



OPERATION AND MAINTENANCE MANUAL

# HB2 Dual Zone Hot Bonder

Revision 2.96

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## HB2 Operation and Maintenance Manual

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### Notice to Users

When a system failure may cause serious consequences, protecting life and property against such consequences with a backup system or safety device is essential. The buyer agrees that protection against consequences from system failure is the buyer's responsibility.

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### Warranty

Every *WichiTech* Composite Repair System is thoroughly inspected and tested before leaving the factory. It is warranted to be free of defects from workmanship and materials for the period of THREE (3) YEARS from the original date of purchase. Return the complete system, freight prepaid, to the factory if any trouble develops during this three-year warranty period. *WichiTech* will repair (or replace, at our option) without charge any system where factory inspection shows that the trouble was caused by defective workmanship or materials.

This warranty does not apply where:

- repairs to the system have been made or attempted by others
  - repairs are required because of normal wear and tear
  - The system has been abused, misused, or improperly maintained
  - alterations have been made to the system
- 

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## About This Manual

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This manual tells you how to operate, program, calibrate and maintain the HB2. Detailed instructions are provided for connecting, configuring, and operating every option of the Wichitech HB2 two-zone hot bonder. Please become familiar with the contents of this manual prior to using the HB2 system. Our telephone number is stamped on the nameplate of your HB2 system should any problems or questions arise. Please do not hesitate to contact Wichitech Industries concerning any matter which may increase your performance in the use of our products. Our toll-free phone number is 1-800-776-4277.

### *Assumptions*

Assumptions are made regarding the user's knowledge and experience in the following areas.

- Ability to attend to aural and visual alarms
- Understanding of the basic concepts of composite repair
- Knowledge of English language
- Awareness of the potential safety hazards associated with 110/220 ac voltage controls and heating elements

### *Notes for Experienced HB2 operators*

With this release of the manual, there are many new features available in the latest HB2 software. Some of the new features were suggested/requested by HB2 users. These features include;

- Independent Yellow Zone power control – In order to use the Yellow Zone, the Red Zone must still be powered up first. However, from that point on, the Yellow Zone can now be turned on/off independently of what's going on in the Red Zone.
- 32 Cures – The HB2 now supports and stores up to 32 cures. The previous maximum was eight. One new library setup menu item was added to allow the operator to printout the names of all the cures currently stored in the library.
- Reset to Factory Calibration – In the past, it has been possible for an inexperienced operator to improperly modify the vacuum and Tc calibration settings and then be forced to return the unit in order to accurately re-calibrate the unit. Two options have been added to the setup to allow the operator to reset these calibration tables. Also, a deadband region has been implemented to help prevent the entry of improper settings.



- Improved Printouts – Two items have been added to each cure printout; the estimated run-time and the ac power setting. This estimate provides the operator with an approximate time at the end of cure. At the end of the cure, the actual run-time is printed. The ac power setting indicates what type of blanket pinning should be used. During the power-up self-test, the HB2 measures the input ac power and determines what voltage is being supplied to the HB2. This setting is used to route power to either a 110 or 220 volt blanket.



## Chapter 1: Overview

*Chapter 1 provides a system usage and HB2 product overview*

The HB2 repair tool is used to cure (via heat and pressure) the adhesive resins found within composite materials and metal-to-metal bond repairs. Composite material repairs are usually accomplished under pressure using a vacuum bagging method where a high temperature film is sealed over the patch and a vacuum is applied through the film. Application of a vacuum provides increased thermal conductivity and de-bulking of repair materials. Heat is applied to the repair area with a heat-generating device such as a heating blanket or heat lamp. The HB2 provides all of the temperature and vacuum monitoring/controlling equipment to simultaneously cure/repair two areas at once.

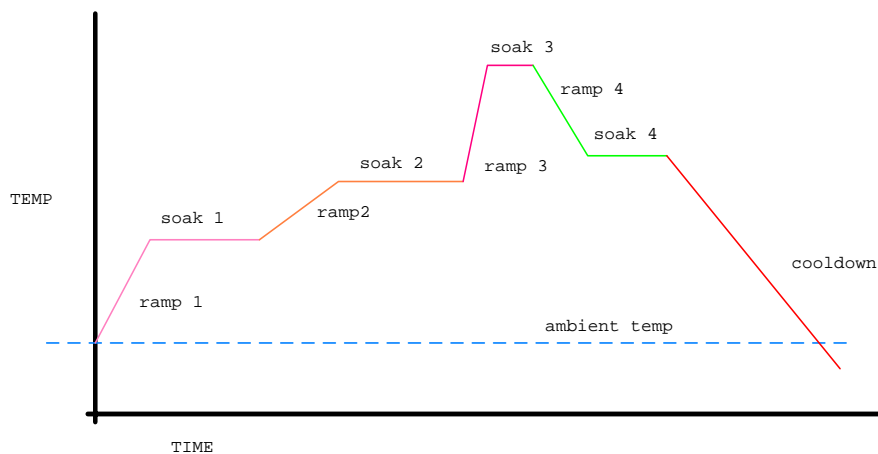


Figure 1- 1 Time-Temperature Profile

The HB2 controls the vacuum pressure and application of heat in the repair area according to a preset program. The HB2 program is set up by the operator to run in distinct “steps” or “soak stages” to assure that foreign matter relative to the cure materials (such as moisture and volatiles) evaporates prior to the actual curing process. The application of vacuum in combination with a preheat cycle enhances the evaporation of foreign matter. The HB2 can execute programs with up to six soak stages.



In the control and monitoring of temperature and vacuum relative to the cure, temperature and vacuum sensing transducers are strategically placed by the operator within or adjacent to the cure area. The data from these sensor transducers is used to implement a closed feedback loop repair system. The HB2 can continually monitor up to 16 thermocouples and 2 vacuum ports simultaneously.

The control of the prescribed temperature over time is accomplished with a computer controller. The operator programs the controller with the desired temperature envelope. Programming the HB2 is accomplished via a helpful system of displayed menus. Operator inputs outside of the ranges displayed on the menu screens are not allowed to prevent programming mistakes.

The HB2 is completely color coded for ease of operation. An extensive system of alarms is implemented to alert the operator of errant cure behavior. All cure related data may be printed on a standard dot matrix printer.

## *Features*

The Wichitech HB2 hot bonding system is a self-contained maintenance and repair tool. The HB2 is small, portable, and easily fits into overhead bin of a standard commercial aircraft. The standard HB2 repair system is a two-zone unit with one shared keypad, two printers, two power-in receptacles, two power-out receptacles, two vacuum gauges, four vacuum measurement ports ( 2 per zone ), sixteen thermocouples (eight per zone) and an internal electric vacuum pump. The lid of the HB2 has sufficient space to store all the ancillary equipment needed to “run a cure”(i.e., thermocouples, vacuum hoses, power cords, etc.) Other system configurations are available that do not include all of these standard features for budget-conscious customers. Purchasing an alternate configuration satisfies the buyer with an immediate budget ceiling who still wants the ability to upgrade to a fully functional two-zone unit at a later time.

The standard HB2 includes all of the following;

- Two fully independent and programmable zones
- User friendly, menu driven controls
- A hardware failsafe that removes power from blanket in event of catastrophic software failure
- 2 independent true sunlight-readable displays
- extensive built-in self test capability with easy to read diagnostics
- Internal vacuum pump
- Front panel mounted circuit breakers
- Database management/storage for up to 32 unique multistage cures
- 8 thermocouples per zone(all readings available simultaneously )
- 1 flush mounted vacuum gauge per zone



- 2 vacuum measurement ports per zone
- 2 on/off vacuum switches
- user input password/keylock protection
- 16 thermocouple reader with all readings available simultaneously
- a piercing audible alarm with a silencing button
- ability to modify any control parameter while running a cure
- operator selection for control by hottest, coldest or median temperature
- operator specified high/low temperature alarm setting
- operator specified low vacuum alarm setting
- automatic open Tc detection and alarm
- automatic “backwards” Tc detection and alarm
- automatic recovery of running cure upon system power disruption
- 1 printer per zone; all required/selected cure information is printed “print-on-demand” in test and running modes
- automatic detection of available power 85-264 VAC, 43-440 Hertz
- programmable 500max or 1000max deg Fahrenheit operation
- color-coded setups and equipment
- A complete cable/hook-up set including;
  - 2 each; power input cables
  - 2 each; blanket output cables
  - 2 each; vacuum hoses
  - 3 each; 6 foot, ‘J-type’ thermocouples
  - 2 each; heat blankets, 8” X 8”
  - 2 each; heat blankets, 10” X 10”

### *Optional HB2 Features*

- alternate thermocouple type operation
- Foreign language menu systems
- Engineering changes/support for your custom application

## Chapter 2: System Description

---

*Chapter 2 provides an in depth physical description as well as a theory of operation of the HB2*

The HB2 is completely self-contained in a small suitcase sized case with an un-attachable lid. The case comes with a strap that allows the unit to lay flat when the strap is disconnected or upright when connected. There are two displays housed in the lid that provide status and control information for each of the two zones. There is also a loud, aural alarm housed in the lid for alerting the operator of potential problems encountered during a cure. A single 16-button keypad is centered on the bottom half of the case. A lighted, “zone-select” switch just above the keypad allows the operator to use the keypad to control either zone. The bottom of the case is laid out symmetrically around the keypad with 2 thermocouple blocks, 2 vacuum gauges, 2 power-in and 2-power out receptacles.

