

MOHR DIGI-TEST
Computer-controlled Fruit Quality
Testing System

—
Manual for Software Version 1.25

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Chapter 1

Introduction

The Mohr Digi-Test (MDT) is a portable, computer-controlled agricultural test system designed to fit the needs of the tree-fruit industry. It provides advanced penetrometer tests, digitally records results, generates reports and spreadsheets, calculates statistics, and facilitates data tracking.

The unit will perform several hundred tests on a single battery charge and the internal computer has backup power that will retain the results of thousands of tests with full raw data storage.

Windows-compatible software is provided to download data from the MDT, to allow for data visualization and further analysis, and to export data to a spreadsheet-readable format.

1.1 Manual Overview

To see the MDT in action and start testing fruits, skip ahead to chapter 2 for installation instructions, or chapter 3 for quick start instruction on using the tester.

The test performed by the MDT is customizable. Details on how to create new tests for new materials or fruits can be found in chapter 9.

Chapter 11 has key maps for the most used functions.

The rest of this introduction describes the machine, what it does and how it works.

1.2 Overview of the MDT

The MDT has sophisticated control electronics that allows it to be programmed to provide a pre-planned trajectory of displacement, velocity, and acceleration while accurately measuring the force encountered by a test plunger. Tests have been developed for apples, pears, cherries, melons, bananas, tomatoes and others. Trajectories for other fruits are under development and may be publicly available in the future. Contact Mohr and Associates for assistance with testing other types of fruits.

Standard calculations performed by the MDT are based on a two-region model of a fruit. Region 1 (R1) extends to a fixed depth (0.32 in. for apples) and represents the skin region of the fruit. Region 2 (R2) extends from R1 to an arbitrary depth proportional to the diameter of the fruit (30% of diameter for apples) and represents the bulk of the edible material in a fruit.

Constant-velocity testing is carried out through the radius of the fruit, from the skin to the end of R2. This constant-velocity test can be interrupted briefly by a constant-force (creep) test at the R1-R2 boundary. In addition, a high-frequency (crispness) test is carried out concomitant with the constant-velocity firmness test in R2.

Constant-velocity test results include Region x averages (A_x), maximums (M_x), and region endpoint values (E_x). Creep is reported as a displacement value (C_0). Crispness is reported as a scaled value representing the energy released during fruit tearing (C_n).

The Quality Factor is a weighted-sum of several of the MDT's standard results: M1 (which is equivalent to current apple industry firmness tests), A2, E2, C0, Cn.

The MDT's internal computer is a 133 MHz Elan 520 (586 compatible), or better, with flash memory. The force is measured to 1/64 of a pound (7 grams) or better using a strain gage load cell. Position is measured by an encoder on the motor shaft which divides 1.0 inch (2.54 cm) inch of plunger travel into 32768 parts or 0.00003052 inch per division (0.000079 cm). Creep strains are reported to 0.001 inch (0.00254 cm).

The MDT is designed to operate as an independent unit, but can communicate with a desktop or laptop PC via Ethernet. For portable operation, it contains NIMH (Nickel-Metal Hydride) batteries that are recharged with the external battery charger provided.

1.3 Safety

The hardware and software features of the MDT have been designed to make the operation of the MDT safe. Several features have been included to ensure the safety of the operator.

When the test plunger makes contact with the fruit, the MDT waits for a go-ahead from the operator in order to proceed. A second push of the key is required to start the testing phase. Forces of over 30 lbs. can be expected during the test and care should be taken to make sure that hands and fingers are out of the way.

Note: the CANCEL key (X) will immediately abort a test when it is pressed.

The MDT is capable of generating much higher forces than are necessary for testing. There is a hardware current limit and a software force limit that will stop a test when high forces are encountered. A block of metal or wood or similarly unyielding object may, however, develop a force fast enough that the MDT's drive mechanisms or electronics could be damaged. Therefore, do not use the MDT to test rigid materials.

We recommend using one hand to hold the apple in position. Use the other hand to press the test button **2** also marked **TEST** to find the top of the fruit. Then press button **1** also marked **HOME** to start the test sequence, which advances the plunger into the fruit.

For accurate results, it is necessary to peel an apple or pear at the point where the plunger will enter the fruit. Cherries and other fruits that use a squeezing style of test should not be peeled. While testing through apple and pear skin is possible, results will be skewed.

Do not place your hands in the path of the plunger or leave valuables in the test chamber when testing.

Please keep the following guidelines in mind while operating the tester:

- Do not test hard objects such as wood, steel, etc.
- Keep your fingers away from the plunger during testing.
- Hold the fruit in place with one hand and press the **TEST** button with the other hand.

- Make sure that your fingers are out of the way of the plunger before you press the **TEST** button.
- Press the **X** key at any time to cancel a test, or to return the plunger to home position.

1.4 The MDT Apple Analysis Method

What follows is a description of the method the MDT uses to test apples. The parameters of the tests are customizable, so that different testing methods can and should be developed for different types of fruits. See chapter 9 for details.

The MDT divides the radius of a fruit into 2 regions. Region 1 (R1) is the outermost region of the fruit, and extends from the surface (with skin removed) to a fixed distance into the fruit from the surface. For apples and pears, R1 ends at 0.32 inches, the depth used by Magness-Taylor and EPT-1 type firmness testers. Region 2 (R2) lies between the 0.32-inch boundary and extends to 30% of the diameter. R2 represents the majority of the volume of the fruit.

Though very interesting, the core of the apple has proved too erratic in its composition to be included in a standard test.

The MDT moves through each region at a constant velocity, recording the pressure or firmness exerted by the apple against the test plunger. During the test, several thousand points of both displacement and firmness data are taken. Maximums and averages are calculated and then stored for each region. Raw data points are stored and can be displayed using a PC and either the serial port or Ethernet port.

The constant-firmness or creep test is carried out at the R1-R2 boundary. During the creep test segment, the MDT maintains a constant force, which is set to 10 pounds (4.54 kg). If the fruit material that is being tested is firm and elastic, it will not show any deformation during the creep test period. However, if the fruit being tested is somewhat viscous, the fruit material will deform. The MDT records the deformation curve of the fruit material. As fruit ages, the amount of creep deflection, or creep strain, increases.

The crispness test, a measurement of the tearing characteristics of fruit material, is carried out during the constant-velocity test of R2.

The Quality Factor (QF) is a weighted sum of several MDT test results,

scaled between 0 and 100 for easy interpretation. This and other numerical MDT results are described in section 1.5.

1.5 MDT Numerical Results

The MDT generates a set of results for each fruit. Each result has a two-letter code that is used as a label throughout the MDT. Selected codes are described below:

- M1 – The maximum hardness in Region 1 (R1)** When using a probe of the standard (0.440”) diameter, this corresponds to the results of the Magness-Taylor Firmness Tester and the EPT-1.
- A2 – The average hardness in Region 2 (R2)** This is a measure of the average pressure throughout the flesh of the apple, from a depth of 0.32 in to the start of the core.
- C0 – Creep deformation** Creep test results taken at the boundary between R1 and R2. After the MDT has passed through region one, it pauses for a moment to perform a creep test. The MDT maintains a constant force of 10 pounds. The MDT measures how far the plunger moves into the fruit under that force during a set period of time.
- Cn – Crispness** Crispness in the fruit is measured by de-trending the raw data in R2, then calculating the power output of the resulting curve. The curve is representative of the tearing of the fruit as the plunger passes through.
- E2 – Force at the end of region 2** The value of E2 is the average of the last 20 force readings in Region R2. It is a measure of integrity of the center of the fruit. Many varieties of apples deteriorate from the inside out. E2 is often the first measurement to show early decline.
- Di – Diameter** The diameter in inches of the fruit along the axis of the test. Diameter is measured when the plunger contacts the fruit surface. An accurate calibration of the position of the testing base is needed for accurate diameter measurements.

