due to a loss of sync between the PC and the Control Case. When this occurs the program will log the event both when the reset occurs, and again once the communications is re-established.

Once disconnected both the Control Case and the PC Interface immediately begin attempting to re-establish the link, and will in most cases succeed in re-establishing communications without any assistance within seconds. In these instances the alarm can safely be ignored as the cycle in progress should not be affected.

If however this alarm appears continuously or if there is a significant delay in the case being able to re-establish communications then the cycle may be affected during this period as power to the heaters will be disabled.

### **9.3.9 Thermocouple above Temperature / Below Temperature**

These alarms are triggered for each individual thermocouple if the error margin between the actual temperature and the temperature control set point exceeds the alarm threshold. The alarm threshold is set on the Thermocouple and Heater Zone Setup screen. See Chapter 4.4 Temperature Alarm Threshold

### **9.3.10 Thermocouple Open Circuit / Reversed**

These alarms are triggered for each individual thermocouple if they are detected be open circuit or reverse polarity. The Process Log also adds a second alarm item when the state is restored to normal operation.

### 9.3.11 Vacuum Input Open Circuit

This alarm is triggered for each vacuum input if they are detected to be open. The Process Log also adds a second alarm item when the state is restored to normal operation

### 9.3.12 Heater Fail

If any heater zone output is controlled to 100% for 60 seconds or more this alarm is raised. The alarm may indicate that there is a fault with the heater as intended, but there are other less permanent causes for this alarm that need attention.

When this alarm appears check that the circuit breaker for the heater zone is switched on and the heater is correctly plugged in. Alternatively this alarm may occur if a heater blanket does not have the power capacity to heat an area that it is being asked to. In this case the alarm may be alerting the operator to a potential temperature cold-spot or that a heater blanket is at risk of being burnt out.

### 9.3.13 Cold Junction Temperature Error

The HBC-4301A Control Case has two cold junction temperature sensors for redundancy purposes. During the calibration process both temperature sensors are calibrated to the same reading. If at any stage the two cold junction sensors read different temperatures then the case will trigger this alarm.

Potential causes may be that the case has been moved from an environment of significantly different temperature and not yet allowed time to equalise, a faulty sensor or a calibration error. If this error occurs during operation check the cold junction error displayed in the Status All Zones screen. If the temperature seems incorrect then do not use the Control Case.

### 9.3.14 Case Temperature / Heatsink Temperature Error

These alarms are triggered when the case temperature sensor or the heatsink temperature sensor read above their alarm thresholds.

The case temperature measures the ambient temperature of the electronics inside the case and should read within  $\pm 6^{\circ}\text{C}$  of the cold junction sensor. If the case temperature alarm is triggered it may indicate that there is a fault with the electronics causing significant heating inside the case.

The heatsink temperature monitors the temperature of the built-in heatsink. The heatsink temperature alarm is triggered if this temperature exceeds  $70^{\circ}\text{C}$ .

### 9.3.15 Low Vacuum / High Vacuum

These alarms are triggered during a cure cycle with an adhesive specified. When an adhesive is specified there are three vacuum alarm thresholds; a minimum vacuum which is set in the Vacuum Control Setup screen, and a maximum vacuum which has two set-points depending on whether the zone temperature is above or below the adhesive flow temperature.

Below the adhesive flow temperature the maximum vacuum alarm threshold is  $-100\text{kPa}$ , but once the zone temperature is above the adhesive flow temperature the alarm threshold changes to the maximum vacuum above adhesive flow temperature in the Vacuum Control Setup screen. See Chapter 5.4 Vacuum Pump Alarms

### 9.3.16 High Pressure / Low Pressure

The Control Case requires a pressurised air supply to operate the vacuum pumps to enable vacuum control. It is required that the pressure be between  $400\text{kPa}$  and  $650\text{kPa}$  for optimal operation. If the pressure is outside of this range then these alarms will be triggered.

### **9.3.17 Supervisor Login / Supervisor Logout**

The PC Interface has a login authentication system to prevent operators from altering settings in the program that may alter the outcome of a cycle. At times it may be required that a supervisor login using their authentication to access otherwise restricted parts of the program. If this occurs during a cycle then these events are logged.

### **9.3.18 Controller Reset**

During a cycle if the power is interrupted to the Control Case then the PC Interface will detect this and an alarm will be raised. After the PC Interface re-establishes communications and identifies that the case has been reset it automatically begins the process of resuming the case to the previous power levels. This alarm is intended to notify the operator of such an instance so that they can assess the period of time the power interruption occurred and whether this will have any adverse effect on the cycle

### **9.3.19 Critical Temperature Alarm / Critical Temperature Alarm Accepted**

This alarm is triggered when the PC Interface detects a thermocouple that has exceeded the set-point by more than 25°C. Once this alarm is triggered all heater outputs are indefinitely disabled to prevent thermal damage. This alarm can be overridden and the power to the heater outputs reinstated by manually clearing the alarm. See Chapter 9.1 Critical Temperature Alarm

### **9.3.20 Guaranteed Soak Error**

The adhesive guaranteed soak system automatically adjusts the minimum soak time based on the minimum acceptance thermocouple temperature. While it is not possible to commence an adhesive cure cycle without any acceptance thermocouples enabled, it is possible that during the course of a cure all thermocouples nominated as acceptance may all somehow fail. In this case the adhesive soak extension required to achieve guaranteed soak cannot be performed, resulting in this alarm message.

### **9.3.21 Zone Acceptance Low**

The adhesive guaranteed soak system automatically adjusts the minimum soak time based on the minimum acceptance thermocouple temperature. During an adhesive cure cycle if the acceptance temperature dips below the flow temperature then the guaranteed soak is paused while it waits for this temperature to increase. If the guaranteed soak is paused for longer than 5 minutes due to low acceptance temperature then this alarm is raised.