The HB2 contains a powerful single board computer that controls all of the hardware functions in the HB2 with one exception. The HB2 contains two AC watchdog timer circuit boards (one for each zone) that operate independently of the main processor. The function of the ACWD is to monitor the power being routed out of the output connector and to automatically shutdown power if the processor has applied full power for more than a preset time period. Under normal conditions with the properly sized blanket, the HB2 should never have to apply full power constantly. If full power is applied constantly for a long enough period, the ACWD will automatically disengage the output. In this way, the HB2 provides failsafe protection of valuable repair setups and materials. The processor also has a traditional watchdog timer that protects operation against spurious events ( such as severe power fluctuations, RAM fault, ... ) that might not allow the processor to keep executing its programming.

The HB2 is completely menu driven for the operator’s ease of use. Using the keypad on the unit, the operator can run a cure, create or modify entries in the cure library, perform maintenance and/or calibration procedures. All operator actions include informative message prompts to assist the operator in making a

valid response to the required action. The keypad is a standard style layout with two special keys; the 'E' or Enter key and the 'M' or Menu key. These keys are used throughout the HB2 to navigate the menu system. They also have unique functions while a cure is running to acknowledge alarm conditions or to modify on-going cure parameters. The system of menus is based on four high level options;

1. **Test Tc Option** – When selected, this option immediately displays the current temperature at the tip of each thermocouple. This option allows the operator to verify that each of the thermocouples are working properly prior to starting a cure.
2. **Assign Tc Option** – This option allows the operator to select the number of thermocouples that will be used during a cure. It also allows the operator to choose the method of Tc temperature control; control by the hottest Tc, the coldest Tc or by the median( average temperature of the hottest and coldest Tc).
3. **Program Option** - The program option is accessible as a high level option and also during a running cure. It provides a sequence of menu screens that prompt the operator for the desired cure settings such as temperature ramp rate, soak temperature, .... After exiting the program option, any changes/settings will remain in effect until the operator modifies the program again by entering the option again. If the program option was entered in the middle of a cure, the changed settings will affect the on-going cure.
4. **Start Option** – The start option initiates the cure process. However, before beginning the cure, the start option makes one last check that all is well( all “assigned Tcs” are installed and functional ), waits for the operator to enter an optional “ID number” and “Job Description”. Once the cure has been started, the central processor executes all of the steps as prescribed by the most recent program option session. All operations are fully automatic with the display continually providing updates on all aspects of the cure every two seconds. If conditions exist that cause the actual parameters to fall outside the limits prescribed by the programming, a loud aural alarm will sound to alert the operator of the condition. The operator can acknowledge the alarm by pressing the “E” key, but the display will still indicate that the condition exists (via a flashing character) until either the operator remedies the condition or until the alarm condition recovers to within acceptable program parameters. The operator can cancel the cure at anytime with two key presses.

There are three more high level options that are used to support the four principal operating modes:



5. **Setup Option** – The Setup option is password protected. It provides access to system wide functions that do not typically need to be accessed by the routine operator. Care should be taken when entering this option because of the radical changes the operator can affect if the wrong settings are programmed.
6. **About Option** –The About option displays and prints information regarding the current version of hardware and software installed.
7. **Print Last Cure Option** – This option allows the operator to re-print the last cure tape. This is a handy option in cases where the printer has run out of paper during a cure.

# 3

## Chapter 3: Getting Started

*Chapter 3 provides instructions for quickly setting up the HB2.*

The HB2 is very simple to use. The HB2 is also very configurable and consequently has a large number of menu screens and possible operator setups. However, it is possible with only 4 keystrokes to start a cure including the initial power on switch closure. In this section, directions are given to begin the simplest of cures to get you started as soon as possible. Once the cure has been started, you can use the “Modify Cure” option to change parameters. This section does not explain all of the available options and possible conditions attainable with the HB2; its purpose is to get you started ....

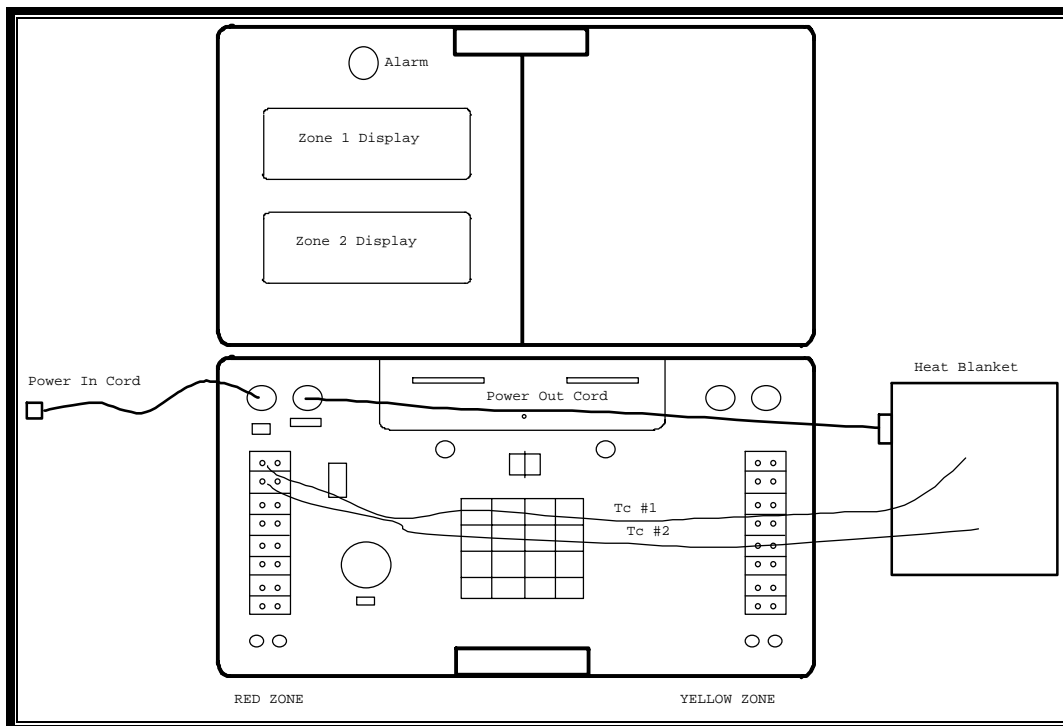


Figure 3-1 A simple HB2 setup



The above figure shows the simplest setup for an HB2 cure. In this configuration, the HB2 is setup to run a cure only on the RED zone. Two thermocouples are installed and have been located near the heat blanket. The input power cord is ready to plug into a standard wall receptacle. Note that the vacuum pump is not connected. It is not needed in the simplest cure setup.

In order to turn the HB2 on, first check that the Ground Fault Interrupter (GFI) on the power input cable has been turned on. If it is on, the LED indicator should be illuminated. If not, press the enable button and the indicator should come on. After the GFI has been turned on, press the RED zones On/Off switch to ON, the switch will light-up and the HB2 will initiate the internal self-tests. Every time the HB-2 is turned on, a self-test automatically attempts to verify all of the required circuitry for running a cure on both the RED and YELLOW zones.

The power on self-tests will take about 8 seconds to complete. If all of the self-tests have passed, at the end of the self-tests the RED zone will display:



Figure 3- 2 The Self-test Result Screen

If you have setup the HB2 as in the figure the yellow zone will not be powered on and the yellow zone will display:



Figure 3- 3 The Yellow Zone Power-Off Screen

After a two second delay, the RED zone will automatically advance to the Main Menu screen (shown below) and the RED zone is ready for use. Since the yellow zone input power is not connected the YELLOW display will not change.

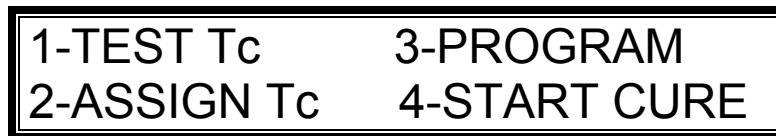


Figure 3- 4 The Main Menu Screen

If you need to adjust the brightness of the display, press the “←” (left arrow key) from the Main menu. With each key press, the brightness can be adjusted by approximately 15%. After eight presses, the brightness setting resets to full brightness. If you press ‘4’ from the Main Menu screen, the HB2 will start the last cure programmed into memory. If this is the first time the unit has been turned

since leaving the Wichitech facility, the HB2 will run a single step cure, 10 deg/min up to 150 degree soak temperature. The first screen that appears after starting a cure prompts you for an operator ID. This could be any string of number(s), a letter(s) up to 15 total characters or it can be bypassed by pressing “E”. For now, press ‘E’.



Figure 3- 5 The Operator ID screen

The Operator ID is included on the cure printout. The operator screen is followed by a similar screen called the Job ID screen.



Figure 3- 6 The Job ID screen

The Job ID is also included on the cure printout. For now, bypass the Job ID by pressing ‘E’. After the Job ID the RED display will advance to the Cure Running Screen. The YELLOW will not change since the YELLOW zone has not been turned on.

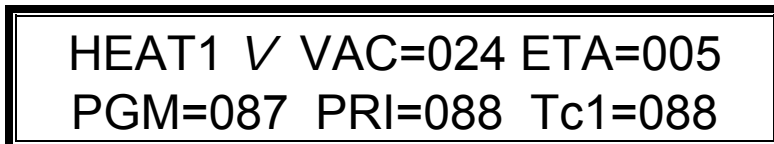


Figure 3- 7 The Cure Running Screen

As the cure progresses, this screen will display changes in the temperature and vacuum as measured in the cure area. This display will change to an ALARM Screen if the measured parameters exceed the pre-programmed limits that are currently in effect. The screen initially indicates HEAT1 because the default cure is to heat the unit up to 150 degrees. As the temperature in the repair area approaches 150 degrees, the ETA (estimated time of arrival) will decrease to 0. When the ETA reaches 0 and the HB-2 enters the dwell or soak stage the screen will change from HEAT1 to SOAK1. The ETA will change to 005 indicating that the HB-2 will maintain the cure area temperature at 150 degrees for the next five minutes. At the end of the SOAK cycle, the SOAK1 will change to COOL indicating that the HB-2 has reached the final segment of the cure. In COOL, the HB-2 passively controls the temperature in the repair area to the final ambient temperature set by the program. At the end of the cure, the ALARM will sound for three (3) seconds to indicate that the cure has completed.