QF – Quality Factor The Quality Factor is a weighted combination of the other results, with the exception of diameter. Designed for Red Delicious apples, the QF is scaled to read 100 for an apple in optimum condition for harvest and 0 for an apple nearing the limit of consumer acceptability. The scaling has to be interpreted differently for other varieties of apples.

These same results are displayed for the whole batch on the statistics screen of the tester, along with the standard deviations for the sample requested. Details on how to access the statistics screen are found in 4.10.

1.6 Statistical Evaluation

The MDT computes averages and standard deviations using the results from each test. The statistics for the current batch can be displayed directly from the test screen. Press the **6** key anywhere on the test screen to call up the statistics.

The MDT also comes with a powerful sort routine that can compile statistics for any combination of field, fruit type, lot and date. See 4.10 for instructions on how to use this function.

1.7 License and Updates

The Winapples software needs a valid license to operate fully. Without a license, the software will not load data, but will perform all other functions.

A license code is given to you at purchase and must be entered into the software. Software that does not have a license code will prompt you to enter one. The license code can be viewed or changed by going to "Help – About" in the menu.

The software contacts our servers daily to validate licenses and to check for software updates. It also may transmit information about MDT testers that have connected with your software, including serial number, number of tests, and calibration information. Regardless of the duration of a license, it needs to be validated through our server at least once every thirty days.

Should an update be available, you will be prompted to allow the download, after which the installation will begin automatically.

Chapter 2

Installation and Setup

What you need:

- A windows computer running Windows 98, 2000, ME or XP.
- An Ethernet connection for the Windows machine, and an open connection for the tester on the same network.
- The ‘netmask’ for the network, and a free IP address to be used by the tester. You may need to get these from a network administrator.
- For calibration: A weight between 25 and 35 pounds, measured to within 1/100th of a pound, that can rest on the external calibration load cell.

2.1 Installing the software

Insert the CD. Find and run ‘setup.exe’ from the CD. This creates a directory (folder) called `c:\digitest` and a subdirectory called `c:\digitest\mdtfiles`

Windows program files are copied into `c:\digitest`. Files needed in the tester are copied to `c:\digitest\mdtfiles`. Note that `c:\digitest` is the default installation directory, but you can change it at the beginning of installation.

2.2 Test the windows software

Open the software and verify that the window appears on the screen. The software will ask you some questions the first time that you run it.

2.3 Boot the tester

Plug the AC/DC adapter into the tester, and connect it to the network. Turn it on.

The tester screen's back light should come on. After a few seconds, the screen should switch to "Mohr Digitest is loading, please wait."

After a few seconds more, the tester should load to the startscreen. The start screen shows the date and time at the top, as well as some other info.

The back key on the tester returns you to the previous screen (and cancels some operations). You can always get to the start screen by hitting the back key a few times.

2.4 Change the network settings on the tester

In order to connect to the host computer, the tester needs to have settings that match your Ethernet network.

From the start screen, press the **5** key. This takes you to the utilities menu.

Use the arrow keys to scroll the cursor down to 'Network Settings'.

Press the **CHECK** key. The tester will show you the current configuration.

Hit the **BACK** key. The tester will now ask for your IP address. The tester needs an address unique to itself, so as not to conflict with the other machines on the network. You may need to ask a network administrator for a valid address.

Enter the address using the number keys. Use spaces for dots. A space is entered with the up arrow. The down arrow acts as a backspace.

Press the **CHECK** key when done.

The tester now asks for the netmask. This usually is ' 255.255.255.0 ' or something similar. Again, you might need to ask a network administrator for the netmask.

When that is entered, hit the **CHECK** key.

The network settings are now updated. Turn the tester off and back on to get it to load the new settings.

2.5 Test the network connection

Start the windows software on the host computer.

Go to the File menu. If 'Server' is unchecked, then select it.

On the tester, go back to the utilities menu, (Hit **5** from the start screen).

The first choice on the menu is 'Tranmit Opt'. Select that with the **CHECK** key.

Move the cursor down and select 'Toggle Realtime'. This will prompt you with a couple of messages about your IP address, and then attempt to connect to the host. If it finishes with "Connection Established", then your network is set up correctly. If it finishes with "Wait Timed Out", there is a problem with your network.

2.6 Calibrate the load cell

See section 7.5 for details on how to calibrate the MDT's load cell.

Chapter 3

Quick Start

3.1 How to Test an Apple With the MDT

- Turn on the MDT. The power switch is on the left side of the MDT. Wait for the start screen to appear; it will take fifteen or twenty seconds to boot.

Note: The MDT may print messages at startup and pause for a keypress. Read them carefully then press a key to continue.

Note: Make sure you have familiarized yourself with safety issues in section 1.3.

- Press **2** on the keypad. You will be taken to the testing screen.
- Place an apple in the MDT.
- Press **2** again to begin a test. The MDT will find the surface of the apple, pause, and print a message saying “Press 1 to continue?”
- Press **1** to continue with the test. The MDT will now move through the fruit. When the test is complete the test plunger will return to its pre-test position.
- Results will appear on the screen. There will be 8 numbers describing the test you just completed.

- Qf is the quality of the fruit scaled from 0 (marginal) to 100 (optimal).
- M1 is the hardness 0.32 inches into the test. M1 is the same result as from the Magness-Taylor and EPT-1 testers.
- A2 is the average hardness in the meaty part of the fruit.
- C0 is the distance traveled during the creep test.
- CN is the crispness of the fruit.
- E2 is the hardness at the edge of the core region.
- Num is the number of the test.
- Lot is the number of the lot in which the fruit belongs.
- Press **2** to test a new fruit, or press **3** to test the same fruit again.

3.2 Reviewing the Results of a Test

- After finishing a test as described in section 3.1, hit the **BACK** key to return to the test screen.
- Make sure that the cursor is blinking on the left side of the screen. If it is on the right side, press the **SHIFT** key to move it over.
- Use the **ARROW** keys to scroll up and down through previous tests. Move the cursor to the test you wish to review.
- Press the **SHIFT** key to move the cursor to the right side of the screen.
- Use the **ARROW** keys to scroll through the different test results. These results are detailed in section 1.5.

3.3 Retesting a Fruit

- If the cursor is blinking on the right side of the screen, press the **SHIFT** key to move it to the left side.

- Use the **ARROW** keys to scroll the cursor to the test you wish to redo.
- Press the **1** key to initiate a re-test.
- The MDT will find the surface of the apple.
- Press the **1** key to continue with the test, or any other key to abort. The MDT will complete the new test and replace the old test.

3.4 Changing the Test Number for the Next Fruit

- From the test screen, make sure that the cursor is at the bottom of the list of tests by pressing the **9** key.
- If the cursor is on the left side of the screen, press the **SHIFT** key to move it to the right side.
- Use the **ARROW** keys to scroll the cursor to the top of the right side.
- On the **RIGHT** hand side of the screen, the number of the next test appears. To change that number, press the **CHECK** key.
- The MDT will prompt you for a number. Enter it using the keypad. If you need to delete a digit, use the **DOWN ARROW** key.
- When finished, press the **CHECK** key again. The test screen will once again appear.
- The number you entered will appear on the right side of the screen as the next test number.

3.5 Getting Results for the Current Lot

- Press the **6** key.
- Statistics for the current lot are displayed. Use the **ARROW** keys to scroll up and down to review averages and standard deviations for the test results of the current lot.

- Press the **BACK** key to return to the test screen.
- You can increment the lot number by pressing the **9** key while in the lot statistics screen. This will also return you to the test screen.

