Novatech Controls

HBC-43
Hot Bonding Controller

Routine Calibration
And
Operational Check

This manual includes the instructions contained in the HBC-43software version <u>1.79a9</u>

Quick Start Instructions

Quick reference for the calibration and checking procedure. For more information, refer to the chapters noted in this manual.

1. Turn the computer on, stop the HBC-43 control program and start Windows and Terminal or HyperTerminal.   (Chapter 2)

2. Turn the HBC-43 on while holding down the button on the main PCB. (Chapter 3)

3. Calibrate the cold junction temperature.   (Chapter 5.1)
   > (Use ?VACUUM, CJO/S)

4. Calibrate the thermocouple inputs, with both <u>zero</u> and <u>span</u>. (Chapter 5.2)
   > (Use ?TEMP, ZEROTCS, SPANTCS)

5. Calibrate the external vacuum transducer inputs.   (Chapter 5.4)
   > (Use ?VACUUM, VACO/S, VACSPAN)

6. Check the vacuum transducers.   (Chapter 5.5)

7. Check the power outputs, manual and automatic modes.   (Chapter 5.6)
   > (Use OUTPUTS)

8. Check the vacuum system, and other items.   (Chapter 5.7 - 5.9)

9. Run the HBC-43 control software and do a full functional check.

   > (Chapter 6.0)

WARNING:

In order to achieve an accuracy of near +/- 1°C using a mV source at low temperatures, the operator must be extremely careful.

<u>Holding a thermocouple plug for 15 seconds will change the temperature by about 2°C.</u>

Table of Contents

1. Introduction

The HBC-43 provides a method of accurately programming and controlling the temperature and the reading the vacuum and pressure for the application of composite material adhesives.

This document describes the method of performing a complete re-calibration and functional check of the electronic systems.

The Hot Bonding Controller was designed in Australia by Novatech Controls. If further assistance is required with the calibration, repair, sales or replacement parts for the HBC-43, please contact :-

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1.1 Equipment Required

- Thermocouple (type K) mV generator, 0.0 to at least 200.0 °C with < 2 Ω output impedance. **
- Digital multimeter, 4 ½ digit or better.
- Electronic thermometer, 0-400°C, +/- 0.5°C, with a Mini Marlin thermocouple input plug.
- Mini Marlin thermocouple shorting plugs (16 off).
- A 450mm by 450mm test heater blanket and parallel indicator lamp.
- Vacuum transducer simulators (Zero and span)
- HBC-43 Operators Manual.

** See the IMPORTANT WARNING about the mV generator output impedance, Chapter 5.2

The calibration method is only intended for technical personnel with a competent level of computer skills, and a very good knowledge of the HBC-43 hot bonding controller.

Background

The HBC-43 was designed to only require a minimum level of maintenance, and now with several years of field use in all the RAAF bases in Australia and other installations, it has proved to be extremely reliable.

Because of the critical process the HBC-43 controls, it is essential that the instrument be checked every 12 months.

1.2 Description of the HBC-43

The HBC-43 has two main control components –

The HBC-43 Control Case
This contains the electronics to read the temperature of each thermocouple and the vacuum or pressure input levels, and set the output power to each heater zone. The case also contains the vacuum pump and associated pneumatic components.
The full circuit diagrams are available in the back of the operator's manual.

The notebook personal computer
The computer provides the graphic interface to the operator and communicates with the control case over an RS232 line. The computer reads the temperatures and vacuum or pressures over the RS232 line, calculates the power required for each zone, and monitors the process for alarm conditions. It also calculates the automatic soak time extension, and saves the data for an automatic restart (in the event of a power failure) and data recall.

 The control case contains three PCB's. The largest of these has the power supply, microprocessor, RS232 isolation, and analog input circuits. The battery backed memory on this board holds the calibration constants.
The other two PCB's provide 8 thermocouple-input stages each. These two PCB's are identical except that a link determines if the boards are used for thermocouple inputs 1 to 8 or for inputs 9 to 16.