!! Remember that this chapter has been streamlined to get you running as quickly as possible. The following sections in the manual will give complete instructions on the operation and maintenance of the HB2. Here are some additional “quick-start” items to keep in mind ....

### *Preparations*

- Read this manual and become familiar with the operating methods before using the HB2 to perform a cure
- Visually inspect the instrument panel, cables and blankets for signs of wear or damage.
- Check that the available ac power is 110 Vac +/- 10% or 220 +/- 10% at a frequency range of 47 to 440 Hertz.
- Check the supply of paper for each printer. The printer paper will need to be replaced before the print roll becomes empty. A colored stripe will appear on the side of the paper when the paper roll is low. If the HB2 has been recently transported, confirm that the printer ribbons are snapped into the proper position.

### *Initial Setup*

- Prepare the area to be bonded in the proper manner
- Install ‘J’ thermocouple(s), heat blanket(s) and bagging material
- Connect the vacuum lines, heating blankets, cables and thermocouples to the proper mating connectors on the HB2
- Connect the RED input power cable to the HB2 connector and then to the available power source. Use the “110V Converter Cable” to connect the unit to a standard household wall socket

## Typical Printout

The following figure depicts the cure printout that would accompany the “getting started” cure discussed in this chapter;

```

*****
*   CURE PROGRAM   *
* OPR:             *
* JOB:             *
* 12:12  07/01/01 *
* ----- *
* AC LINE POWER = 110 *
* ACTIVE T/Cs = 2 *
* CONTROL T/Cs = 1 *
* TEMP CONTL= MEDIAN *
* RAMP = 15 dF/MIN *
* TEMP = 150 dF *
* TIME = 005 MINUTES *
* COOL = 05 dF/MIN *
* FINAL = 100 dF *
* HI-LO = 25 dF *
* PRINT INTERVAL = 01 *
* PRINT TCOPTION= CTL *
* VACUUM = 15" Hg *
* EST RUNTIME = 00:20 *
*****
CYCLE TIME TEMP VAC
RAMP1 001 084 00
RAMP1 002 100 00
RAMP1 003 115 00
RAMP1 004 130 00
RAMP1 005 145 00
SOAK1 001 150 00
SOAK1 002 150 00
SOAK1 003 150 00
SOAK1 004 150 00
SOAK1 005 150 00
COOL 001 145 00
COOL 002 140 00
COOL 003 135 00
COOL 004 130 00
COOL 005 125 00
COOL 006 120 00
COOL 007 115 00
COOL 008 110 00
COOL 009 105 00
COOL 010 100 00
*****
*   CURE COMPLETE   *
* RUNTIME = 00hr 21mn *
* 12:33  07/01/01 *
*****

```

Figure 3- 8 Getting Started Printout

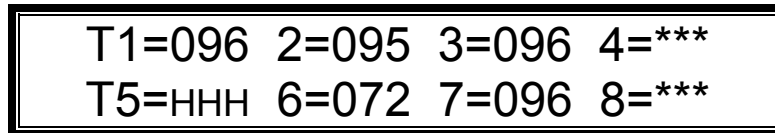


## Chapter 4: Test Tc Mode

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*Chapter 4 explains the various functions in the Test Tc mode.*

The Test Tc mode should be the first step in running a cure. When in Test Tc mode, all eight thermocouples are displayed simultaneously. In one look at the display the operator can verify that all of the Tc's are installed and reporting accurate temperatures. As an example, Figure 4-1 indicates that Tc1, Tc2, Tc3 and Tc7 are all reading about the same temperature; around 096 degrees. For some reason, Tc #6 is reading 072 degrees. The asterisks in the display indicate that Tc4 and Tc8 are open or otherwise non-functional.



```
T1=096  2=095  3=096  4=***  
T5=HHH  6=072  7=096  8=***
```

Figure 4- 1 A Typical Test Tc Mode Screen

The “HHH” display indicates that Tc5 is reporting a temperature in excess of 999 degrees. If this example were to actually occur, it would point out several problems that must be taken care of before starting a cure. Before considering the details of the example, consider two basic concepts.

- If eight Tcs are plugged in, then there should be 8 readings. If there are 4 Tc's are plugged in there should be 4 readings and 4 open indications
- Further, if you hold the tips of all of the Tcs in your hand the readings should all be approximately 90° (your body temperature).

Assume for a minute, that you have plugged in eight thermocouples and you are holding the tips of all eight Tc's in your fingers and the screen in Figure 4-1 is what you are seeing, then ...

- Tc's #1, #2, #3 and #7 are probably ok since they are all displaying the same temperature and that temperature is approximately your body temperature

- Tc's #4 and Tc#8 are not reporting any temperature. These Tc's are open because of a break in the wire or loose connection in the thermocouple plug
- Tc#5 is reporting a temperature equal to or greater than 1000 degrees. This is probably because the wrong type of thermocouple plug is being used. The standard HB2 runs with 'J' type thermocouple a different type of thermocouple could cause this kind of error
- Tc#6 is reporting room temperature. Since there is a reading, there must be a connection between the + and – terminals of the Tc#6 position. This error is typically caused by a plain piece of wire ( or other conductor ) lying underneath the Tc#6 between the 2 prongs of the plug. Keep the HB-2 panel clean and free of debris!

### *Test Tc Mode Special Features*

While in Test Tc mode, pressing the '2' key will print all of the currently displayed Tc temperatures to the printer.



## Chapter 5: The Assign Tc Option

---

*Chapter 5 describes how to setup Tcs for a cure.*

The Assign thermocouple (ASSIGN Tc) mode allows the user to select the number of thermocouples to be used for the cure and to assign each thermocouple as either a primary or backup thermocouple. In addition, the last assign mode screen allows the operator to choose the controlling method that the HB-2 uses to process the thermocouple data.

The first screen to appear in the Assign Tc mode is shown in Figure 5-1. The operator is prompted to enter a number from 1 to 8. This number is the number of Tc's the operator intends to use to monitor the cure. The number to be



ACTIVE Tc = 1 ↑ 5  
[ 1 TO 8 ]

Figure 5-1 Active Tc Assignment Screen

edited will flash on the display (in this manual it is shown as a shadowed character). Wichitech recommends using at least three (3) thermocouples for every cure. The example given by Figure 5-1, shows that the operator wants to use five (5) thermocouples in the cure. The next screen allows the operator to choose which of the five thermocouples are to be used in controlling the cure.



CONTROL Tc = 1 ↑ 3  
[ 1 TO 5 ]

Figure 5-2 Control Tc Assignment Screen

The example given by Figure 5-2 shows that the operator is about to choose the first three (3) thermocouples as control Tc's. By choosing the first three thermocouples as control, he has also programmed Tc 4 and Tc 5 as backup

thermocouples. Thermocouples #6, #7, and #8 are unused. Note that the second lines reflects a maximum of 5 thermocouples as chosen by the first menu screen.

**TEMP CONTROL = MEDIAN  
[ 1=MED, 2=HOT, 3=COLD ]**

Figure 5- 3 Temperature Control Assignment Screen

The Temperature Control Assignment screen allows the operator to choose the way the HB-2 computes the controlling temperature of the cure. If “HOT” is chosen, the HB-2 will scan all of the control Tc’s and use the hottest Tc temperature to control the cure. Similarly, if “COLD” is chosen, the HB-2 will scan all of the control Tc’s and use the coldest Tc temperature to control the cure. If the operator chooses “MEDIAN”, the HB-2 will scan for the hottest and coldest Tc temperature among the control Tc’s then control to the average temperature of the hottest and coldest Tc temperatures.



## Chapter 6: The Program Option

---

*Chapter 6 shows how to program the HB2 to run a cure*

The program mode allows the user to access a library program or install a unique program for the desired cure parameters. To gain access to the program mode, select “3” on the keypad from the main menu screen. The first screen to appear is dependent on the number of cures already in the cure library. If the cure library has at least one entry the Standard/Custom screen appears first otherwise program mode begins with the Number Of Soaks screen.



Figure 6- 1 Standard/Custom Screen

The Standard/Custom screen requires a keypad entry of “1” or “2”. If “1” (STANDARD) is selected the operator can select one of the cures stored in the library (up to thirty-two programs can be stored). If you choose a standard cure at this point you will greatly appreciate the operator who entered the standard cure if it was named with a self-descriptive name. Programs can be saved into the library via the Setup Mode and password access (see Chapter 7: Setup Mode). Fifteen characters are available!; use descriptive names!

After choosing the STANDARD cure, you are prompted to select which of the cures in the library you wish to run. The Name of Library Cure screen prompts you for the cure name you wish to run. Use the Up and Down arrows to navigate through the list of library cure names. Press ‘E’ when the name of the cure you wish to run appears. The name shown in the figure, “1S150D4TC”, is

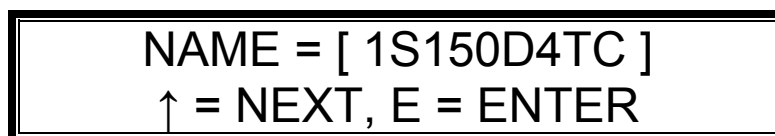


Figure 6- 2 Name of Library Cure Screen

short for 1 Soak, at 150 Degrees using 4 Tcs. After pressing “E”, the HB-2 returns to the main menu screen after having pre-programmed the HB-2 with all of the parameters contained in the “1S150D4TC” library selection. At that point, you can select ‘3’ to re-enter the program mode and choose ‘CUSTOM’ To review the various program parameters preset by the “1S150D4TC” cure.

