Hydraulic Burst/Leak Tester
Owner's Manual

Software Version 1.62

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Table of Contents

Introduction

The Crescent Design Hydraulic Burst/Leak Tester (*HBLT*) system uses distilled water to accurately pressurize a single item according to programmable profiles. These programmed profiles are referred to as "tests." The *HBLT* features simple, yet extensive menus for defining, saving, and running up to 20 different tests, as well as special functions.

The *HBLT* has a backlit LCD screen with a touch-sensitive front for user input. Pressurization is achieved using a hydraulic cylinder. Its piston is driven by a motor connected to a linear actuator. The system is controlled using Crescent Design, Inc. proprietary electronics and firmware.

With optional *Pressure Commander* software, PC compatible computer systems can be used to edit, store, recall, print, and run complex tests of several hundred steps. The *HBLT* may therefore run as a "slave" to a PC compatible system or "stand alone," switching back and forth between these modes.

Leaks detected by the *HBLT* are defined in terms of drop in pressure over 1 second or by absolute drop in pressure from the end of maintain. Bursts (also known as "ruptures") are essentially dramatic (rapid) leaks. In order to detect these hydraulic faults, the *HBLT* checks for pressure drops every one-tenth (0.1) second.

This manual contains complete instructions for setting up and using the *HBLT*.

Machine setup

Perform the following steps before using the *HBLT*. Read through all steps before starting. The *HBLT* is a heavy instrument, so keep in mind that wherever it is set up should be a "permanent" location.

1. Remove from carton

Carefully remove the *HBLT* from its packing carton. It contains electronic and mechanical components that can break if dropped. Set it on a level operating surface where the height of the touch-screen display is convenient for an operator. The *HBLT* operates best in an environment where the temperature is between 60° and 80° Fahrenheit. Since it operates on distilled water and has sensitive components, care must be taken not to expose the unit to temperatures much outside this range.

2. Connect power

The operating voltage on the *HBLT* is selectable between two voltage ranges. It is shipped with the proper voltage setting for the intended destination. If necessary, use the power selector on the back of the instrument to switch between the 105 - 130 Volts A/C and 210 - 260 Volts A/C settings. This selector is located just under the power cord receptacle. To change it, <u>remove the power cord</u> and pry out the selector, then replace it in the desired orientation. Connect the *HBLT* to a suitable electrical outlet with the power cord provided. The *HBLT* consumes a maximum of 400 Watts and operates on any A/C frequency between 47 to 63 Hz.

3. Connect fluid

A quick-disconnect fitting with a built-in shutoff valve is shipped with the *HBLT*. Connect this fitting with a hose to a clean water reservoir. Fill the reservoir with <u>clean distilled</u> water. Connect the fitting to its mating half on the front of the *HBLT*.

IMPORTANT: Do **not** connect the *HBLT* to any kind of <u>pressurized </u>water source. Use a clean distilled water source only.

4. Connect the printer

The *HBLT* uses a printer for recording the tests that have been defined, and for printing out the results of each test as it is performed (see the corresponding sections of this manual for more explanation of these printouts).

The printer must use a standard parallel interface. Attach a parallel printer cable to the DB-25 connector on the back of the *HBLT*. Connect the other (36 pin Centronics) connector to the printer.

Make sure that the printer is turned on, on-line, and has paper properly loaded before you attempt any printouts. If the printer is not selected, reports will be buffered, up to a

maximum of 6000 characters. An optional page eject can be sent after each report. When a printer is switched off or no longer connected, buffering is canceled.

5. Prepare the machine

The HBLT must be calibrated and purged before its first use! It is not calibrated prior to shipment. Please refer to the instructions about purging, and also those for calibrating the sensor (**Engineering Menu**, **Calibration** section) later in this manual. Pressure calibration is not accurate until the system has been purged of air.

Turning on the HBLT

When the *HBLT* is turned on, it will beep and then prompt you to proceed with calibration. Once calibration is performed, switching it on will then beep (two long, three short) and show the greeting screen with the Crescent Design logo, the software versions (kernel and application), and maximum pressure for your particular machine. Press the on-screen GO to proceed to the main menu.

Main Menu

This screen allows the user to go to the purging screen, perform a test, or access the engineering menu screen. The engineering menu allows tests to be created and edited.

Engineering Menu

This screen offers the choices described below, as well as the means to jump back up to the main menu.

Edit test information

This takes the user to the screen where tests are created, changed, deleted, printed, imported, and exported. It is also where the password is changed.

Perform calibration

This choice comes up automatically when the *HBLT* is first installed, and also may be accessed by touching the menu button labeled **Perform calibration** on the **Engineering Menu**.

As the screen prompt instructs, open the pressure outlet to the atmosphere. Touch the "ESC" (escape) button to abandon the calibration, or "OK" to continue. When continuing, attach a calibrated pressure source to the output port of the *HBLT*. This source should be capable of generating precise pressure near to the top of the *HBLT*'s range. Apply pressure and adjust the displayed pressure on the *HBLT* screen so it matches your calibrated pressure source. On-screen "up" and "down" arrows permit on-screen adjustments. The small arrows

are for fine adjustments, and the large arrows for coarse. Press the on-screen "OK" button to complete the calibration, or "ESC" to abandon it.

When calibration is complete, new offset and span values are saved in non-volatile memory. These values are critical to calculations necessary to convert the pressure readings taken by the *HBLT* into engineering units (PSI, atmospheres, etc.). These values will be in force until the next calibration is performed.

System configuration

System configuration consists of setting the criteria for communication with the HBLT. Below are the options and what their definitions. Most options have on-screen buttons that read "YES" or "NO". All buttons (or their prompts) show their current settings for respective options. To change an option, touch its related button and then choose the new setting from the screen prompt.

Set the baud rate

The baud rate is the serial data transfer rate into and out from the *HBLT*. The Import and Export features (under *Edit Test Information*) use serial data transfer, as well as the *Remote control, Pressure Commander* and *Download New Program* functions. When using *Remote control*, be sure and select a baud rate high enough to accommodate the CPS (characters per second) that are output during streaming mode. See Appendix A for details.

From the **Configuration Menu**, touch the on-screen menu button next to the words "Set the baud rate". Eight rates are shown (in bits per second). Touch the menu button next to the rate required, or touch the ESC button to change the current baud rate.

Measurement beep option

This option selects whether or not a "beep" is generated when the *Maintain Pressure Time* ends (see below). It is useful to cue operators on when to take a measurement after pressure has been applied to a product for a certain amount of time.

Page eject option

If you want a page eject command to be sent after printed reports, select this. It is handy for cut-sheet printers, like lasers and inkjets. Ejects apply to test summaries as well as process program printouts.

Purge speed

The Main Menu contains an option for "purging." Purging is the process of pumping water through a product (and whatever interconnected tubing) with the goal of removing any air that may be trapped inside. The purge speed option allows you to specify at what rate water will be pumped out the exhaust when purging. Some products have a very small passage for fluid, and others have relatively large passages. Please note that this option adjusts the purge function only. Individual tests have a separate and different setting for "filling."

Enable safety door

The *HBLT* has an optional connection for a safety switch, assumedly connected to an enclosure where products are hydraulically tested. When this option is enabled (set to YES), no testing will commence until the safety switch indicates that the safety door of such an enclosure is "closed."

Next page >>

The **Configuration Menu** has two screens, one with the settings mentioned above, and a second screen with the two options mentioned below. The *Next Page* button switches between these.

Enable remote control

When this option is set to YES, special characters received on the serial channel (obeying whatever baud rate choices are set above) will enable *Remote Control* of *HBLT* tests as if an operator were pressing on-screen buttons. The optional *Pressure Commander* software also requires that this option be set to YES. Please refer to *Appendix A* for an explanation of the remote control functions, how they work, and when they apply.