3.6 How to Change Farm, Field, Fruit Type and Lot

Farm, field, fruit type and lot are three means of differentiating one test from another.

A farm is made up of a list of fields. These can be used to represent literal farms and fields, but there are other possibilities. For example, a farm might be the name of a packing house, while its fields are the names of the grower pools used by the packer. Lots are the lowest hierarchy for describing tests. They cannot be given a name, but only a number.

3.6.1 Change Lots

- A lot number can be any positive integer.
- From the test screen, make sure that the cursor is at the bottom of the test list by pressing the **9** key.
- The next test number will appear on the right side of the screen followed by the farm, field, fruit type and lot variables. Press **SHIFT** to move the cursor to the right side.
- Using the **ARROW** keys, scroll the cursor to the fifth line. It will read “Lot: 1”, for example, if that is the current lot number.
- Press the **CHECK** key.
- You will then be prompted for a new lot number. Enter it in using the **NUMBER** keys, then press the **Check** key. Press the **DOWN ARROW** key to delete a digit.

3.6.2 Change Fields

- From the test screen, make sure that the cursor is at the bottom of the test list by pressing the **9** key.
- The next test number will appear on the right side of the screen followed by the farm, field, fruit-type and lot settings. Press **SHIFT** to move the cursor to the right side.
- Using the **ARROW** keys, scroll the cursor to the third line. It will display the current field name. Press the **CHECK** key.
- You will see a list of previously selected values. Move the cursor over your choice with the **ARROW** keys, and then press the **CHECK** key.

Note: While looking at the list of fields, press the **9** key to manually enter in a new ‘field’.

Note: If there is nothing to choose from on the list, you will immediately be asked to enter something in manually. See the section 3.7 on how to enter values in manually.

- When finished, the test screen will display the new value. Apples will now be tested under the new ‘field’ value.

3.6.3 Change Farm

- From the test screen, make sure that the cursor is at the bottom of the test list by pressing the **9** key.
- The next test number will appear on the right side of the screen followed by the farm, field, fruit type and lot variables. Press **SHIFT** to move the cursor to the right side.
- Using the **ARROW** keys, scroll the cursor to the second line. It will display the current farm name.
- You will see a list of previously selected values. Move the cursor over your choice with the **ARROW** keys, and then press the **CHECK** key.

Note: While looking at the list of farms, press the **9** key to manually enter in a new ‘farm’.

Note: If there is nothing to choose from on the list, you will immediately be asked to enter something in manually. See the section 3.7 on how to enter values in manually.

- When finished, the test screen will display the new value.
- Because each farm has its own set of fields separate from other farms, you will immediately be asked to select a field after changing farms.

3.6.4 Change Fruit Type

- From the test screen, make sure that the cursor is at the bottom of the test list by pressing the **9** key.
- The next test number will appear on the right side of the screen followed by the farm, field, fruit-type and lot variables. Press **SHIFT** to move the cursor to the right side.
- Using the **ARROW** keys, scroll the cursor to the fourth line. It will display the current fruit type.
- You will see a list of possible values. Move the cursor over your choice with the **ARROW** keys, and then press the **CHECK** key.
- When finished, the test screen will display the new value. Apples will now be tested under the new ‘fruit type’ value.

3.7 Entering Values

- All values are entered using the same screen. This screen can be in two modes: number mode and letter mode. When entering a value, the current mode will be displayed on the screen and can be changed by pressing the **SHIFT** key.
- In number mode, pressing a number key will put that number at the end of the value and move the cursor forward. At any time you can hit the **CHECK** key to accept the number that has been entered.

- In letter mode, pressing a key puts a letter at the end of the string, but does not advance the cursor. This is because each key is used for 3 letters. To get a particular letter, the key marked with that letter may need to be pressed more than once.
- In both letter mode and number mode, a space can be added. In number mode, the **UP ARROW** key puts a space under the cursor and advances the cursor. In letter mode, the **0** key puts a space under the cursor, but the cursor does not advance until the **UP ARROW** key is pressed.
- Spaces serve a special purpose in network configuration. When entering Network addresses and netmasks, any space is translated into a dot.
- When the correct letter is displayed, press the **UP** arrow key to advance the cursor.
- When finished, press the **CHECK** key.
- Please note the following:
 - The MDT will not accept farm or field values that have a space in them.
 - Press the **BACK** or **CANCEL** key at any time to abort.
 - Values may consist of a combination of letters and numbers. Use the **SHIFT** key to switch back and forth.
 - Press the **DOWN** arrow for a backspace.
 - Some values, such as lot number, only make sense as a number. It is still possible to enter letters in these cases, but MDT will throw out the first letter and anything after. If no numbers are found before the first letter or the end of the input, the value will be set to 0.

3.8 How to Review Statistics

This section describes how to review statistics in the tester. The options available in the windows software are more powerful and easier to use.

- Set the farm setting to the value that you wish to examine. Instructions on how to set this setting are found in section 3.6.3.
- If you are in the test screen, press the **BACK** key until you return to the start screen.
- Press the **6** (STAT) key.
- The screen will display a list of fields. Use the **ARROW** keys to scroll through the list.
- Press the **9** (MARK) key to include or exclude a field in the statistics.
- Press the **6** key to include all fields.
- Press the **3** key to exclude all fields.
- When you are finished marking the fields, press the **CHECK** key.
- The MDT will now display the fruit types available in those fields. Mark the fruit types in the same way as the fields, except the fruit types cannot be block marked (see section 3.9 for information on block marks). Press the **CHECK** key when done.
- Select the earliest and latest date to look for test results. Press **SHIFT** to switch to different parts of the date fields. Use the **ARROW** keys to adjust the selected field.
- The MDT will automatically check to see which one is earlier and which one is later. The search will include these two dates as well as those in between. When these dates are set to your liking, press the **CHECK** key when finished.
- The MDT will now display the lots available for those dates. Mark lots in the same way as the fruit types. Press the **CHECK** key to display the selected statistics.
- Use the **ARROW** keys to scroll through the different statistics. Each value is an average and standard deviation pair. The number of tests in the compilation will also be displayed.
- Press the **BACK** key to return to a previous screen.

3.9 Block-Marking Fields

Block marking does a search through all the field names and marks those that fit a pattern you specify.

- The first screen in the statistics viewer is a list of available fields. Move the cursor over one of the fields you wish to block mark and press the **5** key.
- The chosen field is displayed by itself. Use the **ARROW** keys to move the cursor back and forth along the field name.
- Put the cursor on the first letter that you wish to block and press the **9** key.
- Press the **UP** arrow key until the entire section you want blocked is displayed below the field name.
- Press the **CHECK** key. All fields with names that include the letters you blocked in the same spot become marked.

3.10 How to Change the Probe

- Return to the Test Screen.
- Make sure the MDT is empty.
- Press the **2** key to start a test.
- When nothing is in the test chamber, the probe moves to its fullest extent, then returns to start. There is a very brief pause at the bottom before the probe returns. Turn the MDT off at that pause.
- The top of the probe is now exposed. Use a wrench to remove the probe.
- Put in the new probe by hand, then tighten with the wrench.
- Turn on the MDT and return to the test screen.
- Press the abort key (**X**) to move the probe back to the top.

3.11 Setting Probe Diameter

- Go to the main menu by pressing **HOME** from the start screen.
- Using the **ARROW** keys, select 'Options' from the menu. Press the **CHECK** key.
- Using the **ARROW** keys, select 'Probe Diameter'. Press the **CHECK** key.
- Select the type of probe using the number keys, or select 'Custom'.
- If you choose custom, Enter the probe diameter in thousandths of an inch then press the **CHECK** key.
- The diameter is saved and will remain at the new setting when the MDT is turned off.