If the library is empty or you chose option “2” (CUSTOM), you must now input or accept all of the preset parameter values for the cure. For all of the parameter screens that follow, you can accept the displayed value by pressing the ‘E’ key or skip though the various parameters by using the Up and Down keys.

NOTE

After making the entry, the “E” key must be pressed to enter change into program. The “M” key is used to return to the menu without changing the program.

All of the parameter screens show the allowable range of values for the currently displayed parameter. Attempting to enter a value outside of this range will not “take” and not advance to the next parameter screen.

The first parameter screen in Program Mode is the Number of Soaks screen. The number of soaks sets the number of steps for the cure as explained in Chapter 1.

**NUMBER OF SOAKS = 1**  
**[ 1 TO 6 ]**

Figure 6- 3 Number of Soaks Screen

The number of soaks requires a keypad entry of 1 to 6. The number selected will be the number of levels of soak. As an example, if A2" is selected, the program will have two levels of soak. This means the heater blankets will be heated to a user-determined temperature during a specified period of time. When the temperature has been obtained, the heat will remain the same for a period of time (Soak). After the soak time has elapsed, the heat for the blanket may be increased or decreased, depending on the program, until the next level of soak is reached.

**RAMP RATE 1 = 10**  
**[ 1 TO 15° F/MINUTE ]**

Figure 6- 4 Ramp Rate Screen

The ramp rate requires a keypad entry of 1° F to 15° F/minute. As an example, 5° F is selected by pressing 5 on the keypad. The program will now increase the temperature by 5° F every minute until the soak temperature is reached.

**SOAK TEMP 1 = 150**  
**[ 1 TO 500° F ]**

Figure 6- 5 Soak Temperature Screen

The soak temperature requires a keypad entry of 70° F to 500° F. This entry determines the temperature the heating blanket will maintain while in the soak stage of the curing process.

**SOAK TIME 1 = 1**  
**[ 1 TO 999 MINUTES ]**

Figure 6- 6 Soak Time Duration Screen

The soak time requires a keypad entry of 1 to 999 minutes. This entry will determine the length of time the heating blanket will remain at the soak temperature.

**COOLING RATE = 1**  
**[ 1 TO 15° F/MINUTE ]**

Figure 6- 7 Cooling Rate Screen

The cooling rate requires a keypad entry of 1° F to 15° F/minute. The user will select between 1° F and 15° F. This entry will program the cool down rate of the repair. This is a passive function and is dependent upon ambient temperature.

**FINAL TEMP = 150**  
**[ 70 TO 150° F ]**

Figure 6- 8 Final Temperature Screen

The final temperature requires a keypad entry of 70° F to 150° F. This entry determines the temperature at which the program will terminate.

HIGH/LOW ALARM = 1  
[ 1 TO 60°F ]

Figure 6- 9 High/Low Temperature Alarm Screen

The high/low limit requires a keypad entry of 1° F to 60° F. The temperature selected is the temperature in degrees above or below the "programmed temperature" value that will cause an alarm to sound. The High/Low limit allows the operator to monitor areas that may be above/below the required temperatures for a satisfactory cure. The temperature selected will be the same for both the High and Low limits. As an example, if 10° F is entered, the dwell temperature is set at 170° F and the thermocouple senses the temperature has reached 181° F or higher, an alarm indication will be seen on the MENU window. If the thermocouple senses the temperature has fallen to 159° F or less, an alarm indication will be seen on the MENU window. The audible alarm also sounds in both cases.

PRINT INTERVAL = 01  
[ 0=OFF;1 TO 15 MIN]

Figure 6- 10 Time to Next Print Screen

The print interval requires a keypad entry of 1 to 15 minutes or 0. If a printout tape of the cure process is not wanted, enter 0 on the keypad. If a printout tape of the cure process is wanted, enter the number of minutes between 1 and 15 that will determine how often the system should print. If the print interval is selected, the cycle, stage elapsed time, control temperature and vacuum will be printed at the selected interval. Additionally, the printout will show the initial program, any program changes and any alarms that are experienced during the cycle.

PRINT TC OPTION = CTL  
[ 0 = CTL ONLY, 1 = ALL ]

Figure 6- 11 Tc Print Option Screen

VACUUM LEVEL = 15  
[ 1 TO 27" Hg]

Figure 6- 12 Minimum Vacuum Level Screen



The last screen in the program mode allows the operator to set the vacuum level that determines a vacuum alarm condition. If the measured vacuum level falls below this value, the alarm will sound.



## Chapter 7: The Start Option and Running a Cure

---

*Chapter 7 provides details on running a cure.*

Chapter 3, “Getting Started” showed the easiest, fastest way to get a cure running. This chapter will build on that chapter by providing more detail about the various options and features that are accessible while a cure is running.

```
HEAT1 V VAC=024 ETA=005
PGM=087 PRI=088 Tc1=088
```

Figure 7-1 The Cure Running Screen

Figure 7-1 re-prints from Chapter 3, a typical display while a cure is running. Once a cure has started, the HB-2 computer executes the preset program while constantly monitoring all of the available sensors.

### Alarms

If the sensor data show that cure is not operating within the pre-selected parameters, an audible alarm will sound and an ALARM screen will replace the MENU screen. Additionally, if the print function was selected, the alarm code will be printed on the tape. The user must acknowledge the alarm by pressing “E” on the keypad. After “E” is pressed, the MENU screen will change to the start cure mode screen, and the audible alarm will stop. **By pressing the “E” key, the user has not corrected the problem, only acknowledged that a problem exists.** Until the problem is corrected, an alarm letter located between HEAT 1 and VAC on the MENU window will blink. The following figures show examples of all of the HB-2 supported ALARMS:

```
>> ATTENTION <<
TC 1 COLD [122°]
```

Figure 7-2a Low Temperature Alarm Screen

>> ATTENTION <<  
TC 1 COLD [122°]

Figure 7-2b Low Temperature Alarm Screen

>> ATTENTION <<  
TC 3 HOT [156°]

Figure 7-2c High Temperature Alarm Screen

>> ATTENTION <<  
LOW VACUUM

Figure 7-2d Low Vacuum Alarm Screen

>> ATTENTION <<  
TC 1 OPEN

Figure 7-2e Open Thermocouple Alarm Screen

>> ATTENTION <<  
TEMPERATURE FALLING

Figure 7-2f Falling Temperature Alarm Screen

>> ATTENTION <<  
NO HEAT

Figure 7-2g Low Temperature Alarm Screen

Table 1-1 shows all the alarms and their corresponding letters. When the problem is corrected, the alarm letter will cancel. If more than one problem exists, the alarm letters will alternately blink until the problems are cleared. While the cure

mode is operating, there are only two keys on the keypad that are active, the “E” key and the “M” key. By pressing the “M” key while in the cure mode, changes can be made to the program. When the change has been entered on the keypad, press “E” key to enter the change into the program.

### *Print On-Demand Capability*

During the cure, the operator may press ‘2’ at any time from any running cure screen, to print the current status/temperature of all eight thermocouples. The print on-demand items are marked with a “P” character to distinguish them from the scheduled printouts.

### *Hold Mode*

During the cure, the operator may desire to place the HB-2 cure “on-Hold” to allow a slowly heating cure to “catch-up”. The HB-2 can be placed in HOLD by pressing the “→” right arrow key from any running cure display screen. As the HB-2 enters HOLD, a hold init message is printed. While the HB-2 is in hold mode, the display flashes. To escape HOLD mode, press the “→” right arrow key a second time, a hold end message is printed and the display stops flashing and the cure program execution resumes.

### *Display All Tc’s Mode*

During the cure, the operator may desire to watch the temperature at each thermocouple tip simultaneously. Press ‘1’ to view the Display All Tcs Running Cure screen. This screen displays the current temperature at the tip of each thermocouple. All of the alarms, scheduled, printouts and other cure related events continue with no changes. If an alarm condition occurs, the display will advance to the appropriate alarm screen retuning after the alarm has been acknowledged.

T1=096	2=095	3=096	4=099
T5=096	6=***	7=***	8=***

Figure 7-3 Display All Tc’s Running Mode Screen

If the operator presses the ‘1’ key again the HB-2 advances to a graphical display of the cure’s progress. This screen provides a visual indicator of the cures progress through the various steps of the program. The estimated time to complete the total cure is provided on the right hand side of the screen. To escape the Graphical display mode press ‘1’ to return the cure running screen.

### *Graphical Display Mode*

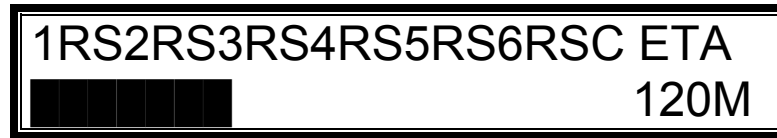


Figure 7-4 The Graphical ETA Screen

### *Editing Parameters during a cure Mode*

The HB-2 allows the operator to modify any cure parameter for any soak stage that has not yet been completed. For instance, if a 4 stage cure is running and stages 1 and 2 have already been completed the operator can only modify stages 3 and 4.

In order to modify a running cure, the operator presses 'M' from any running cure screen. The display automatically advances to the appropriate parameter screen in the Program Mode. The operator may choose to simply view the settings by using the up and down arrow keys. When he reaches the end of the parameter list the HB-2 automatically advances back to the last displayed cure running screen. However, if the operator uses the "E" key at any point, the HB-2 upon return to the last running cure screen will print a list parameters that the operator changed.