Select Remote Output

This option allows the operator to choose the **Select Output Format** menu. This menu allows the user to alter the output format and data rate used during remote operation streaming mode.

Diagnostic Menu

This menu allows you to perform diagnostics on the *HBLT* and analyze its performance.

Touch Screen Test

This screen allows you to test all the buttons on the *HBLT*'s touch-sensitive front panel. The screen is filled with buttons which, when pressed, change to "OK". Press each button to determine if the button is operable. Press the "ESC" button to return to the **Diagnostic Menu**. In the event the "ESC" button is inoperable, turn off the *HBLT* and contact Crescent Design for assistance.

Pressurization Count

In order to give Crescent Design's technicians an indication of the *HBLT*'s level of usage, a counter is incremented every time the *HBLT* is pressurized. The pressurization count screen displays this counter.

Download new program

        This function permits the re-programming of the *HBLT* by running the Crescent Design downloading program on your PC. This program will be supplied to you with any software updates. See Appendix E for more on downloading.

Set the date & time

        This **Engineering Menu** displays the current time and date at the top of the screen. Buttons allow you to adjust the MINute, HOUR, DATE, MONth, and YEAR by touching the "up" and "down" arrows next to these words. New settings will appear at the top of the screen as you adjust. Touch the "OK" button to save the new information, or "ESC" to exit without changing the current settings.

Print the manual

        This **Engineering Menu** function will print an abbreviated version of the Owner's Manual. Make sure that a printer is connected, turned on, on-line, and has paper loaded. You have the option of stopping the printout while in process by pressing the NO button that appears in the message box.

Purging

        Purging is the first of the choices appearing on the **Main Menu**. The object of purging is to remove air bubbles from the fluid path inside the machine. The *HBLT* should be purged prior to each use. Water will exit from this outlet when purging, so it is advisable to set it up so that it may drain into a suitable container.

        Select "Purge the tester" from the **Main Menu**. There are two purge modes available. The first purge mode is continuous purge. This purge mode is useful when filling the *HBLT* for the first time and for filling test fixtures. The second purge mode is single cycle purge. This purge mode uses a syringe and a graphic display to purge trapped bubbles from the system.

        Check that the water reservoir connected to the *HBLT* is installed properly and contains clean distilled water. Touch the "OK" button.

        If you select continuous purge, the HBLT displays a text screen that shows exhaust or intake status. There is a "STOP" button to exit continuous purging.

        If you select single cycle purge, a graphic display guides you through the purging process. Use the syringe and follow the instructions on the HBLT display. The use of the syringe is the best method for removing trapped bubbles from the system. Be sure and pull a hard vacuum when directed by the display.

        Touch the "DONE" button when you are finished purging the machine. **Do not allow air to be pushed or pulled into the machine.**

Select Output Format

This menu allows the operator to select the items and data rate that the HBLT sends out the serial port during remote operation with streaming mode enabled. There are five options for items transmitted.

1. Test state followed by a colon. The states are:

    a. R = Refill state (after a burst or leak is resumed).
    b. U = Ramp up.
    c. u = Ramp up paused by operator.
    d. M = Maintain.
    e. m = Maintain paused by operator.
    f. W = Dwell.
    g. w = Dwell paused by operator.
    h. D = Ramp down.
    i. d = Ramp down paused by operator.
    j. L = Last ramp down.
    k. l = Last ramp down paused by operator.
    l. 1 = Burst during ramp up.
    m. 2 = Burst during maintain or dwell.
    n. 3 = Leak during dwell.
    o. 4 = Leak dip during dwell.
    p. 5 = Burst during ramp down.
    q. 6 = Burst during last ramp down.
    r. 7 = Burst during bottom maintain.
    s. B = Bottom maintain.
    t. b = Bottom maintain paused by operator.

2. Sequence number of data followed by a comma. This also corresponds to the time frequency count.

3. Current Pressure followed by a comma.

4. Peak Pressure followed by a comma.

5. One of four volume options followed by a comma. If this option is selected, the operator has a choice of encoder counts from start of test, encoder counts since last data item, volume in milliliters since beginning of test or volume in milliliters since last data item.

The last delimiter of the items selected is replaced by a single carriage return.

The rate of data output is also selectable. Choices are 100, 50, 20, 10, 5, 2,1 samples per second. If the CPS (characters per second) based on characters to be sent and the serial port baud rate is such that overrun is likely to occur, a warning window is displayed.

During streaming operation, the burst and leak reporting is suspended until the end of the run. This allows simpler data cleanup when data is imported into spread sheet programs.

The user has the option of including a headings record. This allows headings for charts and tables in spread sheets.

To get to the screens, do the following steps:

1. Touch "Engineering menu button" on main menu.

2. Touch "System configuration button" on engineering menu.

3. Touch PAGE button to get second page of system configuration menu.

4. Touch "Select remote output" button on second page of system configuration menu.

5. You are now at the Output Format Menu. The first five options are the fields, in order of appearance, that may be selected. A yes or NO button is displayed depending upon the current state of that field. To change a state, touch the corresponding button. A confirming message with a YES/NO response is displayed. Make your choice. The volume field is a special case. If this field is selected, another menu appears so that you may choose volume units of encoder count total, encoder count increment, volume in milliliters total, or volume in milliliters increment. Touch the button next to the units desired. A YES/NO window appears to confirm. When you have selected the units you want, touch the ESC button to return to previous menu.

6. Touch PAGE to view the second page of the Output Format menu. Here you may select the data rate or optional column headings.

7. Touch the button for Set the data rate and a new screen appears with the values of 100, 50, 20, 10, 5, 2, or 1. Touch one of the rates to select.

8. Touch the Output column heading button to select column headings. A YES/NO window confirms your choice. Only headings for the columns you requested on page one are output.

Selecting and Running a Test

"Run a test" is the second option shown on the **Main Menu**. This will permit you to recall previously specified test profiles (programs), and run them. Test results will be sent to the printer, if attached. On-screen prompts and buttons make selecting, running, and viewing results of programs simple. Name and Lot Code information are entered by on-screen keyboard, which includes alphanumerics, some punctuation, backspace and erase (clear) keys.

To prepare for testing, attach an item (product) to be tested to the pressure outlet (on the front of the *HBLT*).

Touch the menu button next to "Run a test" on the **Main Menu**.

The next prompt asks for "Operator Name." This is optional, meant to identify who ran the test on its report, if printed. Touch the "OK" button in the lower right hand corner once this information has been entered.

The next screen prompts you to enter a "Lot code." This is optional information that will appear on printed test reports. Touch the "OK" button once entered.

A menu of currently stored tests will then appear. Ten test names fit onto the display; up to twenty tests may be defined. Undefined tests are listed as "(undefined)". Touch the PAGE button to switch between the screens of test names.

Touch the menu button next to the name of the test to be run.

A new screen appears, showing the information about the test selected.

Touch the OK button if the information displayed corresponds to the test intended to run. Touch the ESC button if you decide not to run this test.

If OK was pressed, the machine will ready itself. When this action is complete, the test screen will appear (saying BURST-LEAK TESTER READY at the top). In the event that hydraulic pressure exists at the outlet at the onset of the test, the system will attempt to depressurize. Part of this function may include "burping," (clicking noises) as the inlet valve switches on and off in an attempt to equalize pressure between the *HBLT* cylinder and the product being tested. Compliant products, in particular, can cause this kind of activity.

When the outlet pressure has been equalized, the *HBLT* will put up a wait message while its cylinder refills with water, it will then be ready to go, showing a START button. Pressing START will either begin the test, or start the *Fill* function, depending on the test's *Fill speed* setting.