### **9.3.22 Thermocouple Enabled / Disabled or Acceptance Enabled / Disabled**

If the state of a thermocouple that is being used by the system is altered during the course of an active cycle then this results in an alarm message being added to the Process Log

### 10.1 Guaranteed Soak Time Adjustment

The HBC-4301A Hot Bonding Controller is designed to handle cure cycles that involve adhesives using intelligent methods. In addition to adjusting the vacuum level once the temperature reaches the adhesive soak temperature the program also incorporates a real-time guaranteed soak system which constantly monitors the temperature and adjusts the overall soak time accordingly.

Most adhesives have a temperature range in which they can be cured to achieve maximum bonding strength. The time required to achieve this maximum strength is directly proportional to the temperature. While bonding at the maximum temperature possible for an adhesive would result in the shortest possible cure time, this may in some cases not be desired, or even possible.

By integrating the adhesive profiles into the control system the HBC-4301A PC Interface is able to monitor the temperature for each zone, detect when the temperature reaches the adhesive soak temperature, and once it has achieved this it adjusts the soak duration with respect to the acceptance temperature to guarantee that every part of the bonded area has been cured for an optimal time at the actual measured temperature.

#### 10.1.1 Acceptance Temperature

The key to the guaranteed soak adjustment process is the temperature provided by thermocouples nominated as acceptance thermocouples. This is done before the cycle is started using the Thermocouples and Heater Zones Setup screen. See Chapter 4. Thermocouples and Heater Zone Setup.

The acceptance temperature is constantly updated by finding the coldest acceptance thermocouple. This acceptance thermocouple is identified in the Status All Thermocouples table, and the acceptance temperature is graphed on the Temperature Graph.

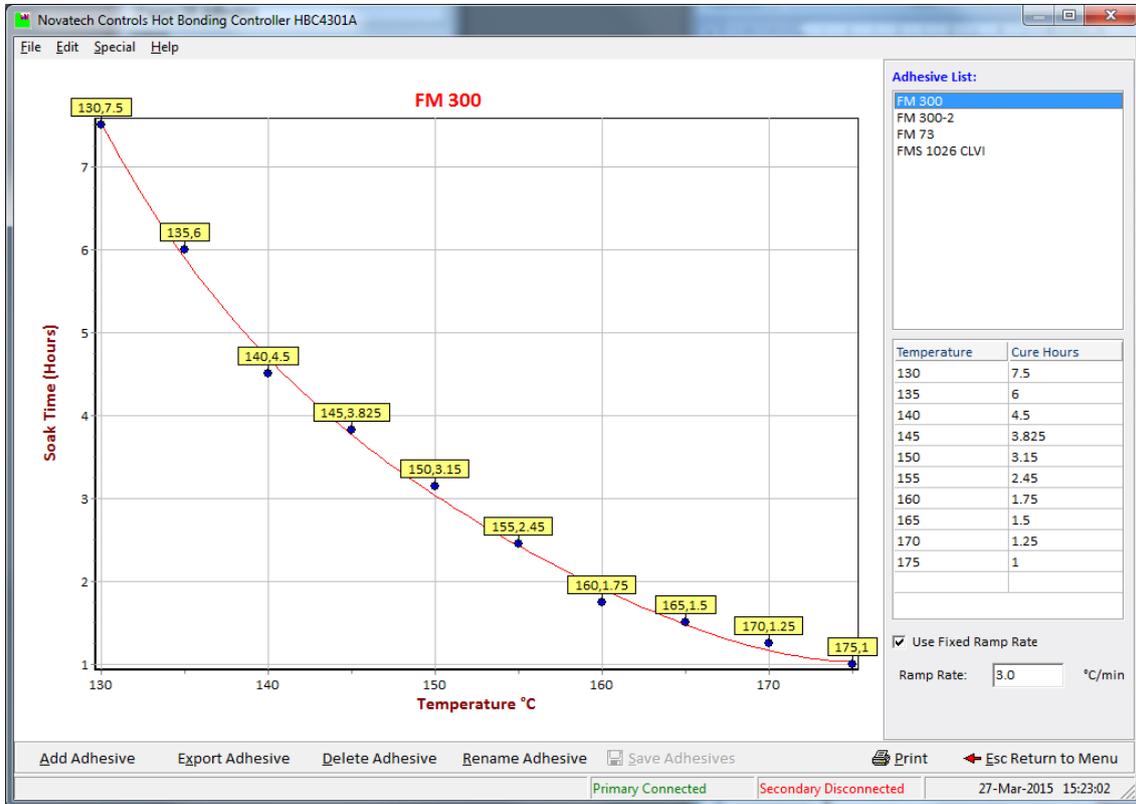
During an adhesive soak stage, while the temperature of the heater zones is being controlled to the highest thermocouple within a heat zone, the adhesive cure time is being extended so that the acceptance thermocouple, which will be lower in temperature, is cured for the optimal time. During the adhesive soak, the acceptance temperature will continue to change slightly, and as it changes the soak time is constantly adjusted to reflect these changes.

Information on the final duration of the adhesive soak stage is stored in the Process Log on the completion of the soak phase.

## 10.2 The Adhesive Profile Manager

The Adhesive Profile Manager is the location where all adhesive profiles are created, edited or viewed. It is accessed via the Control Functions Menu.

To create or edit an adhesive requires Manager level access, although any authenticated user can access the screen and browse the list of adhesives in the interface.



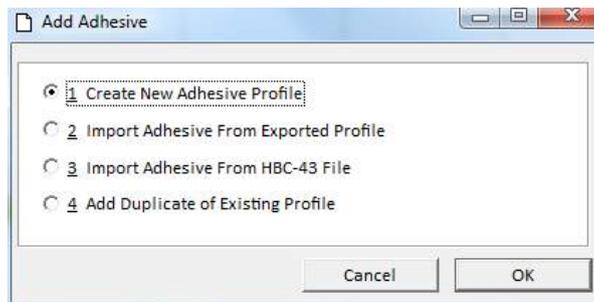
**Figure 21: Adhesive Profile Manager Screen**

There are several methods that could be used to add new adhesives to the PC Interface. The most straightforward method would be to enter the adhesive characteristics in table form listing the cure temperatures in ascending order with their respective cure time in hours.