### *Canceling a Cure*

If the operator decides that he does not want to complete a cure, he can manually terminate a cure by pressing the "E" key from any cure running screen. The operator will be prompted by a confirmation screen that verifies that he really wants to cancel the cure. By pressing 'E', he can return to the cure, by pressing 'M' he cancels the cure. A message is dumped to the printer to indicate that the operator canceled the cure.



Figure 7-4 Cure Cycle Cancelled Screen

### *Cure Completion*

When the cure has executed all of the steps in a cure, a cure complete message is displayed and the aural alarm sounds for 3 seconds to alert the operator that the cure has completed.

>> ATTENTION <<  
CURE CYCLE COMPLETE

Figure 7-5 Cure Cycle Complete Screen



## Chapter 8: Setup Mode

---

*Chapter 8 shows how to access the setup mode and perform the password-protected operations on the HB2*

Setup Mode provides access to programming options and features that will probably be accessed only once during the initial installation of the HB-2 at your facility. The programmed options accomplished in Setup mode affect the operation of the entire unit and should be well thought out and not taken lightly. All operations in setup are password protected and some require two passwords. For most of our customers, Setup Mode is only used by the person(s) or department responsible for programming cures into the library or by those persons who are qualified to calibrate the unit.

Setup mode is accessed from the main menu by pressing '5'. The main menu does not provide any visual clues about Setup Mode until you press this key. For your protection, a factory-preset password is required to enter into selection Setup Mode. This password will be made available at the time of delivery to the person(s) responsible for the calibration and maintenance of the unit(s). If you don't know the password, please have your supervisor contact Wichitech. Our toll-free number is 1-800-776-4277. To return to the Main Menu screen, press 'E' or 'M'.



Figure 8- 1 Setup Password Screen

After entering the password, the operator gain access to the following eight options/features via the Setup Main Menu screen:

- Real-Time System Clock
- Thermocouple Calibration

- Vacuum, Calibration
- Cure Library
- Operating Language
- Units of Measure
- Total Elapsed Hourmeter
- Reserved; special Tc features.

These eight options are displayed two lines at a time. The operator may scroll through the options using the Up and Down arrow keys. To select an option or feature, press the number assigned to the desired option

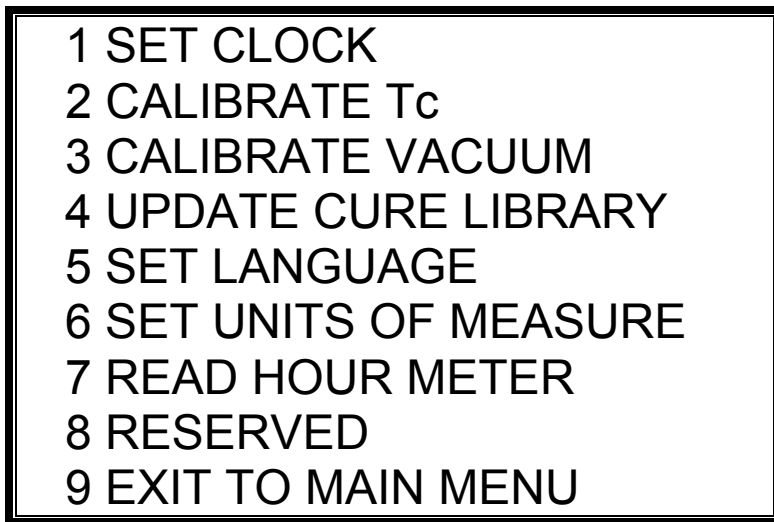


Figure 8- 2 Setup Main Menu Screen

To return to the Main Menu, press either the ‘M’ or ‘9’ key. For convenience, the figure shows all eight options together. The figure accurately depicts how they appear on the display, however remember on the HB-2 only two lines are displayed at a time. If you already know the option number you wish to run, press the appropriate key from anywhere within this screen.

### *Real-time System Clock*

The HB-2 contains a battery backed real-time clock circuit. This clock is preset at the factory to **(GMT-05:00) Eastern Time (USA & Canada)**. This clock is used to print the actual start date and time of each cure on the paper tape. If



Figure 8- 3a System Clock Screen #1



your HB-2 is to be used outside of this time zone, it can easily modified with this option. You might also want to update the clock every year to correct the additive error associated with the clock; the clock is accurate to approximately 1 second per day. At the end of a year, the clock could be off by 1-2 minutes.

The System Clock screen is implemented as two separate screens each with three programmable parameters. The first screen allows access to and displays the date related parameter; the month, the day and the year. As each of these

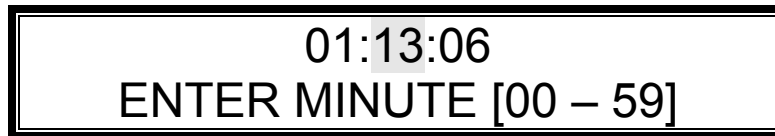


Figure 8- 3b System Clock Screen #2

parameters is viewed ( you select parameters by using the Up, Down, Left and Right keys) it flashes and the second line shows you the acceptable values for that parameter; month (01-12), day (01-31), and year (00-99). The second System Clock screen allows access to and displays the time related parameters; the hour (00-23), minute (00-54) and second (00-59).

To modify a clock parameter, select it using the directional keys then use the numeric keys to enter an acceptable value and finally press ‘E’ to Enter the new value.

### *Calibrate Tc*

The calibrate Tc mode is accessed by pressing ‘2’ from the Setup Main Menu screen. This screen allows the user to individually calibrate each thermocouple in 50 degree Fahrenheit steps against a known reference standard. The standard HB-2 is typically calibrated with a “J-Type” thermocouple standard. Wichitech only uses calibration equipment that is traceable to the National Institute of Standards and Technology and has our calibration equipmentre-calibrated by the manufacturer yearly.

There are two options for calibrating the HB-2 thermocouples. The operator may choose to individually calibration each thermocouple or choose to globally reset all of the calibration data back to the way it was when it left the factory.



Figure 8- 4a Calibrate Tc Menu Screen

When the Factory Reset option( '2') is chosen, the HB-2 resets its Tc calibration table and the screen backs up to the Setup Main Menu screen.

If option '1' is selected, the Calibrate Tc screen appears. The HB2 always starts with Tc #1. If Tc #1 is not installed or otherwise non-functional the display will indicate that the Tc is OPEN otherwise it will report the measured Tc reading. The operator can use the Up and Down keys to access all eight thermocouples.

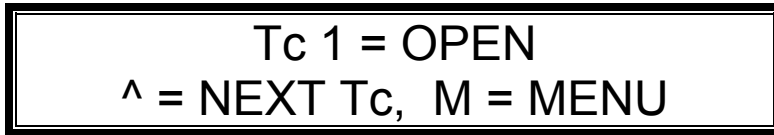


Figure 8- 4b Calibrate Tc Screen

To perform calibration on a single Tc, select the desired Tc with the Up/Dwon keys. Install the thermocouple standard into the desired Tc block. Sequentially , set the thermocouple standard to multiples of 50 degrees F up to 500 or 1000 degrees as appropriate for your unit. At each multiple, press the 'E' key to save the new setting in the calibration table. To prevent possible calibration problems, there is a deadband region to consider while calibrating the Tcs. If the standard is connected and the displayed value is not within +/-15 degrees F of a multiple of 50, then the calibration will not take effect.

### *Calibrate Vacuum*

The calibrate vacuum mode allows the user to set the vacuum of the unit correspond to the vacuum of a known reference. WichiTech Industries uses a vacuum gauge calibrated yearly to standards traceable to the National Institute of Standards and Technology.

To calibrate, connect a vacuum line to the Aout@ quick disconnect on the unit. Connect the other end of the line to a calibrated vacuum gauge. With the pump running, enter the value shown on the vacuum gauge reference into the space shown as zeros where the display shows

VACUUM = 00. Select **AE@** or **AENTER@** to set the vacuum. Exit by selecting **AM@**.

### *Update Cure Library*

The cure library may contain a total of thirty-two, user-programmed cures. The following functions may be performed under update cure library menu

- Add/Edit a cure



- Save a Cure
- Delete a Cure:
- Print Cure Listing
- Print list of cures in the library

### **EDIT A CURE**

Select edit cure to change parameters in any saved library cure. The cures can be accessed by using the up or down arrows to select the cure to be edited. Once the cure to be edited is selected, the programming sequence is the same as discussed in program mode

### **SAVE A CURE**

After the cure has been edited, it may be saved. To assign a name, select alpha characters by using the up and down arrow keys and numbers by using the numeric keys. Press “E” to save the cure and return to the update cure library menu. If the library already contains thirty-two cures, the following message will be displayed when an attempt is made to save a cure - The library is full. Delete a Cure First

### **DELETE A CURE**

To delete a cure from the library, select the cure from the edit phase, press “M” to return to the menu, press A3" to delete cure, press “E” to confirm or “M” to cancel.

**PRINT A CURE** - Used to print the parameters of the selected cure. Upon completion, the user is returned to the Setup Main Menu.

**PRINT ALL CURES** - Used to print the name of all of the cures contained in the cure library.

**EXIT** - Returns the user to the main setup bonder menu.

### *Set Language*

Used to provide for the printing and display of menu selections and operational parameters in either

- 1) English
- 2) French



- 3) German
- 4) Spanish
- 5) Japanese

### *Set Units of Measure*

Used to set the units of measure to either English or Metric.