In the event the test has a *Fill speed* specified, the words "Press to fill" will appear beside the START button. Pressing START will then pump water slowly into the product being tested until 8 PSI of back pressure exists, and then the Cylinder will refill itself. This refilling may again cause "burping" as mentioned above (especially with compliant products). The words "Press to fill" will be erased, and the words "Press START to begin" will appear at the bottom of the screen. Pressing START will then commence testing.

Tests run to completion unless a fault (burst or leak) is detected. During the test, the screen displays what state the machine is in, what cycle it is on, and the current and target pressures. The only other way to interrupt a test is to either press the on-screen STOP button or to open the safety door (assuming that a safety door switch is enabled). After the test is stopped, you may resume the test by touching the Resume button, end the test by touching the OK button, or cancel testing and return to the main menu by touching the ESC button. Resuming refills the cylinder, re-pressurizes the system depending on the state the test was stopped in, and then continues with the test.

The results of each test are sent to the printer port at the end of each test. The printout includes:

Test name: specified test name (Test Type)
Product: specified product name
Operator: operator name
lot: lot name or number
Start at: date, time
End at: date, time
Result: If no burst or leak occurs: "No failure"

If a burst or leak occurs: time elapsed, burst cycle number, burst pressure, and maximum pressure attained.

In order for results to be printed, a printer must be connected, turned on, on-line and ready *before* the test ends. This is optional. The *HBLT* will run through tests with or without a printer connected.

Test Definition and Management

Definition of Terms
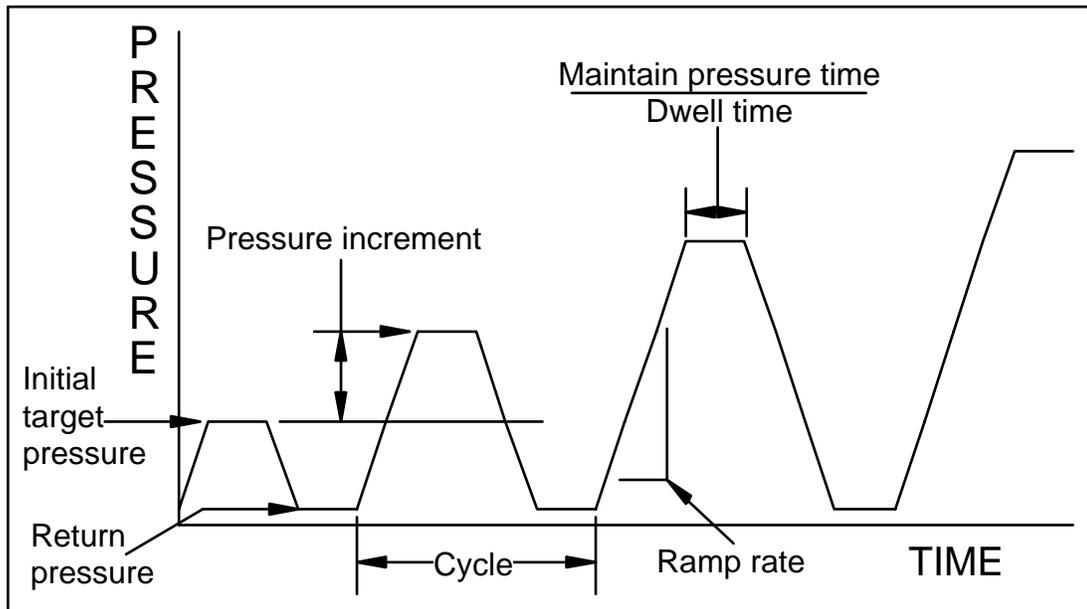
Burping: The process opening and closing the HBLT water inlet in order to equalize pressure between the hydraulic cylinder and a product being tested. Burping causes the *HBLT* to make clicking sounds, and can repeat several times before pressure equalizes. *Compliant* products in particular cause a lot of burping when starting a test because of their elastic nature.

Burst Rate: This is the pressure drop rate expressed in Pressure Units per second. A burst will be reported during Ramp Up or Dwell Time when pressure drops at a rate that equals or exceeds this Burst Rate. Burst Rates must be higher than the Leak Rate specified for the same test. There are two burst rates. The first, up burst rate, is active during ramp up and during maintain/dwell. The second, down burst rate, is active during ramp down and bottom maintain.

Compliance: The tendency of a product (some plastics and rubber, mostly) to stretch or grow under pressure. Compliant products seem to be leaking, whereas in reality they are growing to accommodate a larger volume of water. Long Maintain Times are recommended

for testing compliant products, as well as generous *Leak Rate* settings. Typically, compliant products can only be practically tested for burst conditions.

Cycle: A Cycle is a pressurization and corresponding de pressurization of an item under test.

Cycle Repeat: This is the number of times the *HBLT* will repeat a *cycle* (with its specific programmed *Target* and *Return Pressures*) before proceeding to the next programmed Target Pressure.

Down Rate: The speed at which pressure is removed during the *Ramp Down* part of a testing *cycle.* The speed is expressed in terms of *Pressure Units* per second.

Dwell Time: This is the maximum amount of time, in seconds, for which an item under test will be pressurized at the *Target Pressure*. Dwell Time begins when the *Target Pressure* is first attained. Dwell Time includes within it the *Maintain Time.*

Fast Ramp: A pressurization method that can be applied to any test type, intended to maximize pressurization stress at the cost of target pressure achievement accuracy. The hydraulic pressurizing system runs at maximum possible speed throughout most of the upward pressurization *cycle* .

Fill Speed: The rate at which water is pumped into a product before a test begins. Each test contains its own fill speed, specified in terms of cubic centimeters per second. Select from 4.00 to .01 cc/sec in .01 cc/sec increments. When this is enabled for a particular test (e.g., reads some value other than NO FILL), water is pumped through the outlet at this rate until a back pressure of 8 PSI is achieved, then the test waits to begin its programmed pressure cycle(s).

Firm Product: A part made from plastic or other material which will expand very slightly under pressure before failure. Examples: certain balloon catheters, junctions, fittings.

HBLT: Hydraulic Burst and Leak Tester.

Initial Pressure: This is the first (and lowest) programmed pressure the *HBLT* will achieve during a test.

Leak Dip: This is the pressure drop in absolute pressure from the end of the maintain portion of the dwell cycle. A leak dip will be reported during the *Dwell Time* of test when the *Dwell Time* exceeds the *Maintain Time*. Leak Dips during this period are defined as an absolute pressure drop. See also *Burst Rate* and *Leak Rate*.

Leak Rate: This is the pressure drop rate for leak detection expressed in *Pressure Units* per second. A leak will be reported during the *Dwell Time* of a test when the *Dwell Time* exceeds the *Maintain Time.* Leaks during this period are defined as pressure drops at a rate that equals or exceeds the Leak Rate. See also *Burst Rate.*

Maintain Time: This is a period of time (seconds) during the *Dwell Time* when the *HBLT* actively maintains the *Target Pressure* in the product under test. This means that any pressure drops that occur due to *compliance* or (small) leaks will be compensated for by further pressurization. Maintain Time begins concurrently with *Dwell Time*. Bursts may be detected during the Maintain Time, **but leaks are not**. Maintain Time may be set anywhere

from Zero (which cancels any pressure maintenance) to the total amount of *Dwell Time* (which cancels leak detection).

Maximum Pressure: The highest pressure achieved via two or more *cycles* in a test such as the **Staircase** or **Incremental** modes.

Pliant Product: Flexible tubing or other plastic products that will stretch or grow under pressure before failure. Example: vinyl tubing.

Pressure Commander: Optional PC-compatible (DOS) software that allows you to edit, store, recall, print, and run complex *HBLT* tests that may take several hundred steps. Pressure Commander is an integrated editing and testing application that makes the *HBLT* act as a "slave" to the PC.