Each input stage is fully isolated and has its own:
1. Input amplifier
2. Voltage reference
3. Analog input multiplexor
4. Isolation DC-DC converter

1.3 The Calibration Process

All of the calibration is done from the PC keyboard. There are NO potentiometers or DIP switches to be set. The HBC-43 control case contains software that allows the calibration parameters in the microprocessor battery-backed memory to be set electronically.

The accuracy is then maintained by the microprocessor conducting automatic zero-drift and span-change checks against the precision reference voltage for each input channel.

Given that the temperature sensors are thermocouples, the "cold junction temperature" is critical to the accuracy. This is the temperature of the junction where the thermocouple wires are joined to copper wires. In the HBC-43, this is taken on the underside of the thermocouple input plug strips. An RTD temperature sensor is embedded in the 1 to 8 input strip. An error in the cold-junction calibrated temperature will change all the thermocouple inputs by the same error.

In order to calibrate this temperature, it is necessary to measure the temperature of the input connectors with an accurate independent instrument.

The cold-junction temperature must be calibrated first. There is an offset calibration factor for the cold-junction temperature.

The thermocouple inputs can all be calibrated together with the ZEROTCS and SPANTCS.

The two vacuum inputs can also be calibrated like the temperature inputs with an offset and span factor.

When all of the input calibration is complete, a check sum is calculated and stored in the HBC-43 battery backed memory. This is achieved by typing the word "FINISHED".

2. *Starting "TERMINAL" or "HYPERTERMINAL" on the PC*

The calibration process requires a PC computer with a serial port terminal program. This manual will cover the use of Microsoft™ Windows 3.1 or later as the required software comes installed on the computer. For users of MS Windows 3.1, the required program is 'terminal.exe', located in the windows directory, or for users of MS Windows 95 or later, the required program is HyperTerminal, which can be located in the Start Menu in Programs->Accessories.[1]

2.1 Using Windows 3.1

1. Connect the power pack (or the power lead) to the notebook computer.

2. Connect the serial port lead between the control case and the notebook computer.

3. Turn the power on to the control case (circuit breaker #1), and open up the computer.

4. If the computer starts up with the HBC control program running, go to the main menu (Esc key) and select 'EXIT'.

5. When the computer DOS prompt 'C:>' appears, type 'WIN'.

6. The computer will start Windows version 3.1.

7. When Windows is running, find the 'TERMINAL' icon (in the 'ACCESSORIES group). Double click the icon.

8. A 'TERMINAL' window will open up. If the settings are not already set, select the 'SETTINGS' and then 'COMMUNICATIONS' menus.

9. Make sure the settings are set to -

Baud rate	9600 baud
Data bits	8
Stop bits	1
Parity	None
Flow control	Xon/Xoff
Connector	COM1
Parity check	Off
Carrier detect	Off

10. Click on the 'OK' button when these are set.

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[1] Different versions of Microsoft™ Windows may install the shortcut to HyperTerminal in different places within the Start Menu. If it is not where stated, look in any directories named Communications etc…

2.2 Using Windows 95 or later

1. Connect the power pack (or the power lead) to the notebook computer.

2. Connect the serial port lead between the control case and the notebook computer.

3. Turn the power on to the control case (circuit breaker #1), and open up the computer.

4. If the computer starts up with the HBC control program running, go to the main menu (Esc key) and select 'EXIT'.

5. When the windows start up menu appears, select "Start Windows".

6. The computer will start Windows version 95/98.

7. When Windows is running, find 'HyperTerminal' from the Start button. Use "Programs, Accessories, HyperTerminal. Double click Hypertrm.exe.

