

W-D-2005, W-D-1705, W-D-1505 Digital Hardness tester Instruction Manual



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1 OVERVIEW

The NDT James Instrument's Digital Hammer is a digital meter used for measuring the hardness of paper rolls. Menus are used to navigate through the functions of the instrument. This manual covers the use of the W-D-2005 system, the W-D-1705 and W-D-1505 systems. The differences among these units are the capabilities to print the results in the field and the ability to upload data from the instrument to a PC. The other functions of the systems are the same and this manual covers the use of the all three systems.

The W-D-1705 system includes the field printer to obtain a hardcopy of the results in the field, but it does not have the ability to upload data from the instrument to a PC. The rest of the capabilities of the W-D-1705 are the same as the capabilities of the W-D-2005 described in this instruction manual.

The W-D-1505 system does not include the field printer and neither has the capability to upload data from the unit to a PC. Taken into account the mentioned differences in capabilities between both systems, this instruction manual covers the required material for the proper use of the W-D-1505 system.

The hardness tester is an instrument which is easy to use, to identify areas within a paper roll structure with different properties (different stiffness or strength). It is also a useful tool for quick and approximate measurement of the compression strength of manufactured concrete products.

The principles on which it works are based on the rebound impact of a hammer on a piston which rests against the surface of the material: the greater strength and stiffness of the roll, the greater the rebound impact.

The test makes possible to estimate the strength of paper rolls by the energy absorption of the material of the impact energy delivered by the hammer. The energy absorption depends on the strength and stiffness of the paper roll, in the absence of large inert lumps or clusters of lower density. From the impact and using the rebound number, these areas can be identify.

With the aid of the test hammer the quality of paper rolls in different industries can quickly be examined.

INSTRUCTIONS FOR USE

1. Having taken the test hammer from its case, gently push the piston inwards pressing it against a stiff surface (held the hammer with both hands when using it). The piston will release itself from its catch and emerge from the body of the device which will then be ready for testing.

Press the piston against the surface of the material to be tested, holding the device perpendicularly to the surface. Gradually apply increasing pressure until the mass impact is released. Keep the device firmly pressed against the surface being tested and look at the rebound reading on the scale. **Do not touch the side button whilst pressing on the piston.** On removing the device from the surface being tested, the piston once more emerges completely from the device which is immediately ready for a second test.



2. If it is difficult to see the reading under the conditions specified in the previous paragraph, **press the side button only after impact hold the button in** and remove the device in order to read the scale.
3. If the button is used, as in the above case, the piston remains inside the device when it is removed from the surface being tested. In such cases, in order to prepare the test hammer for further tests, activate in by the method indicated in Paragraph 1. The position of the device when the piston has withdrawn inside is also the position used for packing away the device in its case.

2 MEASUREMENT

2.1 MEASUREMENT PRINCIPLE

The Digital Hammer measures the rebound number of a paper and film rolls. The rebound number is related with the harness, stiffness and strength of the material. There are several factors that must be taken into account when analyzing the rebound number of rolls.

2.1.1 Impact direction

The impact direction of the system has an effect that must be taken into account at the time to correlate the rebound data taken from different directions, this factor it is not relevant for the paper industry. It has to consider this point when testing paper rolls in different directions and the results want to be compared. The system allows the user to choose the angle of impact, which could be -90 degrees when testing in floors or slabs type of structures or against any horizontal surface, 0 degrees when testing against walls or vertical concrete members and finally +90 degrees when testing in an overhead position such as against ceilings. The reason why this is a needed parameter is because the gravity force affects the results and this effect must be taken into account, in Fig 1. this effect is shown in the correlation curves.

2.1.2 Surface texture

The surface texture has an important effect on the accuracy of the test results. It is recommended to test rolls with smooth surfaces. When testing rough textured surfaces, much of the hammer impact energy causes excessive crashing on the surface and a reduced rebound number is expected.

2.1.3 Moisture effect

The presence of surface moisture and the degree of saturation of the surface may have an effect on the rebound number. It is expected to obtain lower rebound numbers when testing wet materials.

2.1.4 Selection of the test area

The member to be tested should be at least 10 cm thick and it should be fixed within the structure. Testing areas exhibiting honey combing, high porosity or scaling should be avoided.