Pressure Increment: This is the amount of additional pressure added to the *Target Pressure* of the previous *cycle* to obtain the *Target Pressure* for the next *cycle*. This is used in Staircase and Incremental modes (see the section on **Pressurization Modes**).

Pressure Units: The *HBLT* works with three different engineering units: Pounds per Square Inch (PSI), atmospheres (ATM), and KiloPascals (kPa). Pressure units are selected when a test is defined, and apply to all data displayed or printed by that test (including via *remote control*). Once pressure units have been selected, they cannot be changed when editing a test.

Purge: The process of emptying air out of fluid pathways. There is an option on the **Main Menu** to perform this function. Also see *Fill.*

Purge speed: The rate at which water is pumped through the outlet during the *Purge* function. This is one of the System Configuration settings in the Engineering Menu.

Ramp Rate: This is the rate at which the *HBLT* achieves pressure, expressed in *Pressure Units* per second. There are two ramp rates specified in a given test. These are called *Up Rate* and *Down Rate*.

Ramp Down: The part of a *cycle* in which pressure decreases. Also see *Up Rate.*

Ramp Up: The part of a *cycle* in which pressure increases. Also see *Down Rate, Ramp Rate.*

Repeat Cycle: A test setting that controls how many times a particular *cycle* will repeat until the next step.

Return Pressure: This is the programmed pressure that the *HBLT* will depressurize to at the end of a given *cycle*. This may be set to *VACUUM*.

Rigid Product: Metal or stiff plastic parts undergoing hydraulic testing. Such parts virtually never stretch under pressure (only fracture). Examples are end caps and valves.

Rubbery Product: Products that easily inflate when pressurized and can conform to enormous increases in hydraulic volume before failure. Large-volume vinyl and latex products fall into this category.

Stretchy Product: Flexible products that stretch significantly when undergoing pressure. Large-volume vinyl products (bags) may fall into this category.

Target Pressure: This is the programmed pressure that the *HBLT* will achieve during a given *cycle*.

Total Cycles: This is the computed total number of pressurization/de pressurization *cycles* performed during a test, taking into account *Repeat Cycles* and how many steps may be required to achieve *Maximum Pressure.*

Up Rate: The speed at which pressure is applied during a test *cycle.* This is expressed in terms of *Pressure Units* per second. See also *Down Rate, Ramp Rate.*

Vacuum: Any state of negative pressure, typically a small number of *Pressure Units* below zero. A severe vacuum (many *Pressure Units* below zero) usually cannot be achieved by the *HBLT*.

Pressurization Modes, or "Types of Tests"

Linear Ramp
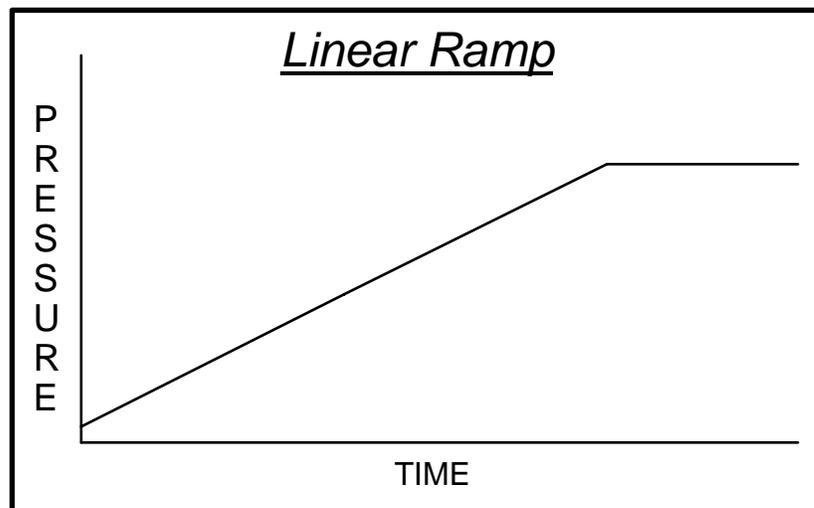
Continuously increasing pressure is applied to a product until it reaches its *Target Pressure*, then stays at that pressure for the *Dwell Time,* or until a burst or leak is detected.

Staircase

Staircase

PRESSURE

TIME

    Pressure increases to programmed *Target Pressure* and remains for the *Dwell Time*. If no burst or leak occurs, pressure is then increased by the *Pressure Increment* amount. The test continues until a burst or leak is detected or until *Maximum Pressure* is achieved.

Fatigue

Fatigue
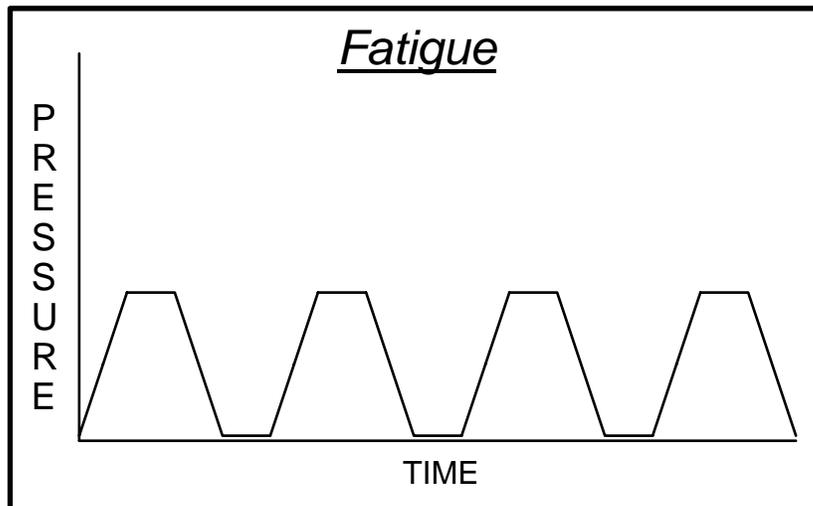
PRESSURE

TIME

    The Fatigue mode repeats a single defined pressurization *cycle*. Pressure increases to a programmed *Target Pressure.* Product will remain at pressure for the specified *Dwell Time*, and then de pressurized to the *Return Pressure*. This repeats for the *Repeat Cycles* defined for the test.

Incremental

Incremental
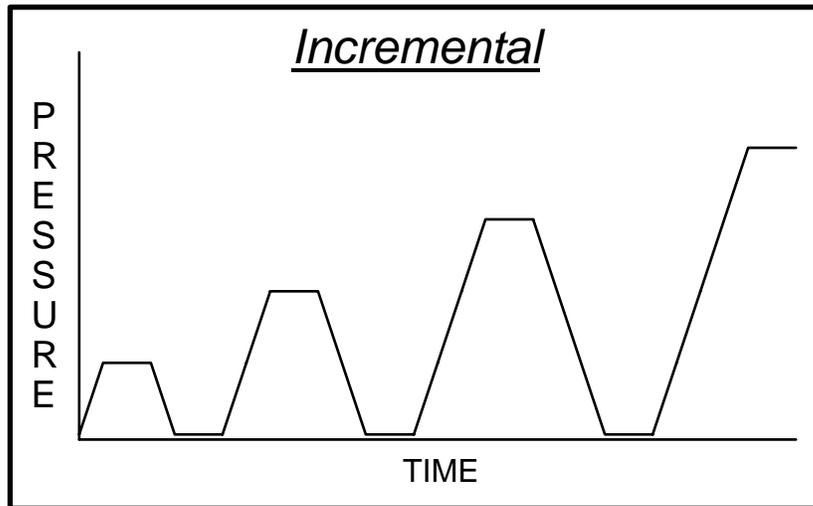
PRESSURE

TIME

      Pressure increases to programmed *Target Pressure* and stays there for the specified *Dwell Time.* If no burst or leak occurs, the pressure is decreased to the specified *Return Pressure* level. This repeats a specified *Repeat Cycle* number of times. Once the *Repeat Cycles* complete, a new *Target Pressure* is computed by increasing the previous pressure by the *Pressure Increment* amount. The test continues like this until a burst or leak, or the *Maximum Pressure* is achieved.