8. A 'HyperTerminal' window will open up. If the settings are not already set, select File, Properties, Configure.

9. Make sure the settings are set to -

Baud rate	9600 baud
Data bits	8
Stop bits	1
Parity	None
Flow control	Xon/Xoff
Connector	COM1
Parity check	Off
Carrier detect	Off

10. Click on the 'OK' button when these are set.

3. The Control Case Modes of Operation

The microcomputer within the control case of the HBC-43 hot bonding controller has two modes of operation:

- Bonding run mode (default mode)
- Calibration mode

For normal bonding mode, the PC needs to be running the HBC-43 control program, and for calibration mode, the PC needs to be running the serial port terminal program.

3.1 Bonding Run Mode

When the HBC-43 is turned on, the automatic start up mode is this 'Run' mode.
The control case will respond to commands sent from the notebook PC so that the HBC-43 control program running on the notebook PC can display temperatures and control the power to the heater blankets.

3.2 Calibration Mode

The control case microcomputer is programmed to automatically maintain the calibration of the temperature inputs. However if small corrections are found to be necessary the calibration mode can be used.

To enter the calibration mode -
1. Turn the power **OFF** to the HBC-43 control case.

2. Undo the 5 knurled screws around the edge of the control panel.

WARNING
The power source for this instrument is 415vac. This can be lethal.
Only qualified service personnel should open this panel.
There are dangerous voltages exposed on screw terminals under this control panel.
Extreme caution is required.

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3. Lift the control panel by lifting on the vacuum pump on/off valve. The control panel will tilt to about 45°, where a stay bar will support the panel.

4. On the base, inside the control case, there are 3 circuit boards. The largest of these, in the rear left hand corner is a circuit board with a single button in about the centre of the PCB.

5. Press and hold this button (while the power is OFF), and turn the power on.

(Turn the power on at the #1 circuit breaker. Hold the button for 5 seconds after turning the power on.)

6. If the notebook PC is still running on its internal battery, the control case will send the following message to the PC -

```
Starting Calibration Mode


TC is the thermocouple channel number, 1 to 16
VC is the vacuum channel number, 1 or 2
OS is the temperature offset at ambient temperature
SP is the temperature error at 400 Deg C
VO is the pressure offset at atmospheric pressure
VS is the pressure error at full vacuum

NOVATECH CONTROLS HBC-43 Version 1.79a9
Calibration commands -
-      OS CJO/S     eg...  -1.2 CJO/S    (Cold Junction Offset)
-   TC OS TCO/S     eg...  8 2.8 TCO/S   (Thermocouple Offset)
-   TC SP TCSPAN    eg...  12 0.4 TCSPAN (Thermocouple Span)
-   VC VO VACO/S    eg...  2 -4 VACO/S   (Vaccuum Channel Offset)
-   VC VS VACSPAN   eg...  1 3 VACSPAN   (Vaccuum Channel Span)
-   TC ?TEMP        eg...  8 ?TEMP
-   ?VACUUM         eg...  ?VACUUM
-   ZEROTCS         eg...  ZEROTCS
-   SPANTCS         eg...  SPANTCS
-   DEFAULT         eg...  DEFAULT   (Reset Calibration Memory)
-   MEM             eg...  MEM       (Calibration memory dump)
-   FINISHED        eg...  FINISHED  (Save Calibration Memory)
-   OUTPUTS         eg...  OUTPUTS   (Cycle Heater Outputs)
-   RESET           eg...  RESET     (Manually Resets HBC)
- To Print this screen again, type ?


> _
```

The control case is now running in the CALIBRATION MODE.

NOTE:
Commands must finish with a ¿ (Enter key)

The normal mode of operation when power is applied to the HBC-43 Hot Bonding Controller is to respond to commands sent from the notebook computer. The computer is programmed to start running the HBC control program when it is turned on.

4. Command Set Description

4.1 Calibration Mode Commands

If communications has been correctly set up on the PC, with the control box running in calibration mode, commands can be sent to the control case.
If the command is correctly entered into the terminal, the control box responds with
```
Command OK.
```
If the command is not correctly entered the control box response with:
```
Command Error.  Type ? for Command List.
```

Command	*CJO/S*
Syntax	`OS CJO/S`
Example	`-1.3 CJO/S`
Response	`Ambient temperature is 22.5`

    Where   OS is the offset error in the ambient temperature, ± 15.0°C.