### *Read Hour Meter*

Used to display the total hours, minutes and seconds of operation of the machine. This is an informational function only and cannot be altered by the user.

### *Reserved; Tc Options*

Used to display the total hours of operation of the machine. Can only be reset by the factory.

### *Exit to MainMenu*

Returns user to the main menu at AASSIGN TC@ (3.3j).

## Chapter 9: About/Information Mode

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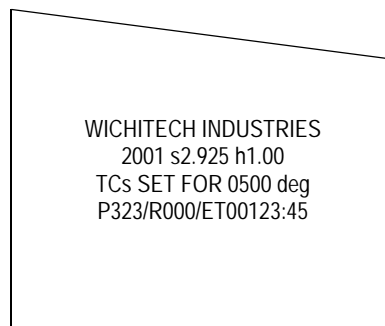
*Chapter 9 explains the features of the About Screen*

The About screen was provided on the the HB-2 as a quick way to verify the current operational setup of the HB-2.



Figure 9- 1 About Screen

The About screen can be accessed by pressing ‘6’ from the main menu. As the screen is displayed the following information will be dumped to the printer:



The second printed line indicates the year the latest software was created, the installed software version and the hardware version. The third line indicates the setup configuration of the RED and YELLOW thermocouple blocks. One of the options available on the HB2 is operation up to 1000 degrees Fahrenheit. If your HB-2 has been configured for 1000 degree operation this line will indicate 1000 degrees. Default operation is 500 degrees. The last line provides the same information as the Self Test printout; the “P” number is the number of times the HB2 has been powered on, the “R” number is the number of times the units has



been reset and “ET” is the elapsed time in hours and minutes. Press ‘M’ to exit the About screen.

## Chapter 10: Last Cure Mode

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*Chapter 10 shows how to re-print the last cure on the HB2*

From the main menu, press '7' to access the Last Cure screen.



Figure 10 - 1 Print Last Cure Mode Screen

The HB-2 retains a maximum of 180 printed lines from the previous cure. Pressing '1' will reprint the cure exactly as it printed during the previous cure as long as it does not exceed 180 lines of data. If the limit is reached, only a portion of the previous cure will be recorded as the memory buffer will be overwritten. Pressing '2' will erase the memory of the last cure to prevent the next operator from accessing the previous cure. The Last Cure screen can be exited without performing any actions by pressing the 'M' key.



## Appendix A: Tips and Hints

---

*Chapter 5 provides a list of common sense bond repair guidelines .*

- Prepare repair per the applicable instruction of the Structural Repair Manual or Technical Order
- Heat blanket should overlap the repair area by a minimum of two inches on all sides
- Select a minimum of three(3) thermocouples and check each for proper operation. In the event of a mid-cure Tc failure, having at least three Tcs allows you to readily identify and remove a failed thermocouple.
- Locate thermocouples around the edge of the repair and at least 2 inches inside the edge of the repair blanket. Pay careful attention to all critical bond areas such as spar caps and doublers. Heat blanket must be placed on **top** of the thermocouples. Try to remember that the bonder is only as smart as the information it receives from the thermocouples
- Thermocouple tips should not come in direct contact with any electrically conductive surface such as metal or carbon fiber. The tips can easily be insulated by wrapping with Teflon or flash-breaker tape.
- Cover heat blanket with at least two layers of breather material prior to bagging repair. Breather provides thermal insulation as well as proper airflow and helps to ensure that the heat generated by the blanket flows into the repair area
- Monitor cure at all times. On very large metal bond repairs or in extremely cold weather, the bonder/blanket may have difficulty producing enough heat to maintain program temperatures. If one or more thermocouples will not maintain program temperature within limits, additional insulation or a heat lamp might be required.
- Long extension cords or heavily loaded circuits may cause line voltage drops or limit the available current which can adversely affect bonder efficiency.



- When de-bagging a repair, remember to unplug the thermocouples from the bonder before opening the vacuum bag. This will help prevent static electricity from damaging ESD sensitive parts in the bonder.
- The HB2 accepts any ac input voltage in the range of 85-265VAC and 47-440 hertz. For safety reasons, output power is used to run either 110 or 220 rated blankets. Anything less than approximately 180 Vac is routed as 110 Vac, anything over is routed as 220 Vac. The input voltage source must be rated for at least 20 amps in order to run large cures.

Never hesitate to ask if you have question. There are no stupid questions and Wichitech Industries loves to hear from its customers! Our number is 1-800-776-4277



## Appendix B: Troubleshooting

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*Appendix B provides procedures for troubleshooting system hardware and software..*

**T**he HB2 was designed and is equipped for years of trouble free operation. However, sometimes events can happen that cause the HB2 to behave seemingly erratically. Some of these events and the expected responses are explained below.

### *Defective Thermocouples*

Thermocouples are analog devices. This means that there is an infinite variety of unique responses from thermocouples. These responses depend upon simple things such as a broken wire to arcane things such as the variance in the extruded diameter of the +wire in relation to the –wire. The HB-2 addresses these responses in two stages; prior to running a cure and during a cure. The principal method of checking thermocouples prior to a cure is accomplished via the Test Tc Screen. In Test Tc, the operator should verify that each Tc to be used actually displays a temperature that approximates the temperature at the tip of the Tc. It is possible that someone had programmed the HB2 for the wrong temperature range ( 1000 degrees vs 500 degrees ). Check this first by going to the “about” screen and examing the printout. The printout data should match the Tc blocks in the HB2. If not use the “reserved” screen to make it so. If this checks out replace the thermocouple.

The Test Tc can also be used to quickly check for thermocouples with “backwards wiring”. Simply rub the tip of the thermocouple between your fingertips. The temperature should rise to approximately 90-100 degrees. If the temperature does not rise but decreases the wires in the thermocouple connector plug are backwards.

As you get ready to run a cure, the HB-2 initially checks that all of the “control” Tcs specified in the Assign screen are installed. If any of the control Tcs are open, the HB2 will display an appropriate message and not allow the cure to proceed.



It is possible for a thermocouple to fail during a cure even after passing all of the previous checks. If the Tc fails open, the HB2 displays an OPEN Tc alarm and depending upon the number of control Tcs will either continue the cure or suspend the cure at zero power until at least one control Tc is available.

### *Overtemperature*

The HB2 looks at the temperature of each control Tc and compares it to the pre-programmed requirements of the cure at all stages of the cure. If the temperature of a Tc exceeds the pre-programmed temperature by the value set by the HI-LO limit, the HB-2 will sound an alarm and immediately back-off the power output.

### *Undertemperature*

Under-temperature is probably the most dangerous of all of the alarm conditions for a bonder to handle. An easily created scenario that will cause the undertemperature alarm to occur, is accomplished by connecting a blanket to a repair area, installing the Tcs but failing to install the Tcs near the repair area. In this case, the HB2 will continue to advance the power while monitoring the Tc maintaining at room temperature. All bonders, except the Wichitech bonders, will continue to advance full power to the blanket while the repair turns to cinders. The HB2 has a built-in capability of monitoring the actual power output of the HB-2. The HB-2 will remove all output power if the monitored output power is on steady for more than a preprogrammed interval.

### *Power Interruption*

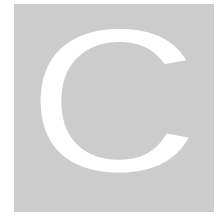
Situations sometimes occur when the power to the HB-2 is disrupted. The HB-2 responds differently to power removal according to the zone in which power was removed and to a lesser degree the mode the unit was in prior to losing power. If power to the RED zone is removed, both zones will be affected since the RED zone input provides power for all of the internal HB2 circuitry. If power to the YELLOW zone is removed, only the YELLOW zone will be affected. If power is removed while the HB2 is not running a cure, the effect is minimal. Assuming that the power disruption did not damage the HB2, simply restoring power and turning the unit on will re-initialize the HB-2. If the HB-2 was damaged, the self-test will fail and display the cause of failure.

When power is removed while the HB-2 is running a cure, the next time power is restored the HB-2 will attempt to re-start the cure it was running when power was removed. In this case, the HB-2 will still run the self-tests before re-starting the cure. If the self-test fails, you will not be allowed to complete the cure. If the self-test passes, the HB-2 will resume operation according to the stage it was in when power was removed; if in a ramp stage it will attempt to resume from that ramp stage, if in a soak stage it will attempt to resume from the ramp just prior to the soak stage, if the HB-2 was in the final cooling stage the HB-2 will either resume



cooling or terminate the cure depending on how long power had been removed from the cure area.

When attempting to resume a cure, the HB2 always assumes that the operator will want to resume the cure. In some cases, the operator may decide that resuming the cure does not make sense. For instance, if power has been off for too long it may not be possible to “save” the repair. In this case, the cure will have to be cancelled by the operator



## Appendix C: Warranty/Customer Support

### WARRANTY STATEMENT

Every WichiTech Composite Repair System is thoroughly inspected and tested before leaving the factory. It is warranted to be free of defects from workmanship and materials for the period of THREE (3) YEARS from the original date of purchase. Return only the bonder, freight prepaid, to the factory if any trouble develops during this three-year warranty period. WichiTech will repair (or replace, at our option ) without charge the system where factory inspection shows that the trouble was caused by defective workmanship or materials.

This warranty does not apply where:

- Repairs to the system have been made or attempted by others
- Repairs are required because of normal wear and tear
- The system has been abused, misused or improperly maintained
- Alterations have been made to the system

In no event shall WichiTech be liable for any indirect, incidental or consequential damages from the sale or use of the product. This disclaimer applies both during and after the term of the warranty.

WichiTech disclaims liability for any implied warranties, including implied warranties of “merchantability” and “fitness for a special purpose” after the three-year term of this warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. Some states do not allow limitation on how long an implied warranty lasts, so the above limitation may not apply to you.