Custom

Custom

PRESSURE

TIME
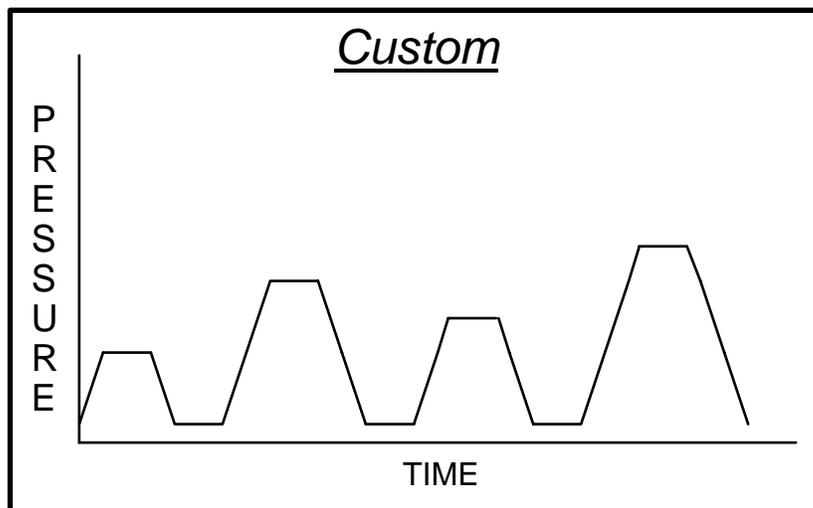
      This is a custom pressurization profile. It works like Incremental mode, except that each successive *Target Pressure* is defined individually. Up to 100 successive Target Pressures can be defined for a given test. These custom target pressures need bear no relationship to each other; one target may be greater than, less than, or equal to any of its neighboring targets.

Editing Buttons

When creating or editing test information, most data entry screens feature a number of editing buttons along the bottom row. These are editing buttons.

ESC

The ESC (escape) button appears on screens enabling you to abort the process of entering or selecting information. It is also used to close menus or submenus and return to a previous level of selection.

BACK

The BACK button is used to step backwards in a multi-step procedure, such as entering or editing test information. Pressing the BACK button permits you to step backwards and change a setting you just entered (and the setting previous to that one, and so on).

Arrow Buttons

When entering numeric values, a right-pointing arrow button appears. When entering alphanumeric information, a left-pointing arrow button appears. These are "backspace" keys, used to erase the last digit (or character) just entered.

SPACE

The SPACE button inserts a blank (space) when typing in alphanumeric information (i.e., test name, product ID, operator name, and so forth).

CLEAR

The CLEAR button erases all alphanumeric information entered on a given screen, or sets a numeric entry to zero.

OK

The OK button acts as an "enter" key, accepting the presently displayed setting.

Compliance Setting

When defining a test, a prompt appears asking for product compliance, offering choices from 1 (*Rigid Product*) to 5 (*Rubbery Product*). Controlled pressurization requires special "tuning" in order to achieve goals accurately. The means by which pressure is achieved when a product stretches under pressure differs from when a product does not stretch. Valves usually are tested best at a Compliance Setting of 1 (Rigid); Catheters at 2 (Firm); Tubing at 3 (Pliant); bags at 4 (Stretchy); and latex at 5 (Rubbery).

Certain products may be manufactured to be less compliant than their component materials may suggest. Irradiated plastics usually increase in rigidity (decrease in compliance), for example.

Highly compliant products (those best fit for settings 4 and 5) consume large volumes of water before showing any pressure at the sensor. When *Fill speed* is enabled for a test, it will attempt to pressurize a product to approximately eight PSI before starting the actual test. Some very compliant products can burst at less than eight PSI (as the sensor sees it), since the

actual weight of water inflating the product can apply much more than eight PSI to its sides, seams, etc.

Highly compliant products may need special test considerations, e.g., testing a product encased in a rugged, constrictive enclosure that prevents it from consuming more than a fixed volume of water. Of course, once inside a constrictive enclosure, the product will not experience the same stresses that it would see in normal use.

"Fast Ramp" Pressurization

Each of the five test types (Linear Ramp, Staircase, Fatigue, Incremental, Custom) ask for an "Up Rate." Most non-destructive tests use a controlled pressurization rate that is entered on this screen in terms of engineering units per second (PSI/sec, kPa/sec, or Atm/sec).

The "Up Rate" screen features a "FAST" button, which when pressed, changes the requested Up Rate to "FAST RAMP". Any test created with a FAST RAMP Up Rate will pressurize as fast as possible within the limitations of the unit. The effective rate in this case can be as fast as 1000 PSI per second, more in some cases, depending on model.

FAST RAMP is intended for destructive testing. Target pressures are not achieved accurately during FAST RAMP testing. FAST RAMP pressurization is very much like trying to move a car between two points using a stop/go switch as opposed to an accelerator and brake.

A side effect of FAST RAMP pressurization is pressure backlash. If a product is brought to a target pressure and does not fail, the rapid stopping of the pressurization process causes a kind of "hiccup" in the pressure curve, which the tester may interpret as a mild burst. It is recommended that the *Burst Rate* be set to higher values for FAST RAMP tests.

FAST RAMP pressurization consists of two phases: full power pressurization and controlled target acquisition. Full power pressurization starts immediately and runs for as long as it can without running risk of going over pressure. Then a controlled ramp rate decelerates to goal.

Defining a New Test

Select "Edit test information" from the Engineering Menu.

Select "New" on the Test Editing Menu.

Select the type of test (see definitions above).

Enter the information requested at the prompts. Each type of test uses a different number of settings. The *HBLT* prompts you to enter each of the settings, displaying minimum and maximum allowable values each time. If you enter a value that is out of range for a test, you will be prompted to correct the value. If an incorrect value is entered there is no need to quit. It is easy to go back and change values by "Editing" a test (see below). The test will be saved automatically when all parameters have been entered.

Once a test has been created, a button appears on screen that enables you to "Quick Start" it. This button appears with the language **Run Process "MYPROC"** where "MYPROC" is the name of the test recently created.

Editing an Existing Test

Select "Edit test information" from the Engineering menu. Note that all test settings **except** for the "Type of test," its name, and the *Pressure Units* may be edited.

Select "Edit" on the Test Editing Menu.

Touch the menu button next to the name of the test to be changed.

Each of the settings, beginning with "Product ID," will be presented, just as when entering a new test. You may change any of these. Simply touch the "OK" button on screens that do not require changes. The new values are automatically be saved after the last screen has been (optionally) edited.

If any settings change, the *HBLT* will ask what to do with these changes. You may choose to save the changes into the original test, updating it; save the edited test under a new name; or discard the changes.

Once a test has been edited, a button appears on screen to enable the "Quick Start" function. This button appears with the language **Run Process "MYPROC"** where "MYPROC" is the name of the test recently edited.

Deleting a Test

Select "Edit test information" from the Engineering menu.

Select "Delete" on the Test Editing Menu.

Touch the menu button next to the name of the test to be deleted.

Review the information about the test selected and touch OK if this is the test intended to delete.

Touch YES to confirm deletion of the test.

Printing a Test

Ensure that a printer is connected to the *HBLT*, and that it is turned on and paper is loaded.

Select "Edit test information" from the Engineering menu.

Select "Print" on the Test Editing Menu.

Touch the menu button next to the name of the test to print. The test parameters will be immediately printed.