3.12 Changing the Date

- Return to the Start Screen. The date will appear on the first line.
- Press the **9** key on your keypad. You will see the date on a screen by itself with a blinking cursor.
- Use the **SHIFT** key to select the part of the date you wish to change, Month, Day, or Year.
- Use the **ARROW** keys to change the selected portion of the date.
- When finished, press the **CHECK** key, or press **BACK** to cancel.

3.13 Changing the Time

- Return to the Start Screen. The time will appear on the first line.
- Press the **SHIFT** key.
- Press the **9** key on your keypad. You will see the time on a screen by itself with a blinking cursor.

- Use the **SHIFT** key to select the part of the date you wish to change, Hour, Minute, or Second.
- Use the **ARROW** keys to change the selected portion of the time.
- When finished, press the **CHECK** key, or press **BACK** to cancel.

Chapter 4

Operating the MDT

The MDT makes fruit testing easy. The operator can begin testing almost immediately with little setup. This section is a more complete discussion of how to operate the MDT and to use advanced features of the unit. There is a Quick Start guide that goes step by step through the basics of using the MDT in chapter 3. Some parts of the Quick Start guide will be elaborated below.

4.1 Battery Voltage

The MDT unit is equipped with Nickel-Metal Hydride (NiMH) batteries.

Battery voltage is found on a small display on the side of the tester.

Normal charge for the batteries is 14.6 volts. The tester functions correctly down to 14.0 volts.

As voltage drops below 14.0 volts, the tester will start having trouble testing harder fruit. As the voltage drops further, other functions begin to fail until the tester becomes unusable.

4.2 Screens and Keys

A few of the keys serve the same purpose all of the time.

The **BACK** key will always take you to the previous screen. Pressing **BACK** a number of times will take you all the way to the start screen.

The red **X** key is a general purpose cancel key that is primarily used to immediately abort a test, but will also cancel other operations. On the test

screen, it reinitializes the tester to its home position.

The **CHECK** key acts as an enter key.

10:55 07/18/2001
s[42/ 1143] 100%
Probe Diam.:0.440"
Creep Time:2.5 sec

Figure 4.1: Start screen

When you first turn it on, the MDT will take several seconds to boot up. During this time it will display a loading message it will also warn you if it detects an error, or some of your settings are non-standard.

The final screen that appears on startup is the start screen, shown in figure 4.1. This screen shows the time, then the date in MM/DD/YYYY format. The second line shows the number of tests stored and the estimated number of tests that can yet be stored. The next line shows the probe diameter. The last line shows the creep time.

4.3 Testing a Fruit

From the Start Screen, press the **2** key. You will be taken to the test screen (figure 4.2). If there is a number in the upper left-hand corner, this is the number of the last test taken with this machine. In figure 4.2, the last test was number 22, but notice that the next fruit number, found on right side of the figure is 1 instead of 23. This is because one of the settings had been changed. Changing the farm, field, fruit type or lot automatically sets the number of the next fruit to 1.

22	Nxt Fruit:1 A
	FARM
	FIELD
	Generic_Apple

Figure 4.2: Test screen

The test screen is divided into two columns. If there are any previous tests stored in memory, then, on the left side, above the blinking cursor appears the number of the last test completed.

This number is the bottom of a list of all tests stored in the tester. The cursor can be scrolled to review these previous tests using the **ARROW** keys.

Push the **SHIFT** key to move the cursor to the right side of the screen. The right side of the screen lists items in the following order:

- the next fruit number to be tested
- the farm setting
- the field setting
- the fruit type setting
- the lot number
- the test profile

The first five settings are used to categorize tests when they are stored in memory.

The test profile determines how the tests are to be performed.

Push the **SHIFT** key and go back to the left side of the screen.

Place a fruit to be tested in the MDT, then press the **2** button. The probe will find the surface of the fruit and stop. Press **1** to continue. When the test is complete, results will appear on the screen. Press **2** to test another fruit, or any other key to return to the test screen.

To review the results of a previous test, use the **ARROW** keys to scroll through the test list as it appears on the left side of the test screen. Results for the test will appear on the right side, including the farm, field, fruit-type and lot settings used to test the fruit.

The list of results is much longer than can fit on the screen. To see the other results, press the **SHIFT** key to move the cursor to the right side of the screen. Then, use the **ARROW** keys to scroll the list of results up and down.

During the first test after turning on the machine, the MDT pauses when advancing the test plunger in order to locate the home position for

the plunger. This ensures accurate diameter readings for the fruit. The MDT then proceeds onward and finishes the test.

From any part of the screen, press the **2** key again to test another fruit. Press the **3** key to test the same fruit a second time.

4.4 Re-Testing a Fruit

From time to time, you may want to redo a particular test. This can be accomplished through the test screen. The original test is replaced, but keeps the original values for farm, field, fruit type and lot.

To perform a retest, move the cursor over the fruit you wish to replace, then press the **1** key. The MDT will then perform a test as normal, replacing the old results with the new.

Note: To delete a fruit, move the cursor over it and press the 8 key.

Note: Quickly set the current farm, field, fruit type and lot to the same values of a previously tested fruit by moving the cursor over the fruit and pressing the 4 key.

4.5 Changing Test Labels

These settings, Farm, Field, Fruit Type, and Lot help define a particular fruit, and tell the MDT how to store the test results. You will want to change some of these settings often, and this can be accomplished from the test screen.

Set these values in advance of testing a sample. They represent the values that the MDT will attach to subsequent tests. Changing them does not affect previous tests. Changing the values of previous tests is, however, possible.

As an alternative to the steps described below, these settings can be changed with a barcode scanner, a method that is both faster and less prone to error. See chapter 5 for information about how to setup and use a barcode scanner.

In the test screen, the cursor needs to be below the bottom in the left-hand test list. Pressing the **9** key will take you automatically to that spot.

The right-hand side of the screen will now show the number of the next fruit to be tested, and below that the current farm, field fruit type, lot, and finally, test type.

Press the **SHIFT** key to move the cursor to the right side of the screen. Use the **ARROW** keys to move the cursor up and down, and press the **CHECK** key to change a particular setting

When you change the number for the next test, you will be prompted to input a number. When finished, press the **CHECK** key. To cancel, press the **BACK** key.

The lot number is changed in the same manner as changing the next test number. Put the cursor on the lot number and press the **CHECK** key, then type in the new lot number. Press the **CHECK** key again when finished.

Changing Farm, Field, Fruit-Type and Test Type will produce a list of available choices. If there are no farms or fields in memory, such as when the MDT is used for the first time, you will not see a list. The MDT will instead ask you to enter the farm or field in manually. For instructions on how to enter farms and fields manually, see section 4.7. Farms and Fields can also be loaded from the windows host. See section 4.6.

Because farms are made up of fields, changing the field will bring up a list of only those fields that are part of the currently selected farm.

Tests that have already been saved can be changed in a similar manner. In the test list, move the cursor of the test you wish to change. Press the **SHIFT** key to move the cursor to the right side of the screen. Move the cursor over farm, field, fruit type or lot, and press the **CHECK** key. You will be asked to confirm the change.

Some points about choosing farm or field:

- If you select a farm, you will also be asked to choose a new field.
- If you try to change the field, but there is no farm selected, you will be asked to select a farm first.
- You can manually enter a new farm or a new field while in the selection lists by pressing the **9** key.
- The very first time you turn on the MDT, it may not have any farm, field or fruit type selected. The MDT always saves any changes you make to the setting, however, and will remember them the next time it is turned on.

4.6 Loading the Tester with Farms and Fields

You can load a farm and field list across the network from your windows machine. Using your favorite text editor, create a text file on your computer in the following format:

```
*Farm1
Field1
Field2
*Farm2
Field1
Field2
Field3
```

Each ‘*’ indicates that the name on that line is a farm. Each line with out a ‘*’ is a field name and is subordinate to the farm above it. See section 4.9 for hints on how to pick good farms and fields.