### 10.2.1 Creating a New Adhesive

To create a new adhesive from table data, login as a Manager and enter the Adhesives Profile Manager screen in the Control Functions Menu.

- Click the button Add Adhesive in the bottom button bar and select option 1 Create New Adhesive Profile. Click OK



**Figure 22: Add Adhesive Dialog**

- In the Next box, enter a name for the new adhesive. Click OK

A new blank adhesive with the name entered will be created and added to the adhesive list. Now you must add data points to this adhesive before it can be use.

- Click on the table to the right of the graph, using the keyboard, enter the minimum temperature at which the adhesive can be cured. Press [Tab] to move to the cure hours column and enter the time in hours required to achieve optimal bond strength at this temperature.
- Continue adding pairs of temperature and cure time data points and watch as the profile is constructed in the graph to the left.
- Once complete click the button Save Adhesives in the button bar to save changes.

After you have finished entering data points check the graph and the computer generated red line connecting the data points. This red line represents the optimal cure time relative to temperature that the program will use to calculate the guaranteed soak time. If you see any unusual dips or bumps in this line then you should look at the table of data for possible errors.

### 10.2.2 Create New Adhesive by Duplicating Existing

In some cases you may wish to create a new adhesive that is similar to one already present in the program. It may be faster to duplicate an existing adhesive profile and apply the changes rather than start from scratch. This can easily be achieved;

- Click the button Add Adhesive in the bottom button bar and select option 4 Add Duplicate of Existing Profile. Click OK
- In the next dialog, select the adhesive you wish to duplicate and click OK
- A new adhesive will be created by adding the suffix '-1' after the existing name. This adhesive will automatically be selected in the list for editing.
- Click the button Rename Adhesive, and in the next dialog change the name to something more meaningful
- Similar to the process of creating an adhesive from scratch, click on the table of temperature and cure time data points and add/remove/edit points.
- Once complete click the button Save Adhesives in the button bar to save changes.

### **10.2.3 Import/Export Adhesive Profiles**

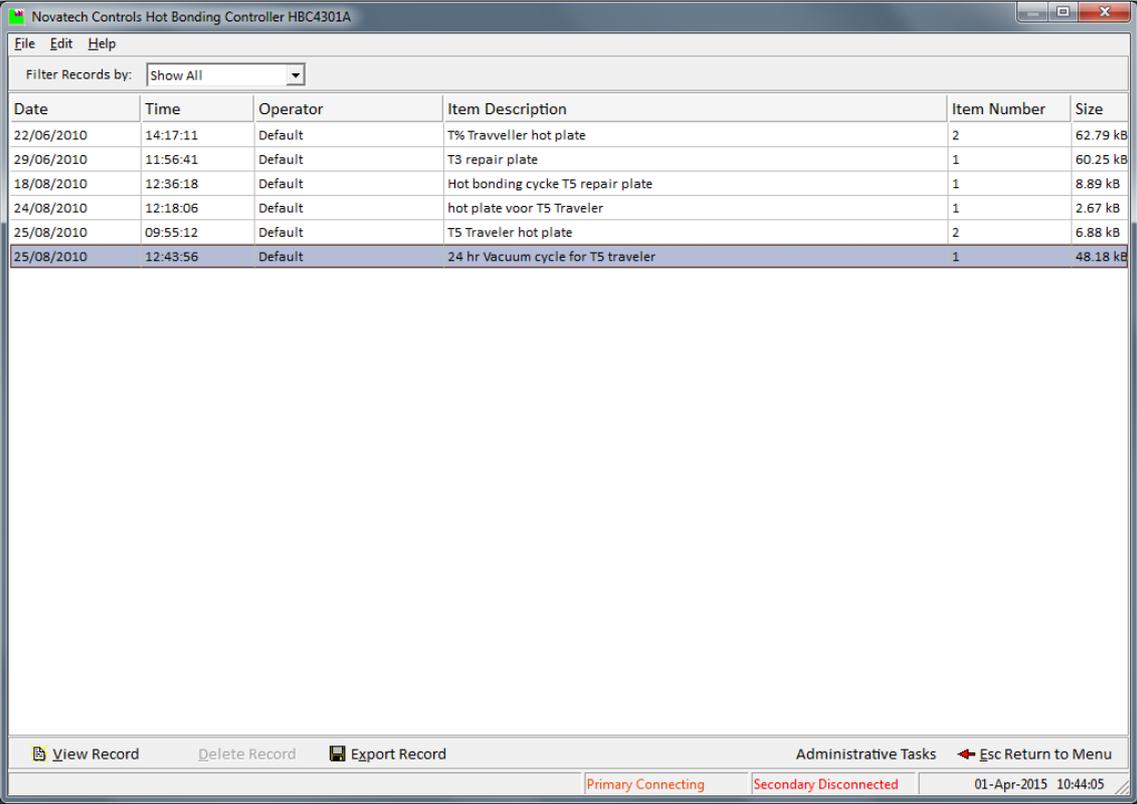
In addition to creating new adhesives by methods of entering data, there is also a system for importing and exporting adhesives to move them between different computers.

The process for importing and exporting adhesive profiles could be a fast and accurate way to move and synchronize adhesive profiles between computers running the HBC-4301A PC Interface. The export button exports the adhesive profile that is currently selected as a file that can be copied to a memory stick and moved between computers. These files can then be imported back into the Adhesive Profile Manager by selecting Add Adhesive and the second option 2. Import Adhesive from Exported Profile.

## 11. PREVIOUS JOBS DATABASE

The HBC-4301A PC Interface has a built in database of previous jobs where all completed jobs that are run on the computer are automatically stored. This previous jobs database can be accessed using the Control Functions Menu, and any jobs in the database can be opened for review, to re-print material or to export the job files to external locations for such purposes as digital backup.

While a cycle is running the PC is constantly saving zone temperature data, vacuum data, data logs and process events to the local drive. As a task is finished, these files are compressed and stored in a single file in the previous jobs database.