2.2 TESTING PROCEDURE

2.2.1 Test area

The test area should be selected to obtain at least 10 readings with the rebound hammer. In the case that it is not smooth enough, prepare the surface of the test area by grinding the surface.

2.2.2 Hammer positioning

Take a couple of measurements on a stiff surface before perform the test to familiarize yourself with the system and prepare it for testing and discard the readings. Use the hammer to test the selected area. Positioning the hammer perpendicular to the surface and deploy the impact plunger pushing against the surface until the push button spring out.

Caution: the hammer should always be held in both hands, perpendicular to the surface before release the impact.

2.3 DATA ANALYSIS

In order to obtain a representative rebound value, 10 readings at the same test area shall be taken, the maximum and minimum value should be discarded and the average of the remaining readings should be computed.

3 Menus

The following are the instruments main menu items (modes of operation).

A mode is selected by using the Up and Down Keys to display the desired mode and then pressing the Enter Key.

REBOUND – The Rebound Mode displays rebound numbers and save it in a Test Record.

ANGLE – The Angle mode is used to set the angle of impact, -90 degrees (floor), 0 degrees (wall) and +90 degrees (ceiling).

- CONFIG – This mode is used to select the Operating Language (English or Spanish) and a Discard Value. Also this mode is used to reset the Test Number to zero.
- UPLOAD DATA – This mode is used to send stored Test Records to a PC Computer
- PRINT – The Print mode is used to select and print a specific Test Record.
- SET CLOCK – This mode is used to set the time and date.
- CAL HAMMER – This mode is used to calibrate the hammer with the use of a calibration anvil.

4 KEYS

The following key switches are used to perform the functions of the instrument.

4.1 Power Switch

Turns the instrument power on and off.

If no keys have been pressed for 15 minutes, the instrument will automatically turn itself off.

4.2 Up Arrow

Used to scroll through the menus and increase a displayed value

4.3 Down Arrow

Used to scroll through the menus and decrease a displayed value

4.4 Enter Key

Used to select and displayed menu item. This key is also used to accept a selected value or configuration item.

4.5 ESC Key

This multifunctional key performs different functions depending on the mode that the instrument is in.

4.5.1 Exiting Print Mode

The ESC Key is used for two different operating conditions within the printing mode. If the print mode is selected and no Test Records have been saved the ESC Key is used to exit the Print Mode. The ESC Key is also used in the Print Mode when the operator does not want to print a Test Record but selected the mode.

4.5.2 Entering Test Routines

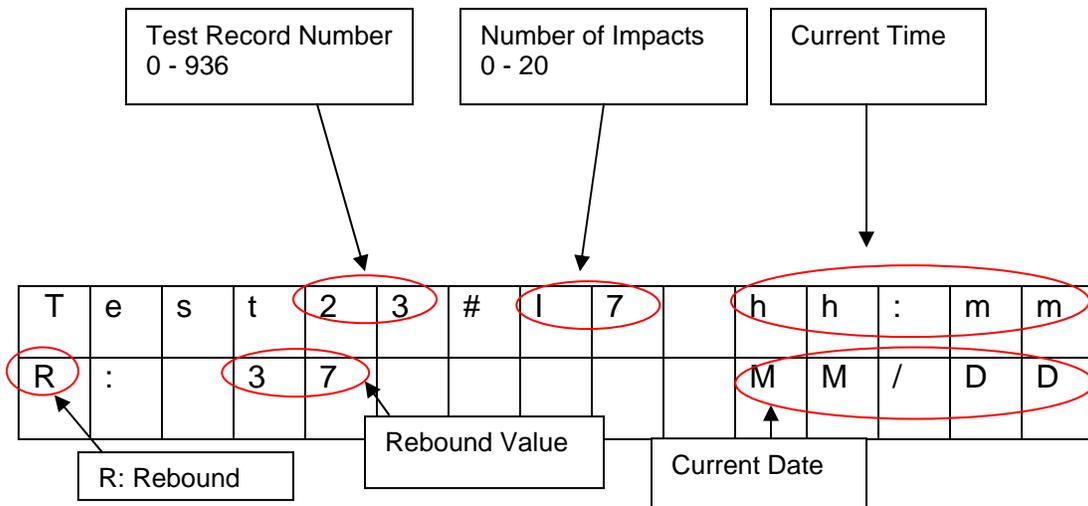
When power is first turned on "NDT James Inst." will be displayed for 5 seconds. If the ESC key is pressed during this time the instrument will use a test menu to enable the operation to perform instrument tests and initialization. Normal instrument functions are not accessible during testing.