Save the file as ‘farmlist.txt’ in the folder ‘MDTFILES’. ‘MDTFILES’ folder is found under the main installation folder for the windows software. By default, this is ‘C:/DIGITEST’.

Make sure the windows software is running and that ‘Server’ is checked under the ‘File’ menu.

Plug the tester into the network and turn it on. When the start screen appears, press the **5** key to get to the utilities menu.

Press the **CHECK** key to enter the Utilities menu, and scroll down to ‘Refresh Farms’

As with all Ethernet functions, this puts the tester into realtime transfer mode, where tests are automatically sent on the network. If you do not desire this, you should reboot the tester before performing any further tests. You may do other Ethernet functions without rebooting.

4.7 Entering in a New Farm or Field

If there are no farms or fields in memory when you attempt to change them, you will be immediately asked to enter a new value manually.

If there are farms and fields you can still manually enter a new farm or field. When viewing the selection list for either farms or fields, press the **9** key to enter in a new value.

The MDT will go to a screen that allows you to enter a new value. Both numbers and letters can be entered on this screen. Because letters and numbers use the same keys, you must press the **SHIFT** key to change between letters and numbers.

To enter a number into the MDT, type in the number as you would a calculator.

Entering letters is more difficult. Each of the keys is used to enter three different letters. Pressing the keys repeatedly will scroll through its three letters. For example, press the **1** key once, and you will get an 'A', press it again, you will get a 'B', and press it a third time, you will get a 'C'. The fourth press will bring you around to 'A' again. The letters for each key are listed on the key label below the key number.

The new letter appears directly under the cursor, but the cursor does not move, allowing you to pick the letter you want. When you have found that letter, press the **UP** arrow to advance the cursor. Then enter the next letter.

With both letters and numbers, the **DOWN** arrow acts as a backspace by deleting the last character, the **CHECK** key acts as an enter key by accepting the new input, and the **BACK** key will cancel this input for a new farm or field.

Your new entry will be automatically selected and entered onto the list.

If you have just manually entered a new farm, you will immediately be asked to enter a new field.

Note: If you go to the farm or field list, but there are no choices for that setting, you will be asked to enter a farm or field manually.

4.8 Clearing all Farms and Fields

If you wish to delete every farm and field name stored on the tester, go to the start screen and press **5** for the main menu.

Scroll down once more to 'Clear Farms' and press the **CHECK** key.

This does not delete tests from the tester, just farms and fields from the selection list.

4.9 Farm and Field Data Structure

The tester uses Farms, Fields, Fruit-Types, Date, and lot numbers to sort different apple tests. While Fruit-Types are preprogrammed, farms and fields can be set to any string consisting of letters and numbers and no spaces. Originally they were meant to represent actual farms and fields for an orchard. We envisioned people setting the Farm value to be the name of the orchards they were working in, then wandering from field to field, testing apples and changing the Field value accordingly. Some people, however, will not be wandering around in orchards, so they need another system for setting Farm and Fields values. There are a few important points to remember in picking good farms and fields:

- Farms should be somewhat equivalent to each other. That is, if the first farm represents an orchard, so should the second. If the first farm represents a fruit packer, the second should also be a fruit packer. As an example, if you are testing newly arrived fruit on a loading dock, a Farm might represent any individual supplier, be they fruit-packer or grower.
- Fields should be more specific than farms. If you're Farm is a fruit-packer, then Field could be set to the packing date, or any lot code that the packer used to label the fruit. Choose values that are most convenient and tell you something specific about the fruit. That can help you later on when you're trying to track down the origin of some data.
- Make the Farm and Field names descriptive. If you are testing apples from 'Tasty Fruits Co.' that were packed with lot code 'ZX123', name the Farm 'TASTYFRUIT' and the Field 'ZX123' instead of 'FARM1' and 'FIELD1'
- Each Field is subordinate to one Farm (this goes along with the second point, above). The tester will ask you to select the current Farm before you can select a Field. You will see a list of only the Fields that belong to the selected Farm. If you have two fields with the same name under different farms, they will be treated as different fields. The windows software has the capability of viewing two different fields with the same name as a single field.

- Farm and Field names should be no more than 18 characters. Each character has to be a letter or number. The tester does not distinguish between capital and lower case letters.
- If two Farm names are the same for the first 8 characters, the Fields from both will appear under each Farm. As an example, if we have Farms named ‘TASTYFRUIT’ and ‘TASTYFRUITCO’, all of the Fields under ‘TASTYFRUIT’ will appear under ‘TASTYFRUITCO’ and vice-versa. Individual apple tests will, however, be distinguished correctly.
- Lot numbers are set in the tester and can be any natural number.

4.10 Viewing Statistics

The statistics viewer can be reached from the start screen by pressing the **6** key. Statistics can only be viewed for the currently selected farm, so it is important that the correct farm is selected beforehand. See 4.5 for instructions on changing farm and other settings.

You will first see the list of fields that make up the farm. You can include as many of these in your statistics search as you wish. The currently selected field will have a star in front of it, showing that it is marked to be included with the search. Fields can also be ”block-marked”, see section 3.9.

Using the **ARROW** keys, move the cursor up and down the list of fields, and press the **9** key to include or exclude the selected field from the statistics search. You can also select all the fields by pressing the **6** key, or deselect all the fields by pressing the **3** key.

Press the **CHECK** key when finished selecting the fields. The MDT will display a list of fruit types that have been used in those selected fields. These can be selected in the same manner as the fields in the previous screen. Use the **9** key to include or exclude a fruit type. Use the **6** key to select all fruit types, and the **3** key to deselect all fruit types. Again, press the **CHECK** key when finished.

The next screen allows you to set the range of dates to be included in the statistics search. Use the **SHIFT** key to move from one date field to another, and the **ARROW** keys to change the field. The search will include the dates selected and those in between. Once again, press the **CHECK** key when finished.

A list of lots available during the selected dates will be displayed. Select different lots in the same manner as fields in the first screen. Use the **9** key to include or exclude a lot. Use the **6** key to select all lots, and the **3** key to deselect all lots. Press the **CHECK** key when finished.

The MDT will now display a compilation of averages and standard deviations for the selected fields, fruit types, and dates. Use the **ARROW** keys to scroll through the statistics. Press the **BACK** key when finished.

When viewing a page of statistics, those values displayed can be permanently deleted from the MDT by pressing the **8** key.

4.10.1 Selecting Additional Lots

The list of available lots appears after you hit the **BACK** button, at this point you are able to reselect which lots you want, press the **CHECK** key, and results from your new selection will appear. Hitting the **BACK** key multiple times will take you through all the screens, where your selections can be altered to give different results.

For example, if you have reviewed the results for Lot #1, and now wants to see the results for all the lots from that field, hit the **BACK** key to return to the lot selection, press the **6** key to select all lots, then press the **CHECK** key. Averages and standard deviation for every lot in the selected fields will be displayed.

4.11 File Maintenance

4.11.1 Deletion of Data

Every fruit tested is stored in a file on the MDT. Statistics for the tests are compiled and stored in separate files. When serial transfer is enabled, all tests saved to the system are sent across the serial port. These tests are not deleted after transfer. These same tests will be sent the next time transfer is initiated. Therefore, from time to time, you will need to clear the machine of stored tests.

To delete all stored fruit tests from the system:

- press the **BACK** key until you reach the start screen.

- When viewing the start screen, press the **8** key to delete all tests. You will be asked to confirm the deletion before proceeding.
- To delete all of the stored statistics, return to the start screen and press the **SHIFT** key followed by the **8** key. You will be asked to confirm the deletion.