_____

Command	*TCO/S*
Syntax	`TC OS TCO/S`
Example	`8 2.8 TCO/S`
Response	`New temperature is 24.0`　(New calibrated temperature)

    Where   TC is thermocouple channel number, 1 to 16
              OS is the offset error at ambient temperatures in a particular thermocouple input, ± 10.0°C.

_____

Command	*TCSPAN*
Syntax	`TC OS TCSPAN`
Example	`12 1.4 TCSPAN`
Response	`New temperature is 380.0` (New calibrated temperature)

    Where   TC is thermocouple channel number, 1 to 16
              OS is the full scale (span) error at ambient temperatures in a particular thermocouple input, ± 10.0°C.

_____

Command	*VACO/S*
Syntax	`VC VO VACO/S`
Example	`1 -3 VACO/S`
Response	`New vacuum reading  -000` (New calibrated vacuum)

    Where   VC is a vacuum channel number, 1 or 2
              VO is the vacuum error, measured in kPa.

Command	*VACSPAN*
Syntax	`VC VO VACSPAN`
Example	`2 4 VACSPAN`
Response	`New vacuum reading  -100` (New calibrated vacuum)

> Where VC is a vacuum channel number, 1 or 2
> VO is the vacuum error, measured in kPa.

●━━━●

Command	*?TEMP*
Syntax	`TC ?TEMP`
Example	`2 ?TEMP`

Response	1	2	3	4	5	6	7	8
	024.2	023.9	024.0	023.7	025.1	024.8	023.0	023.2

> Where TC is thermocouple channel number, 1 to 16

Note: The response to this command will be the control case printing the current temperature of 8 input channels. If the TC (channel number) is **any number** between 1 and 8, **all** of the 8 lower channels will be printed. Any number between 9 and 16 will print all of the upper channels.

●━━━●

Command	*?VACUUM*
Syntax	`?VACUUM`
Example	`?VACUUM`

Response	VAC1	VAC2	AMB	H/S
	+100	-003	023.9	024.0

VAC1 & VAC2 are the two vacuum inputs, AMB is the ambient temperature, H/S is the power output heatsink temperature.

●━━━●

Command	*FINISHED*
Syntax	`FINISHED`
Example	`FINISHED`

This command sets the check sum for all the calibration factors. If this command is not performed, all the thermocouples will read 480°C. For more details see "Operators Manual", Chapter 3.3.1.4, "Actual Temperature".

Perform this command after all calibration of the inputs. Any changes in the calibration factors must be reflected in the check sum, so make sure that this command is the last one performed in the calibration procedure.

Command   ***OUTPUTS***
Syntax   OUTPUTS
Example   OUTPUTS

This command tests the heater power outputs. Each heater output is enabled in order, ramped to full power for 10 seconds and turned off. The output currently being tested is displated on the PC screen.

Command   ***ZEROTCS***
Syntax   ZEROTCS
Example   ZEROTCS
Response   < Display of all 20°C values. >

This command provides a very fast method of calibrating all the zero calibration factors for the thermocouple inputs.
Connect a thermocouple generator set to 20°C to all 16 inputs. Make sure that the cold junction on the generator is set to type 'K' thermocouple.   Check the reading from the HBC-43 with the "?TEMP" are about 20°C, +/- 4°C.
Type "ZEROTCS". The new calibrated readings for all 16 channels will be displayed. The accuracy should be 20 +/- 0.2°C.
Always perform this command before the SPANTCS command.

Command   ***SPANTCS***
Syntax   SPANTCS
Example   SPANTCS
Response   < Display of all 200°C values. >

This command provides a very fast method of calibrating all the span calibration factors for the thermocouple inputs.
Connect a thermocouple generator set to 200°C to all 16 inputs. Make sure that the cold junction on the generator is set to type 'K' thermocouple.   Check the reading from the HBC-43 with the "?TEMP" are about 200°C, +/- 4°C.
Type "ZEROTCS". The new calibrated readings for all 16 channels will be displayed. The accuracy should be 200 +/- 0.6°C.
Always perform this command after the ZEROTCS command.