Importing a Test

This feature allows you to send information that defines a given test from one *HBLT* instrument to another.

Using a Crescent Design customized serial cable, connect two *HBLT* instruments together via their serial ports (located on their back panels).

Next, go to the *HBLT* instrument that is to **receive** test information and select "Import" from the Test Editing Menu.

Go to the *HBLT* instrument that is to **send** test information and select "Export" from the Test Editing Menu. (Follow the instructions under "Exporting a Test".)

Data transfer usually takes only one second. If you attempt to import a test with the same name as an existing test, you will be prompted as to whether to overwrite an existing test. If you attempt to import a test and the test memory is already full, you will be prompted to delete an existing test or to abandon the import. If information is not received within three minutes, the "Import" screen will automatically time-out (returns to a menu).

Once a test has been successfully imported, a button appears on screen that enables you to "Quick Start" it. This button appears with the language **Run Process "MYPROC"** where "MYPROC" is the name of the test recently received.

Exporting a Test

Select "Export a test" from the Test Editing Menu.

Touch the menu button next to the name of the test you'd like to export. The data for that test is automatically sent out the serial port in ASCII form. The data is formatted to be intelligible by another *HBLT* instrument, and may not be obvious to the operator.

It is possible to use a "terminal program" to record exported tests, edit, and later upload them into *HBLT* using ASCII data transfer. Any unacceptable settings will be brought to your attention, as well as related error messages should an imported test have problems.

Changing the password

Tests and other **Engineering Menu** items may be protected with a password. When a password is applied, access is restricted. To enter or change a password, press the "Change password" button on the **Edit Test Information** screen off the **Engineering Menu**. If an existing password is in place, you must enter the previous password before proceeding. If you choose to change the password, you must enter it twice, the second time for confirmation. If the confirming entry matches the initial entry, the new password will take effect and further attempts to access certain functions will require passwords.

When entering the password, the HBLT displays asterisks instead of the entered characters. This feature helps secure the password.

To disable the password, go to "Change Password" and enter a blank password by pressing "Clear" then "OK." Confirm this, and the password will be deleted.

Preventive Maintenance

Except for the touch screen display, no special external cleaning of the *HBLT* instrument is necessary.

Touch Screen

It is important that only a soft damp cloth be used to clean the touch screen on the *HBLT*. Nothing sharp or potentially abrasive should be used. Do not use paper towels to clean the screen, as they can be abrasive to the touch screen surface.

Water Filter

The water filter should be replaced every 3 months. Follow these steps to change out the water filter:

1. Remove the power cord from the back of the *HBLT*.
2. Remove the 8 screws that hold the cover on.
3. Carefully remove the cover of the instrument.
4. Locate the water filter. It is held down by clamps in the center of the hydraulic subassembly.
5. Release the hose clamps.
6. Remove the hose from the filter and replace the filter with a new one.
7. Replace the hose clamps.
8. Replace the cover.
9. Attach the power cord.
10. Turn on the instrument and purge it thoroughly.

Fault conditions

An internal fan in the *HBLT* runs when needed to keep certain components cool. You may hear the fan cycling on and off while a test is running. This is normal.

Overtemperature

Temperature sensors inside the *HBLT* allow the computer to alert you in the case of over-temperature conditions. An error message will appear on the display if either the servo motor or electronics gets too hot. In order to clear an over-temperature error, you must turn off the *HBLT* and turn it back on again.

Motor Stalled

The *HBLT* automatically adjusts for hard-to-pressurize conditions (such as *compliant* products). In the event that the *HBLT* cannot effect pressure increases after 5 seconds of effort, it will assume that its motor has stopped working and will display a "Motor stalled" message. In order to clear this error, turn off the *HBLT* and after a moment, turn it back on again. Check to make sure that the product undergoing testing is properly attached to the outlet and that water flow is closed off.

Overpressure

If the pressure exceeds a safe limit, an over pressure error will be displayed. This typically cannot happen under normal test circumstances, unless some outside force is applying extreme pressure back into the *HBLT*. Another possible cause is incorrect calibration, which would allow the machine to attempt what it reads is a permissible pressure, that is actually out of range.

Appendix A. Serial Remote Control

Serial Remote Control is an option found on the second page of the **Configuration Menu**, "Enable remote control" and "Select Remote Output". When set to YES, this option will permit remote operation of the tester as if an operator were pressing buttons on its touch screen. The baud rate at which remote operations commence is whatever rate is set in the **Configuration Menu** (page 6), "Set the baud rate".

Note that the commands below are *not* those used by the *Pressure Commander* software. *Pressure Commander* interacts with the *HBLT* using a more complex, proprietary, control language that is not documented here.

Selecting a test

The tester's **Main Menu** offers an option for "Run a test." An operator must use the touch screen to choose this option, enter their Operator ID and Lot Code information, and then select the test to run. (After selecting a test, the screen shows test information, and the operator must also press OK to confirm the test selection.) See also the remote command code "r" for a remote-control method of selecting tests.

Remote Control Features

The main test screen (which shows "BURST-LEAK TESTER READY" at the top) may be controlled either by an operator or by characters coming in the serial channel. The following describe characters and their function. NOTE: In the descriptions below, <cr> stands for an ASCII carriage return, code 13 decimal; <lf> stands for an ASCII linefeed, code 10 decimal. Examples in quotes use the quotes to delimit the message; the quote characters themselves are not part of any message.

ESC   (ASCII code 27 decimal) Return to main menu. Once the main menu is displayed, no further serial input is accepted until an operator selects another test as described above. If a test is already in progress or there is no ESC button currently being displayed, this command is ignored.

*   (ASCII code 42 decimal) HBLT RESET command. This is a software function that has no on-screen button equivalent.

?   (ASCII code 63 decimal) status query. During most test states, this command causes the tester to echo back a message formatted like "=XXX,YYY<cr>" where XXX is the current pressure reading (in applicable test units), and YYY the peak pressure reading (again in test units). Example: "=20,200<cr>" and "=1130,1200<cr>". This command is ignored when in streaming mode. See description of command character D (below) for details on streaming.

C   (ASCII code 67 decimal) Streaming mode CANCEL. This is a software function that has no on-screen button equivalent. See description of command character D (below) for details on streaming.

D   (ASCII code 68 decimal) Streaming mode ENABLE. This is a software function that has no on-screen button equivalent. Streaming mode causes a continuous flow of data

to be sent by the HBLT during test operation, one data packet every 10 milliseconds. See the description of the **:** (colon) response code for details on the data packets.

G   (ASCII code 71 decimal) GO button. Tester will behave as if the on-screen GO button had been pressed. The GO button in question is the button that appears on-screen after initial power-up of the HBLT.

K   (ASCII code 75 decimal) OK button. Tester will behave as if the on-screen OK button had been pressed. If a test is in progress or the OK button is not currently being displayed, this command is ignored.

l   (lower case, ASCII code 108 decimal) Lot number string. Tester will behave as if a string were typed in response to the lot number request. Type up to 14 characters followed by a carriage return or linefeed. This command must follow the "r" command.

o   (lower case, ASCII code 111 decimal) Operator string id. Tester will behave as if a string were typed in response to the operator id request. Type up to 14 characters followed by a carriage return or linefeed. This command must follow the "r" command.

R   (ASCII code 82 decimal) START button. Tester will behave as if the on-screen START button had been pressed. If a test is already in progress or there is no START button currently being displayed, this command is ignored.

r   (lower case, ASCII code 114 decimal) execute process command. The lower-case r must be immediately followed by the exact (spaces, punctuation, and case-sensitive) test name and then a carriage return (ASCII code 13 decimal). If this test name matches one of the tests in the HBLT memory, it will be loaded and ready. The system should typically respond with an F (waiting to start). A response of ? followed by the test name happens when no match is found. A non-response (within one or two seconds) would indicate that the HBLT was busy running a test or in another mode (purge or engineering menus, for example) and cannot accept run commands. The test name need not be terminated with a carriage return if its length is exactly ten characters long. NOTE: Most tests contain no lower-case characters. Example: "rMY TEST<cr>".