Date	Time	Operator	Item Description	Item Number	Size
22/06/2010	14:17:11	Default	T% Traveller hot plate	2	62.79 kB
29/06/2010	11:56:41	Default	T3 repair plate	1	60.25 kB
18/08/2010	12:36:18	Default	Hot bonding cycle T5 repair plate	1	8.89 kB
24/08/2010	12:18:06	Default	hot plate voor T5 Traveler	1	2.67 kB
25/08/2010	09:55:12	Default	T5 Traveler hot plate	2	6.88 kB
25/08/2010	12:43:56	Default	24 hr Vacuum cycle for T5 traveler	1	48.18 kB

**Figure 23: Previous Jobs Database Screen**

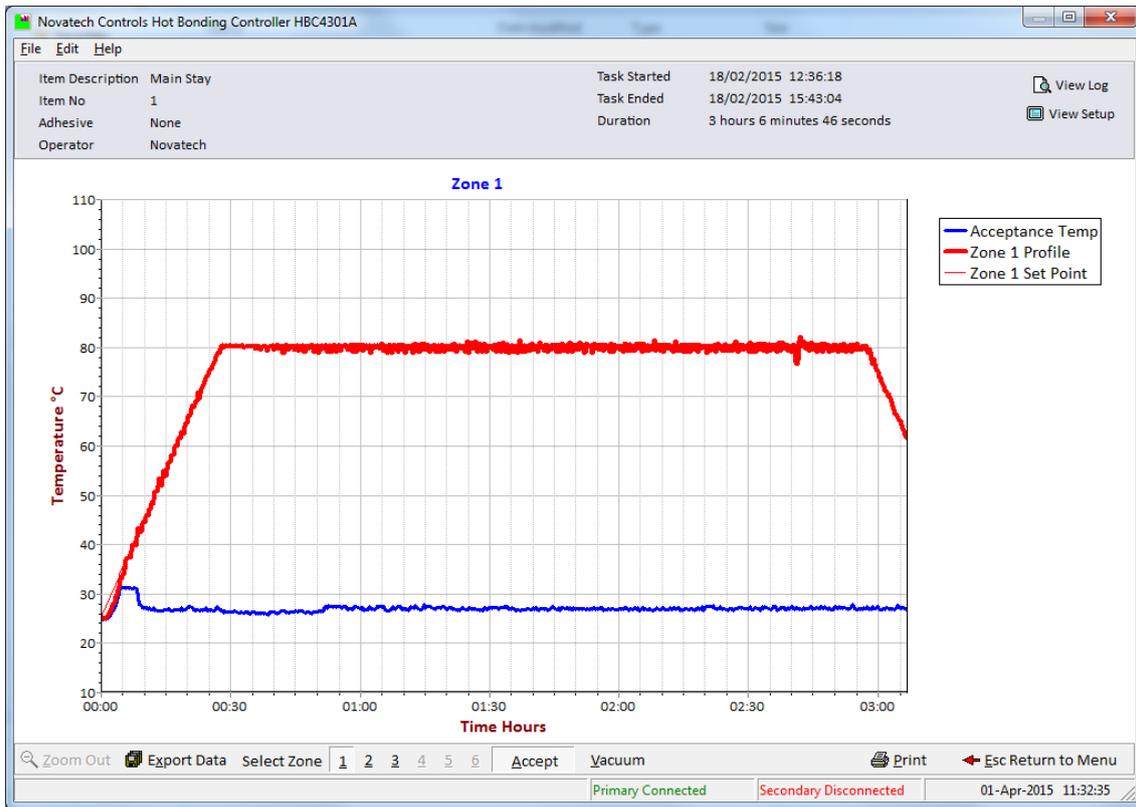
### 11.1 Saving the Current Job when Finished

As each cycle is finished the computer will automatically prompt the user to 'Save and Print'. Even in the event that the operator opts not to print cycle data, the information for the cycle itself including all configuration, runtime information and process logs is still stored to the Previous Jobs Database.

The database has the ability to load previous jobs for review and to reproduce any printed material. The ability to delete records from the database requires Manager Level access.

### 11.2 Retrieving a previous job

A job can be recalled from the database simply by double-clicking on the item in the list, or by using the cursor keys on the keyboard and pressing Enter. A HBC-4301A Control Case does not need to be present to review previous jobs. To help find specific jobs for review the list can be filtered based on basic criteria such as operator, description, adhesive or date.



**Figure 24: Reviewing a Previous Job**

The recalled job will open in a window similar to the original run window, with a graph showing temperature and vacuum as a function of time. Each heater zone can be reviewed individually by selecting the zone from the buttons bar or using the keypad. As with the Temperature Graph screen, the vacuum levels and acceptance temperature can also be toggled.

The information bar at the top provides details such as Operator, adhesive profiles, description of the task and when the task was run. On the top right are two buttons that when clicked recall the configuration of the job, and the process log.

### 11.3 Exporting Data from the Previous Jobs Database

There are two methods for exporting data from the Previous Jobs Database. The first method exports the entire job as a single file, which contains not only the runtime information, but also the job setup and process logs. This would be the preferred option for digital archiving or sending the digital file to another computer for review.

The second method allows just the exporting of the runtime data, which may be helpful if you wish to manipulate and review the data in an external program such as a spreadsheet. This second method of exporting only runtime data separates this data from the configuration and process log information, so for digital archiving or external review it does not provide a complete overview of the job.

#### 11.3.1 Exporting an Entire Record

The option to export an entire record appears on Previous Jobs Database screen. To export a previous job as a digital record use the same process to locate the record as with done to review the job. Once located, rather than double-clicking to review, click the Export Record button in the

button bar at the bottom of the screen. A dialog box will appear asking the operator where they wish to save the file.

The entire job file is exported as a single file archive containing all of the runtime data, configuration information and process log data. This file can then be copied and moved like any other sort of digital file.

For information on importing this record file see 11.4.3 Import Single Record.