Command   ***DEFAULT***
Syntax   DEFAULT
Example   DEFAULT
Response   Setting DEFAULT calibration factors

This command resets all the calibration factors back to the factory default values. Generally the accuracy will be within 3°C without calibration.

5. *Calibration of the Temperature Inputs*

The following temperature inputs are calibrated using the notebook computer.
1. Ambient temperature   - Offset
2. Thermocouples   - Offset and span

5.1 Ambient Cold Junction Temperature

Measurement of the ambient temperature is critical to the accuracy of the temperature reading from the thermocouples. The ambient temperature is added to the voltage from each of the thermocouples before the control case converts the reading to temperature.

Use an independent temperature indicator to measure the temperature in the centre of one of the yellow thermocouple input strips. Make sure that the control panel is closed, and also cover the thermocouple input connectors with an insulating material. Leave the control case for *30 minutes* to allow the temperature of the input connectors to stabilise.

```
Type         ?VACUUM
Response     VAC1    VAC2    AMB     H/S
             +100    +100    023.9   024.0
```

Check the difference between the reading on the computer of the ambient temperature (AMB) and the reading on the independent temperature indicator.
Calculate the temperature to be entered using
      Computer temperature - Temperature indicator = Entered temperature correction

      eg.   23.9 - 22.5 = 1.4
For the above example
```
Type         1.4 CJO/S
Response     Ambient temperature is 22.5
```

5.2 Thermocouple Inputs Calibration

The 16 thermocouple inputs are all individually isolated from each other and all other circuitry within the controller.
Each input can be independently calibrated for both zero and span.

NOTE: The ZERO must be calibrated before the SPAN.

There are two methods of calibrating the thermocouple inputs.

- Individually trim the zero and span for each thermocouple manually. (TCO/S and TCSPAN)
- Use the ZEROTCS and SPANTCS commands that will automatically calibrate all 16 thermocouples for 20°C and then 200°C.

The second method is by far the quickest.

!! IMPORTANT WARNING !!

If you use the automatic method to calibrate the thermocouples, it is necessary to connect a thermocouple mV generator to all 16 inputs at the same time. Because there is a pull-up resistor in each input, the output from the generator may not be correct.
To compensate for the generator error it is necessary to check the calibration with the generator connected to **only one input** after all inputs have been calibrated.

Follow this simple procedure to check the generator error:
1. Follow the "Zero Calibration – Automatic" and the "Span Calibration – Automatic" as shown below.
2. Un-plug 15 of the 16 thermocouple inputs. Perhaps leave thermocouple 5 connected.
3. Leave the controller for 1 minute to settle.
4. Set the thermocouple mV generator to 20°C.
5. Use the "5 ?temp" command to read the thermocouple temperature.
6. If the temperature is now reading 22.3 °C, set the thermocouple mV generator below the required temperatures by 2.3°C. (That is 17.7°C for the ZEROTCS command and 197.7°C for the SPANTCS command)
7. Repeat the automatic calibration, and re-check the calibration for one input, as in steps 1 to 6.

This check must be done every time a calibration is performed.

Zero Calibration - Automatic

Plug the thermocouple shorting plugs into all 16 of the input channels to be calibrated. The mV generator should be set to include the cold junction voltage of a 'K' type thermocouple. Set the mV generator to 20°C.

Read the inputs using both "1 ?temp" and "9 ?temp". They should all be 20°C +/- 3°C even with default calibration factors.