Because statistics are stored by date, do not take up much space, and are not transferred, they may not need to be deleted often.

4.11.2 Desktop File Maintenance

Most file maintenance will take place on the Windows machine. The Windows software enables you to change the settings on whole batches of fruit, and to move the results to other files. The farm setting for a particular fruit determines in which file it will be stored when it is on the Windows computer.

The windows software stores tests across five files. These files all have the same Farm name, but end in '.far', '.rfd', '.rcd', '.rft', and '.tag'. They must all be treated as a unit and should be moved, copied, or deleted together.

Chapter 5

Barcodes

5.1 Barcode Format

All barcode commands to the Digitest are in the form of a string consisting of a command code prefix followed by a value.

Prefixes can be a single character or multiple characters.

While some commands require only a single scan, others require multiple scans.

5.1.1 Prefixes

+ Set Farm. Value is new farm name.

- Set Field. Value is new field name.

\$ Set Fruit Type. Value is an integer fruit type code found in fruits.txt in the Winapples install directory, not variety name.

%L Set Lot. Value is new lot number.

%C Command word. Value is a command word.

%N Set Test Number. Value is the test number that will be assigned the next starch, sugar or watercore scan value. N is an integer.

%S Set Starch Number. Value is a new starch number. This scan should follow “%N” scan, and changes the test that has the same number as the “%N” scan. It can have a decimal.

%H Set Sugar Number. Value is a new sugar value. This scan should follow “%N” scan, and changes the test that has the same number as the “%N” scan. It can have a decimal.

%W Set Watercore. Value is a new watercore number. This scan should follow “%N” scan, and changes the test that has the same number as the “%N” scan. It can have a decimal.

5.1.2 Command Words

Command word codes are prefixed with ‘%C’. They provide a way to use barcodes that do not use the Digitest format.

SETFARM The Digitest will change Farm to the value of the next scan

SETFIELD The Digitest will change Field to the value of the next scan

SETLOT The Digitest will change Lot to the numerical value of the next scan. Non numeric values are translated as zero.

SETFT The Digitest will change Fruit Type to the numeric value of the next scan. As with the ‘\$’ prefix, this command uses the numeric codes found in the fruits.txt file and not variety names.

5.2 Examples

+SHADYACRES In this code ‘+’ is a prefix that commands a change to the Farm setting of the Digitest, while the rest of the string is the new value of the farm. After scanning this example, subsequent tests will be set to the farm ”SHADYACRES”

%L1066 ‘%L’ is the prefix code. This example instructs the digitest to set Lot Number to 1066 (lot numbers are always integers.)

%CSETLOT followed by 1066 ‘%C’ is the prefix code and indicates the following value is a command word. Scan the first code, then scan the second (note that the second code has no prefix), and the Digitest sets Lot Number to the value of 1066

%CSETFARM followed by +SHADYACRES The Digitest will set Farm to “+SHADYACRES” instead of the expected “SHADYACRES”

5.3 Sugar, Starch, Etc.

Sugar, starch and watercore can be scanned into the tester after the tester has pressured the fruit and the results are stored in the windows computer.

These scans only work if the tester has a live network connection to the Winapples server that is in server mode. "Utilities" → "Transmit" → "Toggle Realtime" on the tester initiates the connection.

Each entry is a two scan process. The test number for the fruit being edited must be scanned first. Second, a value must be scanned.

If a value is scanned before a test number is scanned, an error message appears on the tester.

If the scans are made in the correct order, a success message appears on the tester, and the Winapples server will try to find a matching test and set the appropriate value. If no test is found, an error message is printed in the Winapples software, and a success message is shown if the value was changed.

The Winapples software might not find a test to change the value if there is no test with that number, if someone has changed the farm, field, lot or fruit type settings, or if the tests were pressure tested at an earlier date.

5.3.1 Examples

Change sugar value in test 6 to 12.3. Scan the following barcodes in succession:

%N6

%H12.3

Change watercore in test 15 to 2.

%N15

%W2

5.4 Codes and Fonts

Mohr and Associates uses a Code 39 font to print barcodes out of Microsoft Word. Code 39 require each barcode to begin and end with '*'. We create our test codes, then bracket them with '*', then change the font. While standard Code 39 works with the Mohr Digitest, the full-ASCII variation of Code 39 does not.

Code 128 is known to work. Code 128 typically requires special software for barcode creation.

We have not done extensive testing with other codes, but the Unitech MS-330 scanner that we use works automatically with other codes and there should be no problem.

Serial Interface

The serial interface is RS232, 4800 baud, 8 data bits, 2 stop bits, no parity and no handshaking. Either external serial port on the Digitest may be used.

The Digitest is delivered with both serial ports configured to those values, however serial port settings can be changed from the options menu.

The barcode readers are programmed to insert a preamble character '[' and a postamble character ']' before and after each code as it is transmitted to the tester. Without these brackets, the Digitest will ignore the command.

Chapter 6

Details of the Test Screen

The test screen is the most important and most complicated screen in the MDT. This is where all the action is. From this screen you can test and re-test fruit, change settings, review results and look at statistics. It is divided into two columns. The left column is a list of tests stored in memory. When a particular test is selected in the left column, the right column then displays the results of the test. If no test is selected, the current settings for fruit number, farm, field, fruit type and test profile are displayed in the right column.

What follows is a review of what each key does; some of which have already been described in the previous chapters.

1 key Re-do a test. Make sure the test you want to replace is currently selected. It doesn't matter whether the cursor is on the left side or the right side of the screen. The test is the same as a normal test, but beware that it will take on the current farm, field and fruit type settings. To change the settings to match that of the original fruit, press the 4 key when the old fruit is selected. You must do this before the re-test.

2 key Test a new fruit. This starts a standard fruit test. Have the fruit ready in the MDT before starting the test. You can start a test from anywhere on the test screen. When the test is finished, the result is added to the bottom of the list of tests that make up the left side of the screen.

3 key Test the same fruit a second time. This starts a standard test and

assumes that the fruit in the MDT is the same as the previous test. The result is added to the bottom of the list as for the **2** key above, but it will have the same number as the previous test, and the results will be averaged together as a single apple in statistics records.

4 key Grab settings. With a test selected, pressing the **4** key will change all the farm, field and fruit type to match those of the selected test. With no test selected, this key does nothing. This key is typically used when re-doing tests that were in error, or to set the settings correctly to look at statistics from earlier samples.

5 key Toggle Composite. Each fruit can be tested multiple times. Pressing the **5** key will switch the test screen between displaying each individual test, or displaying composite average results for each fruit.

6 key Display batch statistics. The MDT will show a statistics screen with the averages and standard deviations for all fruit tested today in the current farm, field, fruit type and lot.

7 key Help key. Displays some instructions on how to use the test screen. This key is available nearly everywhere in the MDT

8 key Deletes the currently selected fruit. You will be asked if you truly want to delete the fruit. There is no undelete feature.

9 key Moves the cursor to the bottom of the test list that makes up the left side of the screen so that no test is selected. To change the farm, field, fruit type settings and test profile, you need to have no test selected.

0 key When using the scale attachment to weigh fruit before testing, this key zeros out the scale.

ARROW keys When the cursor is on the left side of the screen, the arrow keys scroll up and down the list of tests. When the cursor is on the right side of the screen, the arrow keys scroll up and down the list of results if a test is selected, or current settings if no test is selected.

SHIFT key Moves the cursor left and right between the two columns.

BACK key Returns the MDT to the previous screen. This key has the same effect in almost any screen.

CHECK key If the cursor is on the right side of the screen, then pressing the **CHECK** key will allow you to change the selected setting. Otherwise, the key does nothing.

Abort, X key Abort a test. Press this button to immediately cancel an ongoing test. If the probe is not at the top, or home position, pressing this button will initialize the test machine and bring the probe back home.