### 11.3.2 Exporting Runtime Data

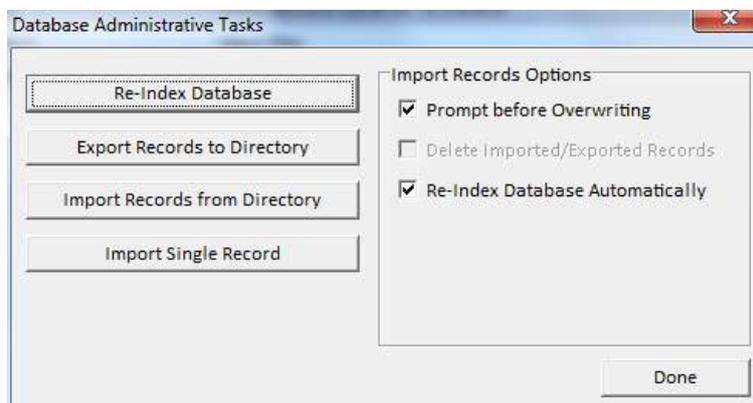
This option is included to allow the program to export just the runtime data as a single file that can be loaded into external programs such as a spreadsheet for external review. To export the runtime data, locate the record and double-click to review the previous job. Once being reviewed click the Export Data button in the button bar at the bottom of the screen. A dialog box will appear asking the operator where to save the file.

The runtime data is exported as a simple text document.

## 11.4 Database Administrative Tasks

The Administrative Tasks dialog provides several options for importing/exporting records from the database. To review a record that has been exported from another computer it must first be imported into the database of the computer to perform the review. Once imported the list of previous jobs will be updated to include the new file.

Importing of records into the Previous Jobs Database is done using the ‘Administrative Tasks’ option in the database screen. This is found on the button bar on the main Previous Jobs Database screen as seen in Figure 23: Previous Jobs Database Screen above.



**Figure 25: Administrative Tasks**

### 11.4.1 Export Records to Directory

This option provides the ability to export all items in the Previous Jobs Database to a directory on the computer for digital archiving. This directory can be an external storage device or network drive.

### 11.4.2 Import Records from Directory

The opposite of exporting all records to a directory, this option allows the importing of multiple records that have been stored in a particular directory

### **11.4.3 Import Single Record**

Used to import individual record files as exported in Chapter 11.3.1 Exporting an Entire Record

## 12. OPERATORS AND PASSWORDS

The HBC-4301A PC Interface has a built in login system that is used to assign access levels to each user. It is quite possible to bypass this system by giving all users Manager level access, however in real-world environments where accountability is integral it may prove valuable to assign some users a lower access level to restrict their ability to change certain settings.

When the program is first installed a default user and password can be used to gain access to all parts of the program with Manager level authority. While the default user has Manager level access, it is not possible to start a cure cycle with the default user. The Default account remains accessible until another user account with Manager level authority is created using the Operators and Passwords screen.

The initial default access is gained by using

Username	Default
Password	password

NOTE: Both usernames and passwords are case sensitive.

There are three levels of access provided by the login system; Operator, Supervisor and Manager.

There is no limit to how many users can be created or what access level is assigned to each. The access level for each user can also be changed by a manager.

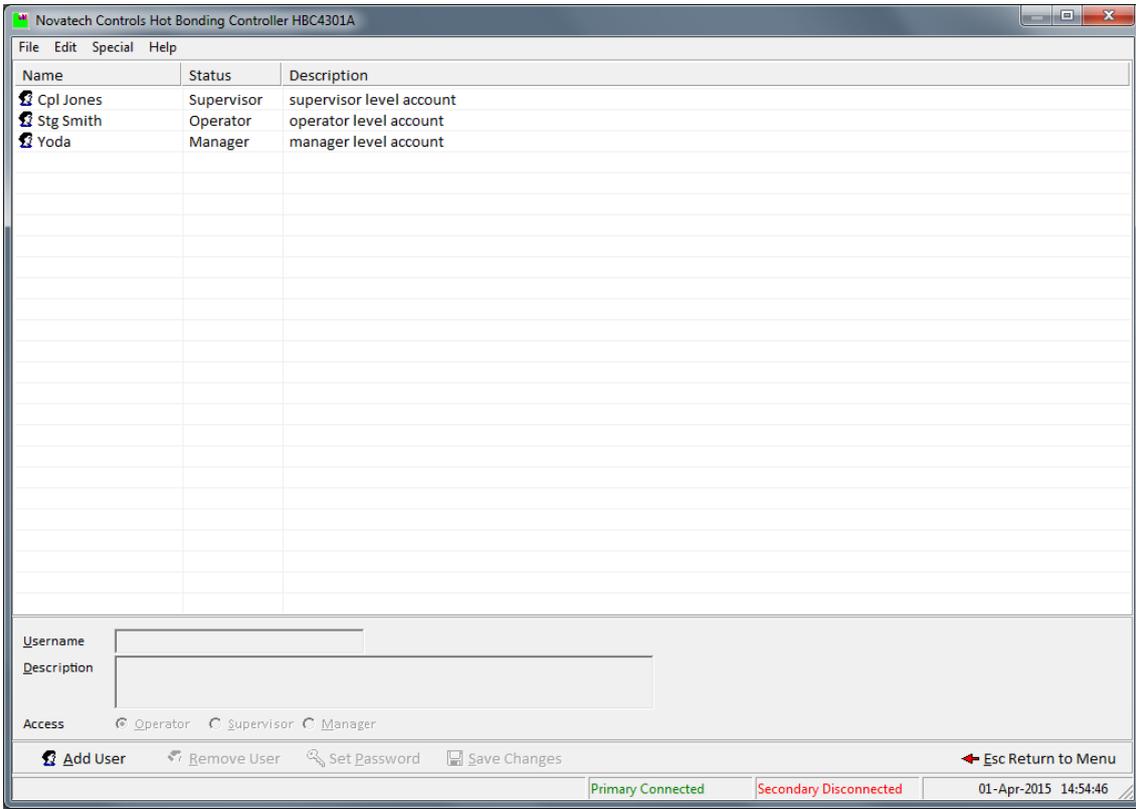
### 12.1 Restricted Access Control

There are several key areas of the program where access is limited to users Manager or Supervisor level access.