Cover the input plugs with insulating material and leave it for *30 minutes* for the temperature to stabilise.

```
Type        ZEROTCS
Response    1       2       3       4       5       6       7       8
            20.0    20.0    19.9    20.0    20.0    20.1    20.0    20.0
            9       10      11      12      13      14      15      16
            19.9    20.1    19.9    20.1    20.0    20.0    20.0    20.0
            Command complete
```

All the thermocouple inputs have now got the correct zero calibration factor installed.

Span Correction - Automatic

The mV generator should now be set to 200°C, and still fed into all 16 inputs.

Always measure the mV's with an independent and accurate meter to confirm the correct setting.

Read the inputs using both "1 ?temp" and "9 ?temp". They should all be 200°C +/- 3°C even with default calibration factors.

```
Type        SPANTCS
Response    1       2       3       4       5       6       7       8
            200.0   199.9   199.9   200.0   200.0   200.1   200.0   200.0
            9       10      11      12      13      14      15      16
            199.9   199.9   199.9   200.1   199.9   199.9   200.0   200.0
            Command complete
```

All the thermocouple inputs have now got the correct span calibration factor installed.

Zero Calibration - Manual

Plug the thermocouple shorting plugs into at least 8 of the input channels to be calibrated.

Cover the input plugs with insulating material and leave it for *30 minutes* for the temperature to stabilise.

```
Type       1 ?TEMP
Response    1       2       3       4       5       6       7       8
           024.2  023.9  024.0  023.7  025.1  024.8  023.0  023.2
           Command complete
```

If the ambient temperature read from the notebook PC using the "?VACUUM" command was 24.0°C, adjust each thermocouple inputs for a reading of 24.0°C by using the command (for input #1) -

```
Type       1 0.2 TCO/S
Response    New temperature is 24.0
           Command complete
```

For input #2 -

```
Type       2 -0.1 TCO/S
Response    New temperature is 24.0
           Command complete
```

Span Correction - Manual

Plug the thermocouple mini Marlin leads from the millivolt source into the channels to be calibrated. The full scale of the HBC-43 is 400 °C. To make sure that the input calibration temperature, when added to the ambient temperature does not exceed 400°C, set the voltage output from the millivolt source to 14.712 mV (360°C for a K type thermocouple).

Plug the mini Marlin thermocouple leads into at least 8 of the input channels to be calibrated.

NOTE: DO NOT rely on the mV source setting on your mV generator. Measure the mV's on the thermocouple leads with an independent and accurate meter.

Cover the input plugs with insulating material and leave it for *30 minutes* for the temperature to stabilise.

If the ambient temperature read from the notebook PC using the "?VACUUM" command was 20.0°C, adjust each thermocouple inputs by using the command
(for input #1) -

```
Type        1 ?TEMP
Response    1       2       3       4       5       6       7       8
            381.5   381.8   382.2   381.6   382.9   380.7   379.8   383.0
            Command complete
```

If the ambient temperature read from the notebook PC using the "?VACUUM" command was 20.0°C, adjust each thermocouple inputs for a reading of 380.0°C by using the command
(for input #1) - This is 360°C plus the ambient temperature.

```
Type        1 1.5 TCSPAN
Response    New temperature is 380.0
            Command complete
```

If you want to check the temperature accuracy of the HBC-43 at any other temperature, set the millivolt source to the correct voltage for the temperature (see the table in appendix A).

Always measure the mV's with an independent and accurate meter to confirm the correct setting.

Don't forget that the ambient temperature must be considered when working out the millivolts required.

Correct millivolts for a temperature on the PC is -
        Millivolts from the millivolt source.
  plus   Millivolts from a thermocouple at the current ambient temperature.

5.3 Heatsink Temperature Check

The heatsink sensor is mounted in the lower side of the finned heatsink on the opening control panel. The sensor is only used as an over temperature warning on the power output control components (triacs).
The sensor is a 100Ω RTD, and is checked at or about the ambient temperature.

Place the sensor of the electronic thermometer on the centre of the heatsink, between the fins.
Leave the electronic thermometer on the heatsink until the temperature reading settles.