4.5.3 Exiting Test Mode

The ESC Key is used to terminate the Analog to Digital test.

5 Operating Modes

5.1 REBOUND



When this mode is selected an operator may cock the hammer and take impact readings. The display will indicate the rebound value and the number of impacts taken. Up to 20 impacts can be taken for a given Test Record. If the operator requires less than 20 impacts he can terminate the Test Record by pressing the Enter Key. The display will momentarily display "Saving Test" and then display the Average rebound value. The operator may view the Median rebound value by pressing the Up Arrow Key. Pressing the Down Arrow Key completes the Test Record and the display will be as indicated above. The Test Record Number will be automatically incremented to the next number.

5.2 ANGLE

Selecting the Angle Mode will enable the operator to select the angle of impact for the hammer. When this mode is selected, displayed will be the current impact angle. Using the Up and Down Arrow Keys other angles may be selected. Angles of impact are -90 degrees (floor), 0 degrees (wall) and +90 degrees (ceiling). Pressing the Enter Key will save the selected angle.

5.3 CONFIG

This mode is used to select the Operating Language (English or Spanish) and a Discard Value. Also this mode is used to reset the Test Record Number to zero. When this mode is selected, displayed will be the current language. Using the Up and Down Keys select the desired language and press the Enter Key. Once the language has been selected all following menu items will be in that language. After the language is selected displayed will be "Set Discard" and the current discard value. The discard value is used to determine what impact data will be used when computing the Average and Median. A small discard value means that impact data with only slight variations will be excepted when computing the Average and Median. Larger discard values may include all impact data within the Test Record. Using the Up and Down Keys select the rebound discard value and press the Enter Key. Displayed then will be "Test Num Reset? N". This configuration item is used to reset the Test Record Number to 0 if desired. Use the Up Arrow Key so that the "N" is replaced with "Y" for yes and press the Enter Key. All previous Test Record will be erased.

5.4 UPLOAD DATA

Stored Test Records are uploaded, sent to a PC Computer using this mode. Test Records stored sequentially in packets can be set to a PC Computer using a standard 9 pin RS232C cable.

5.5.1 Upload procedure

This mode is selected when UPLOAD DATA is displayed and the Enter Key is pressed. The instrument will then display "Erase? NO". Using the Up and Down Keys the operator may choose if the stored Test Records are to be erased after transmission. Pressing the Enter Key will start transmission. The instrument will indicate the number of Test Records (packets) transmitted during the process. When transmission is completed the instrument will display "Completed" "Press Enter". Pressing the Enter Key will end the uploading process.

5.5 PRINT

Stored Test Records can be printed on an external serial printer. A 9 pin RS232C cable is used to connect the instrument to the printer.

5.5.1 Communication Link Specifications

Data is transmitted asynchronously at 9600 Baud, 8 Data bits, 1 Stop Bit and No parity.

5.5.2 Printed Format

The following are two examples of printed Test Records.

Rebound Test Record

```
*****
NDT JAMES INSTRUMENT
*****
TEST RECORD NUMBER 3
July 31, 2006 09:39
RECORD TYPE: Rebound
UNITS: Number
DISCARD: 15
----- IMPACT DATA -----
Impact# 1 - 42
Impact# 2 - 40
Impact# 3 - 45
Impact# 4 - 50
Impact# 5 - 41
Impact# 6 - 40
Impact# 7 - 40
Impact# 8 - 42

----- COMPUTED DATA -----
AVERAGE: 43
MEDIAN: 45
MINIMUM: 40
MAXIMUM: 50

***** END OF TEST RECORD *****
```

Test Record Number

Date and Time (24 Hr clock)

Rebound impact data

Units = Rebound Number

Discard = +/- 15 Rebound Counts

Impact data in rebound counts

5.5.3 Operation

This mode is used to print a specific Test Record. When the PRINT menu item is displayed and the Enter Key press the Print Mode will be entered. If the printer is not connected or turned on the message "Printer NotReady" will be displayed and the Print Mode will not be entered. Pressing the Up or Down Arrow Keys will display other modes. When the printer is connected and turned on, pressing the Enter Key will enter the print mode. Displayed is a Test Number on the bottom left side along with the date it was made on the right side. Using the Up and Down Arrow Keys the desired Test Record number to be printed can be selected. Pressing the Enter Key will start the printing process. At the end of printing either the strength or rebound modes will be displayed depending on the specific model.