Chapter 7

Care and Maintenance

The MDT is a precision piece of electronics. Please be careful with it. Don't drop it, tip it over, or try to test materials it wasn't designed to test (e.g. wood or steel).

7.1 Cleaning the MDT

The MDT is simple to maintain. Turn the tester off. Clean the test area and plunger with a wet rag, or wash it under a tap. Be careful to keep water and other liquids away from the electronics that are housed above the test area.

To clean the plunger, it is necessary for it to be fully extended. See section 7.2 below for instructions on how to extend the plunger.

7.2 Changing the Test Plunger

Different fruits require different shapes for the test plunger. With an empty MDT, start a test by pressing the **2** key on the test screen. Normally, the MDT runs down to the bottom, realizes there is no fruit to test, prints a warning message, then goes back to the start. For our purposes, wait until the plunger reaches bottom, then turn the MDT off before it begins to retract.

The top of the plunger can now be reached with a wrench. When the old plunger is removed, put the new one into place by hand, then tighten it slightly with a wrench.

Follow the procedure outlined in 7.3 to calibrate the length of the test area. The length needs to be calibrated each time the test plunger is swapped.

7.3 Calibrating Length

The length of the test area should be calibrated after each change to the test plunger or the test base.

From the start screen, press **5**. The utilities menu should appear. Use the **ARROW** keys to scroll down until "Calibrate Length" is selected. Press the **CHECK** key to activate it.

The MDT will ask for a length. Put into the tester a ball of known diameter, preferably made of something stiff, like wood. Enter the diameter of the ball in thousandths of an inch (A ball 2.48" wide would be entered as 2480) and press the **CHECK** key. The MDT will bring the plunger home, then move down to touch the ball, then return home. At this point, it will have calibrated the length of the test area.

7.4 When to Calibrate the MDT

The MDT should be calibrated when it is initially setup and periodically thereafter. Frequency of calibration depends on testing conditions and required accuracy.

7.5 Calibrating the MDT

From the start screen, press the key marked UTIL. From the utilities menu use the arrow keys to find the 'Zero' or 'Display Force' option, then select it with the **CHECK** key. The screen will now display the force as read by the MDT. Make sure there is nothing in the MDT and nothing is touching the test plunger.

If the force is higher than 0, and less than 0.25 pounds, the zero offset does not need to be adjusted. If it does need to be adjusted, subsection 7.5.3 has the detailed instructions.

7.5.1 Calibrate the External Strain Gauge

Next, calibrate your external strain gauge. Set up the strain gauge outside of the tester. You will need a weight in the 25 to 35 pound range that you can rest on the strain gauge load cell, and that you know accurately to 1/100th of a pound.

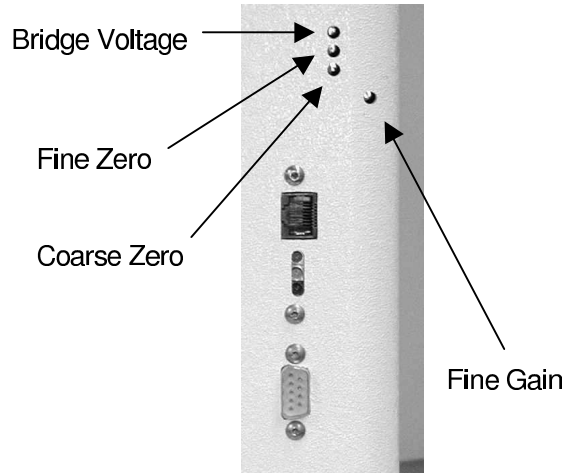


Figure 7.1: Calibration adjustment pots.

Turn off the tester, then connect the serial port on the strain gauge to the MDT using a null modem cable. Turn the tester back on.

Press the **5** key to go to the 'Utilities' menu, and select 'Calib Calibrator'.

Follow the directions on the screen until the screen is showing the force on the external strain gauge.

Use the knobs on the external strain gauge unit to adjust the value to 0.0 pounds.

Put your known weight on the load cell.

Push the **1** key and enter the weight in hundredths of a pound, followed by the **CHECK** key.

Remove your known weight from the load cell.

With nothing on the load cell, push the **1** key. The MDT will ask for the force on the load cell, enter zero and press the **CHECK** key.

When finished, press the **CHECK** key again. Follow the directions on the screen. When you return to the menu, the check to see if the strain gauge is accurately calibrated using your known weight.

7.5.2 Calibrate the Tester

Position the load cell under the test plunger.

Select 'Calib Tester' from the utilities menu.

Follow the direction on screen. The tester will bring the plunger into contact with the load cell.

The tester automatically calculates a digital scale value to account for errors in gain.

7.5.3 Adjust Zero Offset

This section is only needed if the zero offset is out of acceptable range. The zero offset is the force read by the tester when it is not in operation and no external load is on the load cell. This force should always be greater than 0 and less than 0.25 pounds.

Use an Allan wrench to remove the top panel on the tester. This will allow easy access to the pot adjusters, and let you drive the test plunger by hand.

There are four pot controls that can be found on the right panel of the MDT: three in a row, and one offset to the right. The lowest pot on the left is a coarse zero control, and the middle pot is a fine zero control. The offset pot adjusts the gain. The top pot is bridge voltage. Do not adjust bridge voltage.

Use a pot-trimmer to slowly rotate the zero control until the force is less than 0.25 pounds, but somewhat higher than zero. The tester does not report negative values, so setting it to true zero will give biased results. The slight positive offset will be measured and accounted for in each test.

7.5.4 Adjust Gain Manually

This section is very seldom needed, but if calculated gain is too far off, bigger than 1.25 or less than 0.75, gain should be adjusted by hand. Also, if the automatic routines detect an error in gain that is very large, it will warn you to calibrate gain by hand.

To calibrate the amplifier gain, return to the utilities menu and select ‘Zero’ or ‘Read Force’. The force line displays the true force recorded by the tester.

Use an Allan wrench to remove the top panel on the tester. This will allow easy access to the pot adjusters, and let you drive the test plunger by hand.

With the strain gauge positioned under the test plunger, wind the test plunger down until it contacts the strain gauge.

Compare the ‘force’ reading on the tester with the value displayed on the calibration unit. When gain is set properly, the *difference* between these two values will remain constant from 5 to 24 pounds.

If not, there is an error in the gain. Adjust the gain control appropriately. The gain control is lower and offset from the other three controls on the right side.

Perfection in this case is not necessary since the automated calibration described in subsection 7.5.2 will account for any remaining error.

Afterwards, re-run ‘Calibrate Tester’ from the utilities menu.

As ‘Calibrate Tester’ adjusts for small errors in gain, manually calibrating the gain as above should not be necessary over long periods.

Chapter 8

Transmitting to a Computer

8.1 Changing the Network Settings

The MDT is designed to communicate with the Windows software using either a serial port or the TCP/IP protocol. The two settings needed for Ethernet transfer, IP Address and Netmask, must be obtained from the Network Administrator for your network.

Go to the start screen on the MDT.

Press the **5** key to go to the utilities menu.

Select 'Network Settings'

The first screen displays information files pertinent to MDT's network components. Press the **BACK** key to skip it.

The next screen prompts you to enter an IP address for the MDT. For a dot, Use the **UP** arrow key to enter a space into the number. These will be converted to dots. Press the **CHECK** key when done.

Enter the netmask for your local network in the same manner as the IP address. Press the **CHECK** key when done.

Note: The MDT does not use any of the automatic addressing protocols such as BOOTP or DHCP.

8.2 Network Transfer

Plug the MDT into a network hub on the same local net as the Windows computer. Your Network administrator will have to set the MDT network settings to match your local network.