	Operator	Supervisor	Manager
Start the PC Interface	✓	✓	✓
Access the Operators and Passwords screen			✓
Create or delete user accounts			✓
View adhesive profiles	✓	✓	✓
Create or modify adhesive profiles			✓
View records in the Previous Jobs Database	✓	✓	✓
Delete Records in the Previous Jobs Database			✓
View and edit PID Parameters			✓
Configure a new Heat Cycle	✓	✓	✓
Authorise the start of a new Heat Cycle		✓	✓

## 12.2 The Operators and Passwords Screen

The Operators and Passwords screen is accessed via the Control Functions Menu. Access is restricted to Manager Level access only.

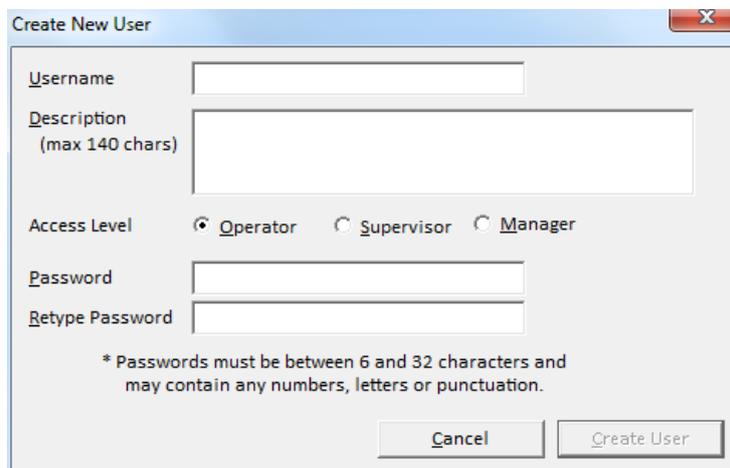


**Figure 26: Operators and Passwords Screen**

The table shows a list of usernames, their assigned access level and an optional description of the account.

### 12.2.1 Adding and Removing Users

From the Operators and Passwords screen, a user can be added by pressing the Add User button in the button bar at the bottom of the screen. This shows a dialog to enter details for the new user.



**Figure 27: Create New User Dialog**

Once the required username and password fields have been filled the Create User button becomes active allowing the new user to be added to the program.

To delete an existing user, select the user from the list and click the Remove User button in the button bar at the bottom of the screen.

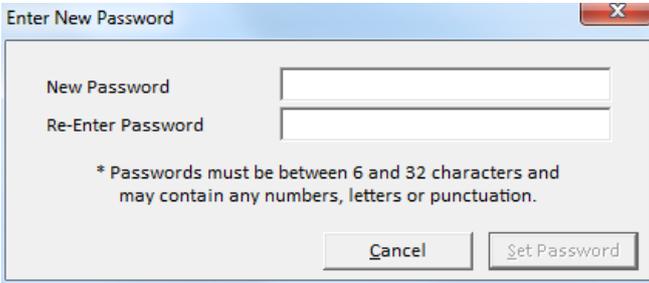
Changes to the list of users, whether adding, modifying existing or deleting existing users is made permanent after pressing the Save Changes button in the button bar at the bottom of the screen.

### 12.2.2 Resetting a Password

It is possible for a Manager to reset the passwords of other users on the system. This may be necessary if the user forgets their password.

To reset the password of an existing user, select the user from the list on the Operators and Passwords screen and click the Set Password button on the button bar at the bottom of the screen.

A dialog box will appear prompting to enter a new password. Once a new password has been entered, press the Save Changes button in the button bar to make this new password permanent.



Enter New Password

New Password

Re-Enter Password

\* Passwords must be between 6 and 32 characters and may contain any numbers, letters or punctuation.

Cancel Set Password

**Figure 28: Set Password Dialog**

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## 13. PID PARAMETERS

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One of the main tasks of the HBC-4301A Hot Bonding Controller is to control the power to each of the heated zone outputs to the generated temperature set point. This is done using a closed-loop feedback control system where the power output is modified using a PID controller.

**NOTE:** Control theory of a PID controller and any tuning theory is outside of the scope of this manual and it is not recommended that you alter any PID parameters without proper training and knowledge. This chapter provides a brief background which may assist in troubleshooting any temperature control related problems.

PID is an abbreviation for Proportional-Integral-Derivative, which refers to the three components of the closed loop control system which combine to produce a control output. Each component looks at the error level between the signal and set-point and provides a partial control output. The three parts are combined to create a control output level which is applied to the heater zone output.

### Proportional

The proportional control produces an output value by taking the error between the signal and set point which is multiplied by the proportional gain.

In the PID Control screen, the number shown is the Proportional Band in degrees C or F. A large proportional band gives a low gain which results in a smaller change in proportional output for any change in the error. A small proportional band will provide a higher gain and a more responsive proportional response. A small proportional number may result in instability and oscillations.

The proportional gain is the most important value and cannot be disabled.

### Integral

The integral control integrates error over time and provides an accumulated offset that is multiplied by the integral gain.

In the PID Control screen, the number shown is the Integral reset rate, which is inversely proportional to the integral gain. A larger Integral reset rate will result in a lower integral gain and a slower accumulated offset. A small integral reset rate may result in instability and oscillations.

Integral action can be disabled by setting the I value to zero.

### Derivative

The derivative control looks at the instantaneous rate of change in the margin of error, which is multiplied by the derivative gain. The derivative control is negative, so it tries to reduce the rate of change in the error.

In the PID Control screen, the number shown is the Derivative action, which is directly proportional to the derivative gain. Increasing this number will increase the derivative gain and vice versa.

Derivative action can be disabled by setting the D value to zero.