## Appendix D: Safety Instructions

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**T**his operations manual contains applicable specific “WARNINGS”, “CAUTIONS”, and “NOTES”. The information under these headings should be strictly observed. In addition to these specific items, common sense and good safety practices should be followed.

---

### WARNING

---

Highlights an operating or maintenance procedure, practice, condition, statement, etc. which, if not strictly observed, could result in injury to, or death of, personnel and/or damage to equipment.

---

### CAUTION

---

Highlights an operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to, or destruction of equipment, or loss of mission effectiveness or long-term health hazards to personnel.

---

### NOTE

---

Highlights an operating or maintenance procedure, condition, or statement.

Before attempting to use the WichiTech Composite Repair System, personnel should be aware of the hazards normally associated with this equipment. The hazards which could be encountered are summarized as follows:

Power Input - If a power input other than recommended voltage is used, serious injury to the user and/or equipment damage can occur.



Heat Hazards - Because of the high temperatures used during the repair of composite materials, serious injury to the user and/or equipment damage can occur.

Warnings - The following WARNINGS appear in the text of this manual and are repeated here for emphasis.

=====

**WARNING**

=====

Improper installation of repair materials, heating elements, bagging devices and sensors or incorrect vacuum or temperature settings could result in injury to user and/or physical damage to equipment.

=====

**WARNING**

=====

The alarm condition, Tc HOT, is considered critical. If this alarm is not corrected, a fire hazard could exist. Because of this, if this alarm occurs, the temperature controller will stop power to the heating blankets until the alarm condition is corrected.

=====

**WARNING**

=====

A minimum of three thermocouples should be used. Failure to use three or more thermocouples could result in injury to user and/or physical damage to equipment and/or materials.



## Appendix E: Technical Specifications

### OPERATIONAL SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Control System	Operator-Programmable
Heating Zones	2 independently programmed zones
Heating System	Electric blanket, heat lamps
Heat/Dwell Steps	1 to 6
Heat Up Rate	1 to 15 degrees F per minute in 1 deg steps
Dwell Temperature	Ambient to 500 degrees F (999 optional)
Dwell Time	0 to 999 minutes per step
Cool Down Rate	1 to 15 degrees F per minute
Temperature Accuracy	+/- 1.0 degree F( after calibration )
Vacuum Accuracy	+/- 0.1 inch Hg( after calibration )
Thermocouple inputs	16(8 per zone), 40 deg F to 500 deg F ( 500 optional)
Active Control Thermocouples	16(8 per zone)
Vacuum inputs	2(1 per zone), 0 to 30 inches Hg
Internal Vacuum Source	Oil-Free, Electric, 0.95 CFM, 27.0" Hg
External Vacuum Source	"Shop Air" with venturi
Printers	2 Plain Paper Dot Matrix(1 per zone)
AC Safety Devices	Heat Sensing Circuit Breaker(1 per zone) Ground Fault Interrupter(1 per zone) Output Power Breaker/Monitor(1 per zone)
Alarm Conditions( 7 )	Low Vacuum            Open Thermocouple Under Temperature    Over Temperature Backwards Tc            Failed Tc Blanket Control Failure



## ENVIRONMENTAL SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Size	21 X 14 X 8 inches
Weight	35 pounds
AC Power Supply	#Universal AC input, 47-440 Hz, 85-264Vac
Operating Temperature/Humidity	-10 to +60 deg C, 20% to 90%(non-cond)
Storage Temperature	-20 to +85 deg C, 10% to 95%

Table 1-1. Specification Table

# - Note: Heating blankets are typically manufactured for either 110Vac or 220 Vac operation. The HB2 will operate on any voltage between 85Vac and 265 Vac.(The HB-2 auto-senses over the entire ac input voltage range – there are no jumper selections required ). However, care must be taken when the available input voltage deviates from either 110 or 220 Vac in selecting the appropriate blanket type.

### *Options and Specials*

WichiTech constantly evaluates its products with regard to cost and functionality. The specification tables found in this section reflect the most cost effective, dual-zone, hot bonder solution in the market today. However, if your application requires a different parameter that is not listed or a more stringent value please contact us for an alternate solution. WichiTech frequently modifies its standard product for specific applications including EMI/RFI shielding, number of thermocouples, power ratings, etc. Our toll-free phone number is 1-800-776-4277.

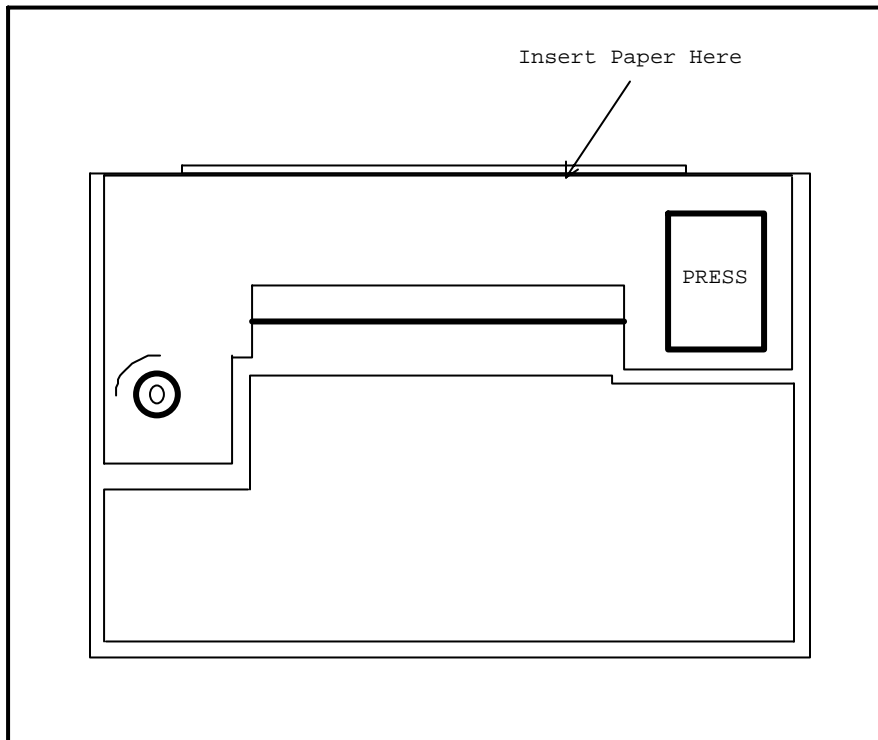


## Appendix F: Printer Maintenance

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### *Paper Feed Switch*

With the HB2 powered on, pressing the PAPER FEED switch (located below each printer) advances additional paper.



### *Replacing the ribbon*

The ribbon may be removed by pushing lightly on the right side of the ribbon cassette. Replace by inserting the right side first and gently “snapping” into place. To tighten the ribbon, turn the dial in a clockwise direction



### *Replacing the paper*

Push on the printer panel release button and open the door. Lift out and discard the depleted roll. Inset dowel on the new roll into the slots in the paper well. The printers use 2-1/4 inch wide paper, which is available at all office supply stores. The paper is available in various diameter rolls. If the small diameter roll is not available, pull sufficient paper off the roll until the roll will fit into the paper well.

Feed the paper through the print head by pushing the paper into the slot in rear of the printer while pressing down on the paper feed switch. Continue feeding the paper until sufficient paper is available to feed the paper through the slot in the printer door. Replace the door securely by pushing down on the release button.



## Appendix G: Battery

---

### *Battery Life and Storage Conditions*

The battery in the HB2 will provide approximately 9,000 hours of backup time for the onboard real-time clock and static RAM. However, backup time longevity is affected by many factors including the amount of time the HB2 is un-powered. Only when the HB2 is powered off does the battery supply power to the SRAM and clock, so that the battery life only gets used when the HB2 is turned off.

The battery has a capacity of 165 milli-Amp hours. At 25 degrees C, the real-time clock draws 3 uA when idle, and the 128K SRAM draws 4uA. If the HB2 were un-powered 100 percent of the time, the battery would last 23,570 hours( 2.7 years).

To maximize the battery life, the HB2 should be stored at room temperature until needed. Take care that the HB2 is not exposed to extreme temperature, or humidity for extended periods.

To ensure maximum battery shelf life, follow proper storage procedures. Protection against environmental extremes will help maximize battery life.

#### *Replacing the Battery*

The battery is not a user-serviceable item. If the HB2, no longer “keeps time“ when the power is turned off, return the unit to Wichitech Industries for service. Check for “keeping time” by turning the HB2 on and making a note of the time. Turn the HB2 off. Wait an hour. Turn the HB2 on again and verify that an hour has elapsed since the noted time.



## Appendix H: Blanket Size vs Machine Capacity

---

### *How large a blanket ?*

In a controlled environment, the answer depends on two main factors; the available ac power and the watt-density of the blanket. It can also depend on the shape and construction of the blanket, the target temperature, the ramp rate as well as other factors.

As a rule, power is measured in watts and is determined by multiplying the input ac rms voltage times the available rms current (Power = Voltage X Current). The standard HB2 contains a 20 amp circuit breaker. Larger circuit breaker currents are available (contact Wichitech for more information) but the 20 amp breaker is standard. For an HB2 running on 110 volts at 20 amps, the available power is 2200 watts (110 X 20 = 2200). For an HB2 running on 220 volts the available power is doubled at 4400 watts (220 X 20 = 4400). Keep in mind that these calculations have assumed that the input voltage is 110 or 220 volts. Use an rms meter to measure the voltage at your facility to get a more accurate value for your available power. Available power can also be reduced by several other factors; installation wiring, installation circuit breaker, extension cords, ambient temperature and the bonder own current requirements. The HB2 computer requires a small fraction of 1 amp to operate.