Read the temperature as read by computer (H/S) -
```
Type        ?VACUUM
Response    VAC1   VAC2   AMB    H/S
            +100   +100   023.9  024.0
```

This response shows that the heatsink temperature is 24.0° C.

There is <u>not</u> an adjustment for the heatsink temperature, but if the computer and the thermometer temperatures do not agree within 5°C further service will be required.
Consult the factory for further advice, or use the schematics provided in the back of the operators manual to diagnose the problem.

5.4 Vacuum Gauge External Inputs

The HBC-43 has 2 inputs on the fixed control panel for external vacuum transmitters.
The transmitters are designed to -
  Transmit 4mA when connected to a vacuum level of -100 kPa,
  Transmit 20mA when connected to a vacuum level of atmospheric pressure (0 kPa).

To generate signals that correspond to low and high vacuum levels connect a resistor between pins 2 and 3 on the vacuum input sockets (labelled VACUUM 1 and VACUUM 2).
Use vacuum levels just above zero and just below full vacuum as values below zero and above 100 are not displayed.

To generate the vacuum level without a vacuum transducer use resistors –

3300 Ω	4 mA	-97 kPa
780 Ω	20 mA	-5 kPa

The calibration of these two inputs is done by adjusting the zero (or offset) at atmospheric pressure, and span at -100 kPa.

Zero (offset) Correction

To read the vacuum inputs -

```
Type        ?VACUUM
Response    VAC1   VAC2   AMB    H/S
            -004   -098   023.9  024.0
```

To correct vacuum #1 for example (offset error)

```
Type        1 4 VACO/S
Response    New vacuum reading  -000
```

Span Correction

To correct vacuum #2 for example (span error)

```
Type        2 -2 VACSPAN
Response    New vacuum reading  -100
```

5.5 *Vacuum Gauge Transmitters*

The calibration for the external vacuum transmitters is achieved by adjusting the offset control on the vacuum sensor. The adjustment is found at the end of the sensor, under the brand label.
Plug in the vacuum sensor into vacuum input number 2.

```
Type        ?VACUUM
Response    VAC1   VAC2   AMB    H/S
            +100   -003   023.9  024.0
```

The controller will read the vacuum sensors, ambient temperature, and the heatsink temperature.

The computer will not read above zero (positive numbers) for the vacuum. To confirm that the vacuum transmitter is not sending a value less than zero, adjust the transmitter as follows –

1. Adjust the offset control on the vacuum sensors by turning it clockwise until the displayed value reads above zero.
2. Adjust the control anti-clockwise by small movements until the vacuum just reads zero.

Repeat this procedure for the other vacuum sensor.

5.6 Power Outputs Checking

The power outputs may be adjusted either manually or under computer control. The two modes are selected using the corresponding Auto/Manual switch on the control panel.
There are no calibration adjustments for the power outputs. This procedure will check the operation of the power controllers, and expose any possible faults.

Manual Controls - Operation
1. Set all the Auto/Manual switches to the **Auto** position.
2. Turn the manual control fully anti-clockwise.
3. Check that the zero figure on the scale ring around the knob is above the position pointer on the control panel. If not, loosen the two setscrews in the knob, and set the knob position to make the zero on the scale line up with the position pointer.
4. Plug the test heater into the outlet socket on the control panel.
5. Select the 2000 VAC range on the digital volt meter (DVM).
6. Plug the DVM into the test points on the heater test box.
7. Switch the Auto/Manual switch to **Manual**.
8. **Slowly** adjust the manual control from 0 to 10 (or maximum) while watching the indicator lamp on the heater test box. Make sure that there is a smooth increase in power level over the full range.
9. Repeat the rotation of the manual control several times, also watching the indicator lamp on the control panel. This lamp is a neon type and therefore will not be lit until the manual control reaches about position 3.
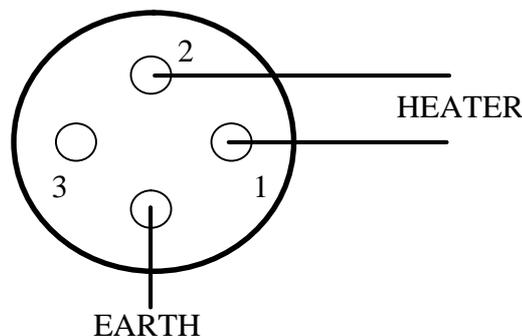
NOTE:
The power controllers have a soft start, which limits the speed that the power can be increased to the heater blankets. Even if the control knob is turned from 0 to 10 in half a second, the power will take 10 seconds to reach full power output.
The power can be taken down within a second.