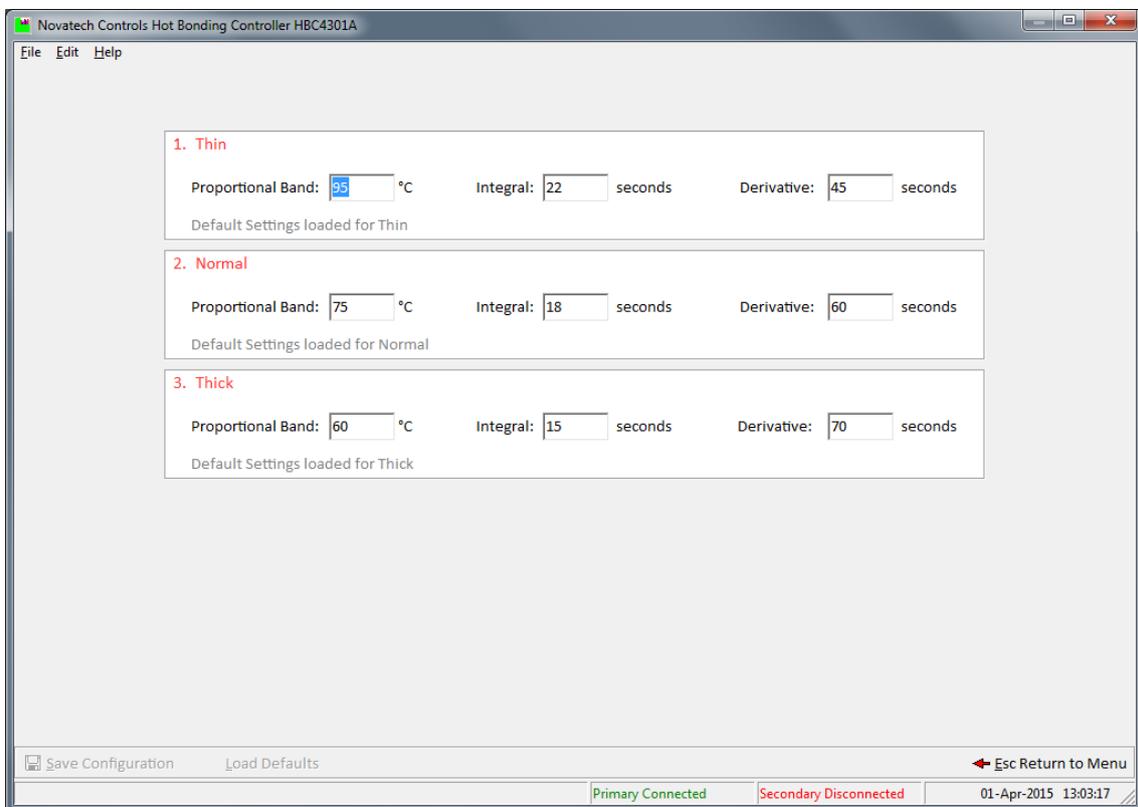
### 13.1 Thin, Normal, Thick

The HBC-4301A PC Interface has three defined sets of PID parameters which have been tuned to respond to various applications with different thermal characteristics. To simplify the selection process they are named Thin, Normal and Thick.

As a generalisation they are intended to be used for heating surfaces that might be described as Thin, with a low thermal mass and likely to change temperature rapidly, through to Thick, which has a larger thermal mass and changes much more slowly. This is a very simplistic concept however as it does not take into account the variance in power capacity of different heater blanket sizes and powers. In short, there is no substitute for doing heat surveys and trial runs.

### 13.2 Changing the PID Values

The PID Values can be changed in the PID Parameters screen which is accessed via the Control Functions Menu. Access to this screen is limited to logins with Manager Level access.



**Figure 29: PID Parameters Screen**

The PID Parameters for each of the three modes can be altered for process tuning. Each of the three modes can be reset to default settings individually using the Load Default Settings for xxx button which appears on the lower-right of each of the boxes when changed, or together by pressing the Load Defaults button in the button bar at the bottom of the screen.



**Figure 30: PID Parameters showing Load Default Button**

### 13.3 Default PID Values

The default PID values as shipped with the PC Interface are;

- Thin:            95    22    45
- Normal:        75    18    60
- Thick:         60    15    70

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## 14. TROUBLESHOOTING GUIDE

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This basic troubleshooting guide gives a simple point form list of items to check for the most common sorts of faults.

### 14.1 A Zone does not Heat Up

- One of the circuit breakers has not been turned on.
- The zone has not been enabled on the Thermocouple and Heater Zone Setup screen.
- If the power output lamp is on, the blanket is probably faulty.
- The heater is plugged into the wrong power outlet socket.
- One or more of the thermocouples configured for that zone in the Thermocouple and Heater Zone Setup screen is physically located in another zone.

### 14.2 A Zone Heats above the Set Point Temperature

- One or more of the thermocouples configured for that zone in the Thermocouple and Heater Zone Setup screen is physically located in another zone.

### 14.3 The computer keeps 'Beeping'

- The computer communications cable is not connected to the computer.
- The power is not on at the HBC-4301A Control Case. Check the green power LED on the power supply inside the control case, and the fuse in the power supply.

### 14.4 There are Too Many 'temperature too high / low alarms'

- Thermocouples and zones are configured incorrectly in the Thermocouple and Heater Zone Setup screen.
- The temperature alarm thresholds set in the Thermocouple and Heater Zone Setup screen are too narrow.
- The PID Control is causing temperature oscillations; try a different setting for PID Control in the Thermocouple and Heater Zone Setup screen.

### 14.5 The screen of the PC goes blank

- Check the PC is connected to mains power
- Check the PC has not gone into sleep-mode
- The temperature / vacuum profile and process log / alarms will be saved and the job can be re-started.

### 14.6 The temperature does not control to the set point

- The PID Control is causing temperature oscillations; try a different setting for PID Control in the Thermocouple and Heater Zone Setup screen.
- A thermocouple is faulty.