The watt-density for practical heating blankets range from approximately 3watts per square inch to 10 watts per square inch. Watt densities below 3 watts/sq inch are usually not sufficient to heat a composite repair area fast enough to complete a cure in a reasonable amount of time. Watt densities above 10 watt/ sq inch will create enough internal heat to actually break down the silicone structure of the blanket. The standard blankets that Wichitech provides are usually 5 watts per square inch. Wichitech does routinely provide other watt densities. Call us about your unique applications. So for an HB2 running on 110 volts, using a 5watt per square inch blanket structure the total area that can be heated is 440 sq inches (2200watts / 5 watts per sq inch = 440 sq inches). Wichitech can construct blankets of any shape desired. Some equivalent shapes of 440 sq inches are,



12inch by 36 inch rectangle, a 21 inch square or a 9inch radius circle. For an HB2 running on 240 volts, these sizes are doubled

Another option is possible since the HB2 is a dual zone bonder; the operator could use a dual zone blanket. If both zones are setup to run an identical cure, with 220 volts on both zones, the effective area of a 5 watts per sq inch blanket is 1760 square inches or a rectangle measuring 3 feet by 4 feet!.

Keep in mind that your bonder should be current limited at or below your installation's wiring capability. If you connect a 30 amp bonder to your 20 amp service you are running the risk of fire and/or damaging your installation wiring. Know your facilities' capabilities!

For extremely large repairs, Wichitech can provide a three phase power boosters that connects directly to the HB2 output. Consult Wichitech for more information.

### *Available Power vs. Blanket Size Charts*

For your convenience, the next two pages are provided as a quick blanket sizing reference.



Dim	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	46	48	40
4	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00	5.33	5.67	6.00	6.33	6.67
6	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00
8	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00	10.67	11.33	12.00	12.67	13.33
10	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33	9.17	10.00	10.83	11.67	12.50	13.33	14.17	15.00	15.83	16.67
12	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
14	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.00	15.17	16.33	17.50	18.67	19.83	21.00	22.17	23.33
16	2.67	4.00	5.33	6.67	8.00	9.33	10.67	12.00	13.33	14.67	16.00	17.33	18.67	20.00	21.33	22.67	24.00	25.33	26.67
18	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00	19.50	21.00	22.50	24.00	25.50	27.00	28.50	30.00
20	3.33	5.00	6.67	8.33	10.00	11.67	13.33	15.00	16.67	18.33	20.00	21.67	23.33	25.00	26.67	28.33	30.00	31.67	33.33
22	3.67	5.50	7.33	9.17	11.00	12.83	14.67	16.50	18.33	20.17	22.00	23.83	25.67	27.50	29.33	31.17	33.00	34.83	36.67
24	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00
26	4.33	6.50	8.67	10.83	13.00	15.17	17.33	19.50	21.67	23.83	26.00	28.17	30.33	32.50	34.67	36.83	39.00	41.17	43.33
28	4.67	7.00	9.33	11.67	14.00	16.33	18.67	21.00	23.33	25.67	28.00	30.33	32.67	35.00	37.33	39.67	42.00	44.33	46.67
30	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00	47.50	50.00
32	5.33	8.00	10.67	13.33	16.00	18.67	21.33	24.00	26.67	29.33	32.00	34.67	37.33	40.00	42.67	45.33	48.00	50.67	53.33
34	5.67	8.50	11.33	14.17	17.00	19.83	22.67	25.50	28.33	31.17	34.00	36.83	39.67	42.50	45.33	48.17	51.00	53.83	56.67
36	6.00	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00	39.00	42.00	45.00	48.00	51.00	54.00	57.00	60.00
38	6.33	9.50	12.67	15.83	19.00	22.17	25.33	28.50	31.67	34.83	38.00	41.17	44.33	47.50	50.67	53.83	57.00	60.17	63.33
40	6.67	10.00	13.33	16.67	20.00	23.33	26.67	30.00	33.33	36.67	40.00	43.33	46.67	50.00	53.33	56.67	60.00	63.33	66.67
42	7.00	10.50	14.00	17.50	21.00	24.50	28.00	31.50	35.00	38.50	42.00	45.50	49.00	52.50	56.00	59.50	63.00	66.50	70.00
44	7.33	11.00	14.67	18.33	22.00	25.67	29.33	33.00	36.67	40.33	44.00	47.67	51.33	55.00	58.67	62.33	66.00	69.67	73.33
46	7.67	11.50	15.33	19.17	23.00	26.83	30.67	34.50	38.33	42.17	46.00	49.83	53.67	57.50	61.33	65.17	69.00	72.83	76.66
48	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00	64.00	68.00	72.00	76.00	80.00
50	8.33	12.50	16.67	20.83	25.00	29.17	33.33	37.50	41.67	45.83	50.00	54.17	58.33	62.50	66.67	70.83	75.00	79.17	83.33
52	8.67	13.00	17.33	21.67	26.00	30.33	34.67	39.00	43.37	47.67	52.00	56.33	60.67	65.00	69.33	73.67	78.00	82.33	86.67
54	9.00	13.50	18.00	22.50	27.00	31.50	36.00	40.50	45.00	49.50	54.00	58.50	63.00	67.50	72.00	76.50	81.00	85.00	90.00
56	9.33	14.00	18.67	23.33	28.00	32.67	37.33	42.00	46.67	51.33	56.00	60.67	65.33	70.00	74.67	79.33	84.00	88.67	93.33
58	9.67	14.50	19.33	24.17	29.00	33.83	38.67	43.50	48.33	53.17	58.00	62.83	67.67	72.50	77.33	82.17	87.00	91.83	96.67
60	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.0

## 120 VAC BLANKETS; 5 WATTS PER SQUARE INCH

HB1 & HB2 Service

20Amp Caution

20-30Amp Service

Over 30Amp Service



Dim	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	46	48x	40
4	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50	2.67	2.83	3.00	3.17	3.33
6	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00
8	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00	5.33	5.67	6.00	6.33	6.67
10	0.83	1.25	1.67	2.08	2.50	2.92	3.33	3.75	4.17	4.58	5.00	5.42	5.83	6.25	6.67	7.08	7.50	7.92	8.33
12	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00
14	1.17	1.75	2.33	2.92	3.50	4.08	4.67	5.25	5.83	6.42	7.00	7.58	8.17	8.75	9.33	9.92	10.50	11.08	11.67
16	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00	10.67	11.33	12.00	12.67	13.33
18	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25	15.00
20	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33	9.17	10.00	10.83	11.67	12.50	13.33	14.17	15.00	15.83	16.67
22	1.83	2.75	3.67	4.58	5.50	6.42	7.33	8.25	9.17	10.08	11.00	11.92	12.83	13.75	14.67	15.58	16.50	17.42	18.33
24	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
26	2.17	3.25	4.33	5.42	6.50	7.58	8.67	9.75	10.83	11.92	13.00	14.08	15.17	16.25	17.33	18.42	19.50	20.58	21.67
28	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.00	15.17	16.33	17.50	18.67	19.83	21.00	22.17	23.33
30	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50	23.75	25.00
32	2.67	4.00	5.33	6.67	8.00	9.33	10.67	12.00	13.33	14.67	16.00	17.33	18.67	20.00	21.33	22.67	24.00	25.33	26.67
34	2.83	4.25	5.67	7.08	8.50	9.92	11.33	12.75	14.17	15.58	17.00	18.42	19.83	21.25	22.67	24.08	25.50	26.92	28.33
36	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.67	18.00	19.50	21.00	22.50	24.00	25.50	27.00	28.50	30.00
38	3.17	4.75	6.33	7.92	9.50	11.08	12.67	14.25	15.83	17.42	19.00	20.58	22.17	23.75	25.33	26.92	28.50	30.08	31.67
40	3.33	5.00	6.67	8.33	10.00	11.67	13.33	15.00	16.67	18.33	20.00	21.67	23.33	25.00	26.67	28.33	30.00	31.67	33.33
42	3.50	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00	22.75	24.50	26.25	28.00	29.75	31.50	33.25	35.00
44	3.67	5.50	7.33	9.17	11.00	12.83	14.67	16.50	18.33	20.17	22.00	23.83	25.67	27.50	29.33	31.17	33.00	34.83	36.67
46	3.83	5.75	7.67	9.58	11.50	13.42	15.33	17.25	19.17	21.08	23.00	24.92	26.83	28.75	30.67	32.58	34.50	36.42	38.33
48	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00
50	4.17	6.25	8.33	10.42	12.50	14.58	16.67	18.75	20.83	22.92	25.00	27.08	29.17	31.25	33.33	35.42	37.50	39.58	41.67
52	4.33	6.50	8.67	10.83	13.00	15.17	17.33	19.50	21.67	23.83	26.00	28.17	30.33	32.50	34.67	36.83	39.00	41.17	43.44
54	4.50	6.75	9.00	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00	29.25	31.50	33.75	36.00	38.25	40.40	42.75	45.00
56	4.67	7.00	9.33	11.67	14.00	16.33	18.67	21.00	23.33	25.67	28.00	30.33	32.67	35.00	37.33	39.67	42.00	44.33	46.67
58	4.83	7.25	9.67	12.08	14.50	16.92	19.33	21.75	24.17	26.58	29.00	31.42	33.83	36.25	38.67	41.08	43.50	45.92	48.33
60	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	42.50	45.00	47.50	50.00

240 VAC BLANKETS; 5 WATTS PER SQUARE INCH

HB1 & HB2 Service

20Amp Caution

20-30Amp Service

Over 30Amp Service

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