The "r" command resets the operator id string and lot number string to null. Use the "l" and "o" commands to set the lot number and operator id respectively after you issue the "r" command.

S   (ASCII code 83 decimal) STOP button. Tester will behave as if the on-screen STOP button had been pressed. If a test is not in progress or the STOP button is not currently being displayed, this command is ignored.

X   (ASCII code 88 decimal) export currently-loaded process. When the HBLT is "idle" in between tests, including immediately after a test has terminated (with or without error), the description of the process presently being run will be sent via the serial channel exactly as if it had been EXPORTed via the Engineering Menu. Note that decimal points are omitted; tests set for atmospheres show numbers that actually represent atmospheres times ten (e.g., a target pressure of 100 is actually 10.0 atmospheres). PSI and kPa units are represented straight-forwardly.

Z   (ASCII code 90 decimal) resume a test stopped by S command, burst, or leak. If a burst or leak stopped the test, the cylinder is refilled. If stopped in a pressurized state, the HBLT is re-pressurized.

Response codes

The tester will send various codes indicating test status by itself when a test is in progress (or just stopping). The following are the codes and their meanings:

=   (ASCII code 61 decimal) status report, responding to remote query. This response code is followed immediately by XXX,YYY<cr> where XXX is the current pressure (in test units), and YYY the peak pressure (in test units).

:   (ASCII code 58 decimal) streaming data report. This character is followed by a sequence of digits (as many as four) representing current pressure (including a preceding minus sign if appropriate), a comma, and another sequence of digits (as many as five, again with preceding minus if appropriate) representing the number of steps the actuator took since the last sampling period, then a carriage return. The pressure will be in the type of engineering units specified for the test. Example data responses would be (without quotes): `":50,-5<cr>"` and `":-5,100<cr>"`.

?   (ASCII code 63 decimal) remote test name rejected. This character is followed by the test name (up to 10 characters long) and a <lf><cr> sequence. This is always in response to a remote command "r" followed by a test name that does not match any in memory. Since test names are punctuation-, case- and space-sensitive, common errors can be having an unintentional space (or other character) follow the "r" command, or in sending a lower-case test name when most all tests contain no lower case.

DA   (ASCII codes 68 and 65 decimal, respectively) test aborted by operator (safety door open, RESET via remote control or front panel). This response code is followed immediately by XXX<cr> where XXX is the peak pressure (in test units). Example: "DA1200<cr>".

DB   (ASCII codes 68 and 66 decimal, respectively) test aborted, up ramp burst condition. This response code is followed immediately by XXX,YYY,ZZZ<cr> where XXX is the burst pressure (in test units), YYY the peak pressure (in test units), and ZZZ is the time elapsed since the pressure started ramping up in the current cycle. Example: "DB360,500,4.2<cr>". (Burst at 360 units, peak 500, 4.2 seconds.) The HBLT emits this message when an up ramp or dwell burst occurs. However, during streaming data mode, the message is displayed after the test completes.

DC   (ASCII codes 68 and 67 decimal, respectively) test aborted, down ramp burst condition. This response code is followed immediately by XXX,YYY,ZZZ<cr> where XXX is the burst pressure (in test units), YYY the peak pressure (in test units), and ZZZ is the time elapsed since the pressure started ramping up in the current cycle. Example: "DC360,500,4.2<cr>". (Burst at 360 units, peak 500, 4.2 seconds.) The HBLT emits this message when a down ramp or bottom maintain burst occurs. However, during streaming data mode, the message is displayed after the test completes.

DD (ASCII codes 68 and 68 decimal, respectively) test aborted, leak dip condition. This response code is followed immediately by XXX,YYY,ZZZ<cr> where XXX is the burst pressure (in test units), YYY the peak pressure (in test units), and ZZZ is the time elapsed since the pressure started ramping up in the current cycle. Example: "DB360,500,4.2<cr>". (Burst at 360 units, peak 500, 4.2 seconds.) The HBLT emits this message when a leak occurs. However, during streaming data mode, the message is displayed after the test completes.

DK (ASCII codes 68 and 75 decimal, respectively) test completed, no errors. This response code is followed immediately by XXX,YYY<cr> where XXX is the peak pressure (in test units), and YYY is the time elapsed since the pressure started ramping up in the current cycle. Example: "DK1130,8.1<cr>". (Leak at 1130 units, 8.1 seconds.) The HBLT emits this message when a leak occurs.

DL (ASCII codes 68 and 76 decimal, respectively) test aborted, leak condition. This response code is followed immediately by XXX<cr> where XXX is the peak pressure (in test units). Example: "DL29<cr>". However, during streaming data mode, the message is displayed after the test completes.

F (ASCII code 70 decimal) waiting for start button. This character is transmitted after a test is prepared and ready to run, and also after 8 PSI of back pressure is detected during the *Fill* pre-testing process. The latter only occurs when the *Fill speed* setting is enabled.

H (ASCII code 72 decimal) Machine sign-on. At power-up, the system will send a message like "HBLT (1800 PSI) ver. 1.40<lf><cr>" indicating the appropriate PSI configuration and application version number.

M (ASCII code 77 decimal) maintain cycle ending. This character is transmitted after any applicable pressure maintenance during a test. If a test's "Maintain pressure time" setting is zero, this character is transmitted each time the hydraulic pressure reaches its (next) goal. If a test has a non-zero "Maintain pressure time," then this character is sent after the *Maintain Time* expires. However, the HBLT does not emit this character when streaming mode is active.

Appendix B. Model Parameters

1000 PSI Model Parameters	PSI	Atm	kPa
Ramp Rate, minimum per second	10	.7	69
Ramp Rate, maximum per second	500	35.0	3500
Initial Pressure, minimum	5	.3	30
Initial Pressure, maximum	1000	68.0	6800
Target Pressure, minimum	10	.6	60
Target Pressure, maximum	1000	68.0	6800
Return Pressure, minimum	VAC	VAC	VAC
Return Pressure, maximum	1000	68.0	6800
Increment Pressure, minimum step	1	.1	10
Increment Pressure, maximum step	1000	68.0	6800
Maximum Test Pressure, minimum	5	.3	30
Maximum Test Pressure, maximum	1000	68.0	6800
Leak Rate, minimum per second	5	.3	35
Leak Rate, maximum per second	50	3.5	350
Up Burst Rate, minimum per second	20	1.5	150
Up Burst Rate, maximum per second	1000	68.1	6895
Down Burst Rate, minimum per second	20	1.5	150
Down Burst Rate, maximum per second	1000	68.1	6895
Leak Dip, minimum	3	.2	207
Leak Dip, maximum	1000	68.1	6895

1800 PSI Model Parameters	PSI	Atm	kPa
Ramp Rate, minimum per second	20	1.5	150
Ramp Rate, maximum per second	1000	70.0	7000
Initial Pressure, minimum	10	.5	50
Initial Pressure, maximum	1800	120.0	9999
Target Pressure, minimum	10	.5	50
Target Pressure, maximum	1800	120.0	9999
Return Pressure, minimum	VAC	VAC	VAC
Return Pressure, maximum	1800	120.0	9999
Increment Pressure, minimum step	1	.1	10
Increment Pressure, maximum step	1800	120.0	9999
Maximum Test Pressure, minimum	10	.5	50
Maximum Test Pressure, maximum	1800	120.0	9999
Leak Rate, minimum per second	10	.5	50
Leak Rate, maximum per second	100	7.0	700
Up Burst Rate, minimum per second	40	3.0	300
Up Burst Rate, maximum per second	1800	127.4	9999
Down Burst Rate, minimum per second	40	3.0	300
Down Burst Rate, maximum per second	1800	127.4	9999
Leak Dip, minimum	3	.2	207
Leak Dip, maximum	1800	127.4	9999

Appendix C. Special note about ramp rates

Under certain conditions, the *HBLT* may not be able to make a pressure jump at the requested ramp rate. This typically occurs when small jumps are requested, particularly at low pressures. An example would be going from zero to 25 PSI at 250 PSI per second. Theoretically, this should take 1/10 of a second. In practice, the motor has to begin decelerating almost as soon as it starts accelerating.