If the Print Mode is selected and no Test Records have been stored, displayed will be "No Records, PressEsc". The ESC Key is used to exit the Print Mode returning to either strength or rebound mode.

While in the Print Mode the ESC Key may be pressed to exit without printing.

5.6 SET CLOCK

This mode is used to set the internal Real-Time-Clock. This device keeps track of the current time and date. A battery is attached to this device so that even with power turned off it still operates.

This mode is selected when SET CLOCK is displayed and the Enter Key is pressed.

The cursor starts blinking over the Hours display. To set the current hour, use the Up and Down Keys to display the hour and then press the Enter Key to select it. The cursor then automatically moves to the Minutes display. It is set the same way as the hour. The cursor will then move to the Month, Day of the Month and finally the year, as the current items are set. When the clock's settings are complete the mode will be automatically changed to either Strength or Rebound.

5.7 CAL HAMMER

This mode is used to calibrate the Digital Hammer for 68 rebound counts. When this mode is selected displayed will be "Cock Hammer" or if the hammer is already cocked the message "Read Anvil will be displayed. Insert the hammerhead into NDT James' calibration anvil and release the hammer. The hammerhead will impact the calibration surface and rebound 80 counts. Displayed briefly will be "Calibrated", the mode will then automatically changed to either Strength of Rebound.

6 Test Functions

Test functions can be accessed by pressing the ESC Key when power is first turned on and “NDT James Inst.” is displayed. Several functions are available for both testing and initialization. To return the instrument back to it's normal functions will require that power be turned off and then back on. Below are the available functions.

6.1 TEST KEYS

Displaying this menu item and pressing the Enter Key will enable a technician to verify the operation of the key switches. The instrument will display the function of a pressed key. Power must be turn off to exit this test.

6.2 TEST DISPLAY

This test is used to determine if all characters can be displayed. Starting with the first line, all displayable characters will be displayed. When this line is finished data will be sent to the second line. This process will continue until all displayable characters have been sent to the display. Using the Up and Down Keys other test functions may be accessed.

6.3 TEST SERIAL COMM

This test is used to verify the serial communications functions and accuracy. A loop back plug connecting pins 2 and 3 together is connected to the upload serial port. If this plug is not install and error message will be displayed. A string of characters “COMM. Test 1234” are transmitted and then received. The received characters must be the same as transmitted for a successful test. Displayed will be “Loop back test, COMM. Test 1234”. If an error occurs during the test a receiving error message will be displayed. Using the Up and Down Keys other test functions may be accessed.

6.4 TEST DATA MEMORY

This test is used to verify the operation of the external EERPOM memory used to store Test Records. Testing will take some time because for each byte in the memory, the data is first saved, then 0xAA is written to that memory location, then it is read back. The read data must equal 0xAA. Then 0x55 is written and read from the same location. The read data must equal 0x55. Finally, the memory location's original data is restored. This process is continued for each location in the memory. On the second line of the display the current memory location is displayed. At the end of the test all data written must be read correctly for the test to pass. The instrument will display “Memory Test OK” and memory location 8190 at the completion of a successful test. Using the Up and Down Keys other test functions may be accessed.

6.5 SET HAMMER ZERO

This mode is used to initialize the hammerhead's zero position.

Use the Up and Down Arrow keys to display "SET HAMMER ZERO" and press the ENTER Key. Displayed will be "Cock Hammer Head, Press Enter". Cock and lock the hammer (or hammer fully deployed) and then press the ENTER Key. Displayed will then be "ZeroReadingSaved". Turn off power.

6.6 INIT MEMORY & TN

This mode will reset the address pointer to external EEPROM memory and set the Test Record Number to zero.