### **14.7 A temperature is reading “o/c”**

- The thermocouple is reading open circuit. Check to see whether there are any loose connections on the thermocouple plug.
- Replace the thermocouple

### **14.8 The Temperature in One Zone goes High while a Second Zone goes Low**

- Likely the heaters and thermocouples for the two zones are switched at the Control Case
- If this occurs, a Critical Temperature Alarm will trigger and all heater outputs will be disabled. See Chapter 9.1 Critical Temperature Alarm

### **14.9 A “Heater Fail” alarm is triggered**

- The heater has been running at 100% power level for more than one minute.
- Check the heater output is switched on at the circuit breaker on the Control Case
- Consider upgrading or providing an additional heat source for the area.

### **14.10 The vacuum fluctuates too much in automatic control mode**

- Reduce the air supply pressure if a low vacuum (-40 to -60kPa) is required.
- If the vacuum is too high consider introducing a small controlled leak to the bagging to allow excess vacuum to release and allow some control

### **14.11 The PC will not connect to the HBC-4301A Control Case**

- Check the cable is connected to the USB port on the PC and inserted and screwed down to the Computer port on the Control Case
- Check to see whether the PC drivers are installed properly and the USB serial cable can be detected by the program. See Chapter 4.6 Serial Device Detection
- Try a different USB port, and if possible a different USB cable.
- Restart the computer
- Reinstall the HBC-4301 PC Interface.

## 15. MAINTENANCE

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The accuracy of the Hot Bonding Controller is dependent on the electronics built into the control case. The electronics was designed to need very little maintenance or calibration. This has been achieved by the use of extremely stable voltage references, which are used in a continuous self-calibrating process, as well as built in self-checking processes. This is all scheduled and controlled by an internal microcomputer.

However for safety, the control box should be thoroughly checked by trained and competent personnel every year.

The annual check and calibration should include –

- Calibration of the thermocouple inputs.
- Calibration of the vacuum and pressure measuring electronics.
- Calibration of the external vacuum sensors.
- Checking of the zone power outputs.
- Operational check of the earth leakage detector.

The software in the HBC-4301A control case includes a restricted access calibration function. The entire calibration procedure is carried out from the keypad of the HBC-4301A control case. The calibration factors are stored in permanent memory in the control case. There are no potentiometer adjustments. Instructions for the calibration procedure are contained in a separate instruction manual. This manual is supplied with the HBC-4301A control case but should be kept separate from the HCB-4301A to ensure unauthorised personnel do not change the calibration settings.

When the calibration check / adjustment is required, and a suitably trained organisation is not available, contact –

**Novatech Controls Pty Ltd**

Tel +61 3 9585 2833

Fax +61 3 9585 2844

[www.novatech.com.au](http://www.novatech.com.au)

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## 16. HBC-4306 ACCESSORY CASE

The HBC-4306 Accessory Case is a separate item that is required to be used in conjunction with a HBC-4301A Control Case. The Accessory Case is managed separately to allow flexibility, and assigned its own unique serial number.

### NATO Stock Number: 5949-66-160-1260

The accessory case is designed to carry all the items required with the HBC-4301A Control Case. The case is 710 x 455 x 250mm and has wheels and a fold away handle for easy handling by one person.

The table below lists the contents of the Accessory Case

Qty	Description	NTC Stock No	NATO Stock No
2	50 x 300 heat blanket 150W	21117	4920-66-052-0618
2	50 x 450 heat blanket 225W	21119	4920-66-152-0620
2	75 x 150 heat blanket 112W	21116	4920-66-152-0617
2	150 x 150 heat blanket 225W	21118	4920-66-152-0619
2	150 x 300 heat blanket 450W	21121	4920-66-152-0622
2	200 x 200 heat blanket 400W	21120	4920-66-152-0621
2	200 x 300 heat blanket 600W	21122	4920-66-152-0623
2	300 x 300 heat blanket 900W	21123	4920-66-152-0624
2	300 x 450 heat blanket 1350W	21124	4920-66-152-0625
2	450 x 450 heat blanket 2025W	21125	4920-66-152-0626
3	Heater extension lead, 5m	21341	
16	Thermocouple "K" 5m C/W Plug	21213	6685-01-280-0224
1	Power 3 phase inlet power lead, 5m Without plug	21346	
1	Power single phase inlet power lead, 5m, 3pin Plug, 10A	21349	
2	Vacuum transducer and lead complete assembly, 5m	21339	6695-99-752-3211
2	Vacuum hose, 5m	21338	
2	Vacuum sniffer gauge	21041	
1	Exhaust hose, 5m	21074	
1	Portable Temperature indicator	21106	6685-66-162-5057
1	Printer lead, USB	21329	5935-01-220-8517
1	Printer, Model, P/No iP100 or equivalent	21086	7025-99-235-6579
1	Power pack and lead, Printer		6150-66-157-1173
1	Instruction books, printer		
1	Printing ink cartridge, black		3610-66-153-5439
1	Printing ink cartridge, colour		7510-66-154-4250
1	Y" Splitter Cable, IEC to 2 x GPO	21350	
1	NTC empty carry case, P/No. 7630BE	21128	

# DECLARATION OF CONFORMITY

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Application of Council Directive: 89/336/EEC (92/31/EEC)  
Standards to which conformity is declared: EN61000-6-1: 2001  
IEC61000-4-2: 2001  
IEC61000-4-3: 2002  
IEC61000-4-4: 1995  
IEC61000-4-5: 1995  
IEC61000-4-6: 1996  
IEC61000-4-8: 1993  
IEC61000-4-11: 1994  
EN61000-6-3: 2001  
CISPR 22: 2002  
IEC61000-3-2: 2001  
IEC61000-3-3: 2002  
IEC-68-2-2  
IEC-68-2-3  
AS1099.2.6

Manufacturer's name: Novatech Controls Pty Ltd  
Manufacturer's address: 309 Reserve Road  
Cheltenham VIC 3192  
AUSTRALIA

Importer's Name: \_\_\_\_\_  
Importer's address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Type of equipment: Hot Bonding Controller  
Equipment Class: ISM, Group 1, Class B  
Model Number: HBC-4301

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*I, the undersigned, hereby declare that the specified above conforms to the above directive(s) and standards(s).*

Place: Melbourne

Signature:



Date: December 9, 2003

Full Name: Terry Brereton  
Position: General Manager