To manage this, the *HBLT* program applies rules to bound the actual rates used internally to achievable values. This is generally invisible to a user.

It is important to realize that what the *HBLT* does is attempt to accelerate to the operating ramp rate, and then decelerate to zero speed at the target pressure. As a result, the time to achieve a given pressure will not be the pressure change divided by the ramp rate. It will always be a longer time. The smaller the pressure jump, the greater the exaggeration will be.

Appendix D. Option jumpers

The main circuit board containing the *HBLT* electronics and logic are six option "jumpers" that define what model, pressure, and features apply to the specific model *HBLT* you have. There are **no** jumpers here intended for customer use; they are all factory use only and should not be changed or removed.

Appendix E. Downloading

Downloading is the process of programming the *HBLT* with a new "application," or software that permits operation (running and defining tests and so forth). Usually, downloading is invoked by requesting it via the **System Configuration** menu. In the event that the reprogrammable memory circuits inside the *HBLT* lose their information, a message will be displayed similar to: "NO APPLICATION PRESENT - Please begin downloading new application."

Downloading requires that a computer (usually a PC compatible) be attached to the serial port and a special application run on the PC that downloads application data into the *HBLT*.

When downloading is invoked via the **System Configuration** menu, the screen indicates that it is waiting for download data to begin. This screen also features a STOP button that you may use to abort the downloading before it begins and large numerals counting down minutes and seconds. The minutes and seconds indicate how much time remains before the download request is automatically canceled (usually starting from five minutes).

Once downloading begins, the screen will show a Download ID and Received ID. These both should read BLT (for standard software versions). Below this information will be a Record Addr, short for record address. This displays hexadecimal numbers that count up as the application data comes into the system. At the bottom of the screen will be status messages. The normal status should read "Receiving data."

Download Status Messages

The following is a list of status messages and their meanings, that may appear on the bottom of the downloading screen. All messages are informational; the downloader automatically makes whatever corrections and retries if it can. After a number of consecutive errors occur, the process will abort and the screen will indicate the problem and/or prompt to begin downloading again.

Address err

The application data was received with an improper programming address. The system will automatically progress to another status message if correct data does not come in within a certain amount of time.

Character timeout

A generous amount of time has elapsed since any data was received. If this message lingers, it may suggest a poor connection between the *HBLT* and the PC compatible performing the transfer. After successive failures to communicate, the system will progress to show an abort message.

Data/CRC err

The application data was received with improper formatting or checksum. The system will automatically progress to another status message if correct data does not come in within a certain amount of time.

Download aborted

The download process had too many problems in receiving data, including the lack of data. Several attempts have been made to recover and retry without success. Usually an "OK" button appears on screen. After pressing OK, the download will start over from the beginning.

Download succeeded

The application has been received, initialized, and is about to be launched. The application's main "greeting screen" should appear almost instantly.

Erasing database

The application has been received and the end-of-data message was correct. The application is being invoked with the express purpose of erasing any process database information left over from the previous version. This is done because process data structure differs from version to version. The system will automatically progress to another status message.

Erasing unused EEPROM

The download process received all application data without error. Unused memory locations are being erased for safety. The system should progress beyond this step in a matter of seconds.

Last block err

The end-of-data message was formatted improperly. The system will automatically progress to another status message almost instantly.

NO APPLICATION PRESENT

This message indicates that the application memory contains no data or, whatever data it once contained lost integrity. You must begin running the download program (on a PC compatible) before the *HBLT* can function.

Receiving data

Application data is presently being received and programmed. When things are functioning smoothly, the new application will be ready to run in a matter of minutes.

Receiving last block

The application data has been completely received and the end-of-data message is being checked for validity. The system will automatically progress to another status message almost instantly.

Title record err

The initial data was received, but does not correspond with the expected values. Typically the screen will show Download: BLT and next to Received ID: will be something other than BLT. What appears next to Received ID: may be useful information for diagnosing problems if this occurs frequently. The system will automatically progress to another status message if the correct initial data does not come in within a certain amount of time.

Waiting for record

Application data is received in bursts of information known as records. A certain minimum amount of time has elapsed without a subsequent record coming in. The system will automatically progress to another status message if another record does not come in within a certain amount of time.

Waiting for start

This indicates that the initial data has yet to come in. Typically the screen will show Download ID: BLT and Received ID: shows a blank. The system will automatically progress to another status message if the initial data does not come in within a certain amount of time.

Write failed

The memory circuits inside the *HBLT* did not program and verify properly. The system will automatically progress to another status message if subsequent retries fail.

Appendix F. Troubleshooting

If the *HBLT* will not operate when the power switch is turned on, the most likely fault is the line cord pulling out of the wall plug or the IEC receptacle on the back of the machine.

If the machine still won't work, check the fuse. To gain access to it, remove the line cord from the back of the machine and pry out the fuse carrier below it. There are two fuses, a two amp fuse for use in 230 volt locations, and a four amp fuse for use with 115 volts. Both are 5 x 20 millimeter "SLO-BLO" types. Do not use an ordinary fast-acting fuse as the start-up surge will blow it within a few power cycles.

WARNING! When replacing the fuse carrier, observe the markings to be certain you are installing it for the correct line voltage.

Below are shown a list of messages displayed by the *HBLT* under conditions in which operation is interrupted. These messages are displayed on a special screen indicating "ERROR! ERROR! ERROR!" at the top and bottom.

In some circumstances mentioned below, you must take steps to correct the fault condition, turn the *HBLT* off, and then on again. If you have successfully corrected the error condition, you will be allowed to proceed.

Message	Explanation
Pressure limit exceeded.	The hydraulic pressure exceeded operational limits. Remove pressure from the system manually by venting the outlet. Excessive pressure can damage the pressure transducer. One cause of this problem is miscalibration. If it reoccurs soon after a calibration, contact Crescent Design for assistance.
The motor is overheating.	The motor that generates hydraulic pressure has overheated. Turn off the machine and contact Crescent Design for assistance.
Motor stalled.	Five seconds elapsed without any pressure change. Check for proper attachment of product to be tested to the outlet, and that water flow is cut off. Switch off the HBLT and after a few moments, switch on again and retry.
The motor driver is too hot.	The circuits that power the motor that generates hydraulic pressure have overheated. Continued operation would risk damage. Let the system cool for five minutes with the power off. If the problem re-appears, contact Crescent Design.
Can't configure machine.	Option switches or internal setup is incorrect. Contact Crescent Design for assistance in solving this problem.

Ver mismatch x.xx/y.yy	The Kernel version y.yy is incompatible with the Application version x.xx. Contact Crescent Design for assistance in solving this problem.
Transducer not installed.	The pressure transducer is disconnected or malfunctioning. Contact Crescent Design for assistance in solving this problem.
Unknown press config (xxx)	The pressure limit xxx (in PSI) is unknown to the software. This can also be caused by improper option settings or setup. Contact Crescent Design for assistance in solving this problem.
Error code #xxx	An internal software error xxx was detected. Contact Crescent Design for assistance in solving this problem.