Use the Up and Down Arrow keys to display "INIT MEMORY & TN" and press the ENTER Key. Displayed will be "Mem &Test# Reset".

6.7 TEST ADC

This mode is used to test the functionality of the potentiometer mounted on the hammerhead and the Analog-to-Digital circuitry. When this mode is selected, displayed will be "Press ESC to end" and a number from 0.000 V to approximately 4.995 Volts. Moving the potentiometer from its minimum position to its maximum position should display its corresponding voltage. Pressing the ESC Key will exit this test.

6.8 TEST PRINTER

When this mode is selected a short test message will be printed and this mode will be automatically exited. Below is what the printed test message should look like.

```
*****  
NDT JAMES INSTRUMENT  
*****  
0123456789  
ABCDEFGHIJKLMNOPQRSTUVWXYZ  
Abcdefghijklmnopqrstuvwxyz  
The quick brown fox jumped
```

7 INITIALIZATION (please note this procedure has been performed at the factory and is left here for reference purposes only)

Before the instrument can be used it must be initialized. Following the steps below will ensure that the Digital Hammer is ready to take impact readings.

7.1 Initialize Memory and Test Record Number

When power is first turned on press the ESC Key to select the instruments test functions, "Self Test Prog." will be displayed. Use the Up and Down Arrow keys to display "INIT MEMORY & TN". Pressing the ENTER Key will initialize the memory (reset the address pointer in the external EEPROM memory) and set the Test Record Number to zero. After initialization "Mem & Test# Reset" will be displayed.

7.2 Set Hammer Zero

While still in the test menus use the Up and Down Arrow keys to display "SET HAMMER ZERO" and press the ENTER Key. Displayed will be "Cock Hammer Head, Press Enter". Following these instructions, cock and lock the hammer (or hammer fully deployed) and then press the ENTER Key. Displayed will then be "ZeroReadingSaved". Turn off power.

7.3 Calibrating the Hammer

Turn on power, select the "CAL HAMMER" menu item and press the ENTER Key. Displayed is "Cock Hammer" or if the hammer is already cocked the message "Read Anvil will be displayed. Insert the hammerhead into NDT James' calibration anvil and release the hammer. The hammerhead will impact the calibration surface and rebound 68 counts. Displayed briefly will be "Calibrated". Turn off power.

7.4 Instrument Configuration

Turn on power.

Before using the instrument the following items need to be verified or selected:

From the CONFIG menu

Operating Language: English or Spanish

Discard Value: 1 – 20 rebound counts

Reset Test Number: No or Yes (reset has already be done)

For Strength models from the ANGLE menu

Impact angle: -90° (floor), 0° (wall) or $+90^{\circ}$ (ceiling)

8 MAINTENANCE

8.1 CHECK FOR PERFORMANCE

It is recommended that calibration of the test hammer be checked regularly-usually after 2000 strokes. The James Calibration Anvil has been designed for just that purpose. The calibration Anvil weighs approximately 35 lbs. (16 kg.) and it should be order separately. The Anvil is used to check that the Impact energy level of the hammer. This parameter is critical to correlate the rebound number with the compressive strength of the concrete, the software sets the reading taken at the Anvil as 68.

8.2 CLEANING THE INSTRUMENT

The impact plunger and housing should be wiped using a dry and clean cloth after using the instrument. Avoid the use of abrasives or solvents to clean the hammer and do not use water to clean it.

9 SPECIFICATIONS

Digital Model W-D-2005, W-D-1705, W-D-1505

Display	2x16 trans-reflective
Operating temperature	32 to 122 °F (0 to 50 °C)
Battery	2'AA'
Construction	All aluminum for rugged environments
Ap. Size	4" x 4" x 10" (100mm x 100mm x 270mm)
Weight	3.2lbs (1.4 kg)

Digital Model W-D-1205

Size	2.5" x 1.9" x 1.2" (64mm x 49mm x 31mm)
Weight	up to 0.270 kg (0.6 lbs) with paper
Battery	Internal Lithium ion with 1 yr
approximate life	Charger 100V AC-240V AC 5V DC 3.0A
Operating temperature	32 to 122 °F (0 to 50 °C)