Program Control (Auto)
1. Set all the *Auto/Manual* switches on the control box to *Auto*.
2. Type "OUTPUTS"

The power outputs will ramp slowly from zero (off) to full power over about 15 seconds. Each output will cycle to full power, starting at zone 1 output, in order through to zone 6 output.

Heater connections from the rear view of a heater plug (4 pin plug)

5.7 Earth Leak Detectors / Circuit Breakers

Turn all the earth leak detectors ON.
(If only one 3-phase lead is available, just turn on the three breakers associated with that input power connector).
Test each breaker by pressing the "TEST" button on the breaker. The breaker should turn off. If the breaker does not turn off, the circuit breaker **MUST** be replaced.

5.8 Vacuum System

The vacuum system is made up of -
- Air on/off valve
- Pressure regulator
- Air pressure gauge
- Vacuum air ejector pump
- Vacuum gauge
- Output 'Quick Connects'

Check the air pressure gauge against an inlet pressure gauge when the pressure regulator is screwed full clockwise.

Check the vacuum gauge against one of the remote 'Quick Connect' gauges plugged onto one of the vacuum connections on the control panel.

With the pressure regulator set to 400 kPa (with at least 450 kPa on the inlet air pressure line), and the vacuum lines closed off at the 'Quick connects', the vacuum should be capable of achieving at least –80 kPa. If this vacuum cannot be achieved, repair or replace the air ejector vacuum pump. (Sometimes the volatiles in the adhesives will condense in the pump and restrict the aperture).

5.9 Other Checks

Check the following items for physical damage and broken or loose connections -

- RS232 cable
- Power cables
- Heater extension leads
- Heater blankets

- Vacuum sensor leads

6. Operational Checks

After all the chapters covering the calibrations and checks have followed, the HBC-43 should be checked using the control software on the PC.

Start the HBC-43 with Control from the PC
Turn the HBC-43 power off, and wait 10 seconds.
Turn it back on again. This will set the HBC-43 back to the "RUN" mode.
Close Windows on the PC, re-start the HBC-43 control program.

6.1 Testing the Accuracy of the HBC-43

Temperatures
Read the AMBIENT TEMPERATURE and the HEATSINK TEMPERATURE from the text box in the "**All Zones**" screen. (**F**unction key **1**). Confirm these reading with the independent temperature indicator.

Simulate ambient temperature on all of the thermocouple inputs using a short circuit Marlin plug on eight channels at a time.

(Note: If the Marlin plugs are held for more than a few seconds each, the warmth absorbed while being held will significantly alter the temperature reading of that channel).

Simulate an elevated temperature at about 200°C on all input channels, eight channels at a time. Check the indicated temperatures on the "**All Zones**" screen.

Vacuum
Plug the vacuum transducer simulator connectors into Vacuum 1 and Vacuum 2. Use both the near zero and the near-full-scale simulators. Read the vacuum levels on the "**All Zones**" screen.

Appendix A

Conversion table for a 'K' type thermocouple.

Temperature	mV's
0	0
20	0.798
40	1.611
60	2.436
80	3.266
100	4.095
120	4.919
140	5.733
160	6.539
180	7.338
200	8.137
220	8.938
240	9.745
260	10.560
280	11.381
300	12.207
320	13.039
340	13.874
360	14.712
380	15.552
400	16.395