Load the Windows software, go to the file menu, and make sure the ‘server’ option is checked.

Go to the start screen of the MDT, the screen that displays the date and time. Pressing the **BACK** key repeatedly will get you there.

Press the **1** key to get to the main menu

Select ‘Transmit’

Select ‘Ethernet’

The MDT will prompt you with some information about the Ethernet connection, and ask you to press a key after each prompt.

All fruit tests will now be transmitted to the Windows software, but will also remain stored on the tester.

If the data is not deleted, then it remains on the tester and will be transmitted again to the Windows computer the next time you transfer data.

It is a good idea to check first that the data was transferred correctly before deletion.

These tests can be cleared from the tester by pressing the **8** key while the start screen is displayed.

As with all Ethernet functions, the tester should be rebooted before any further testing is performed, as the tester is now in realtime mode, see section 8.3. You can perform any other Ethernet operation without rebooting.

8.3 Real Time Network Transfer

Load the Windows software, go to the file menu, and make sure the ‘server’ option is checked.

Go to the start screen of the MDT.

Press the **1** key to get to the main menu.

Select ‘Transmit Options’

Select ‘Toggle Realtime’

The tester needs a few seconds to load the Ethernet drivers, after which it will display the tester’s network address.

Press any key to connect. The tester will print a message if connection was successful, or an error has occurred.

Press the **2** key to go to the test screen. Test as normal, but now the data is saved directly to the Windows computer over the Ethernet. It will not be stored in the tester.

8.4 Exporting to a Spreadsheet

See section 10.8 for instructions on how to download data to a Windows machine and export it to a spreadsheet.

Chapter 9

Test Profiles

A file called a test profile determines the parameters of a test, such as velocity, maximum distance, etc. You can edit a test profile or make new ones and download them to the tester. They are found in the 'mdtfiles' folder, which is in the main installation directory (default is `c:\digitest\mdtfiles`). Test profile file names always end in '.tp'.

Use your favorite text editor such as notepad to edit the apple.tp file. It will look like this:

```
Apple test specification
Region1?      Index distance
1             0.4
Region2?      Core Ratio
1             0.3
Creep?        Creep Force          Creep Time
1             10.0                 0.5
Crispness?
1
RindThickness -- Minimum distance from base
.1
Testvelocity      Seekvelocity      Slow Data Rate
1                 1.5                 0
Sensitivity        Average
0.1                10
```

Each number is the value of a variable that determines how the tester operates. The name of the variable appears above its value.

When the tester first begins a test, it seeks for the surface of the fruit. It moves at set velocity, labeled ‘Seekvelocity’ in the test profile. ‘Seekvelocity’ is entered in inches per second.

While it is moving, the tester takes force readings until it records a force greater than a set trigger value. This trigger value is labeled ‘Sensitivity’ in the test profile. ‘Sensitivity’ is entered in pounds. As the force readings are accumulated, they are averaged. The number of samples to average is entered under ‘Average’ in the test profile.

‘Sensitivity’, ‘Average’, and ‘Seekvelocity’ determine how the tester performs while searching for the surface. As ‘Sensitivity’ gets smaller, ‘Average’ must get larger to compensate for noise, and ‘Seekvelocity’ must get smaller in order to reduce noise and to compensate for a slower sampling rate.

Before the tester begins to test the fruit, it checks the ‘Region1?’ flag from the test profile. This tells the tester to perform a constant velocity test. If this number is 0, then the Region 1 constant velocity test is skipped.

As the tester continues with the Region 1 test, it takes readings of force and displacement at a constant velocity. That velocity is labeled ‘Testvelocity’ in the test profile, and is entered in inches per second.

The sampling continues until the test plunger reaches a set maximum distance from the surface of the fruit. This distance is defined as ‘Index distance’ in the test profile. ‘Index distance’ is entered in inches.

After the Region 1 test is finished (or skipped), the tester checks the ‘Creep?’ variable. If it is set to 1, the tester performs a constant-load creep test for a set period of time. If it is set to 0, the creep test is skipped.

During a creep test, the tester presses down on the fruit with a force in pounds equal to ‘Creep Force’. It does so for a number of seconds equal to ‘Creep Time’. The tester measures the displacement of the plunger during this period.

After the creep test, the tester checks ‘Region2?’. If it is 1, the tester performs another constant velocity test using the same ‘Testvelocity’ as the Region 1 test. If it is 0, that section of the test is not performed.

Unlike the Region1 test, the Region2 test proceeds to a set percentage of the diameter of the fruit. This fraction is given in the variable ‘Core Ratio’. For example, a ‘Core Ratio’ of 0.5 would set Region 2 to test to the center of the fruit. The distance from the home position to the base needs to be calibrated accurately for the measured diameter to be accurate. See section 7.3.

When ‘Crispness?’ is 1, the tester calculates the crispness measured in

the data from Region 2. If Region 2 is not used, 'Crispness?' should be set to 0.

If a fruit has a particularly tough rind at the base, and you want to avoid testing it, you can set the 'rind thickness' value in inches. The tester will not approach the testing base any closer than this distance when collecting data. This requires an accurate calibration of the distance from the home position to the base (see section 7.3).

When creating a new test profile, all of the values must be included in their proper positions, even if they are unused for that test. The simplest way to do this is to copy an old test profile and change the values. The file name of the test profile is the name that will be used by the tester. 'apple.tp' will appear as 'APPLE' in the tester menu. Any test profiles you want to load onto the tester must be kept in the 'mdtfiles' folder, which is a sub folder of the installation directory. By default the installation folder is `c:\digitest`.

Once you have your test profiles setup up, run the windows software on the host machine, and make sure 'Server' is checked in the 'File' menu. With the tester hooked to the Ethernet, go to the tester's 'Utilities' menu. Scroll down and select 'Get Test Profiles'. The tester will download the test profiles.

Test profiles can be deleted off of the tester by selecting 'Clear Test Prof.' from the utilities menu.

As with all network functions, you must restart the tester if you wish to run a test afterwards. You can perform any number of network functions without restarting the tester.

Chapter 10

Windows Software

The MDT Windows software is the ideal place for reviewing your fruit test data. It has the ability to graphically display the results for each fruit and compile averages and variations for groups of fruit.

10.1 Downloading Test Results from a Tester

Data transfer is detailed in chapter 8. Data transfer is over Ethernet and is initiated by the tester, not the windows software.

10.2 View Data

Data is arrayed on screen in a Tree format. The branch nodes of the tree are the values of the different settings (farm, field, fruit-type, etc.) of the tester when the tests were taken. The leaf nodes represent individual tests.

Use the mouse to open branches of the tree out to the leaf nodes, then select individual tests. Graphs of the pressure throughout the fruit and the FFT appear. Numerical results are displayed alongside the data tree.

10.3 Menus

- File

Change Directory The data tree represents the fruit found in the current working directory. Select this item to change which direc-

tory is represented. The current directory is always the location to which fruit tests are downloaded from the MDT. When you close the software, the current directory is saved and will still be the current directory when you run the software again.

Server Results can only be downloaded from the MDT if the ‘Server’ item is checked.

Options Change the com port and baud rate used to download tests from the ”Options” screen.

Connections List any active, real time Ethernet connections, including IP address and average testing rate.

Exit Quit out of the Windows software.

- Edit

Rename renames the currently selected item on the tree.

New top level creates a new tree item of the type at the top level.

New current level creates a new item of the same type as the currently selected item’s children.

Delete Fruit deletes the selected fruit, but not any other node types. Other node types are deleted if they have no more child nodes attached.

- View

Graph Options Allows you to change some variables, such as axis length, of the different graphs.

- Data

Sort by Farm, Field, Fruit type , Lot, and Date Sort the data tree so that the selected type of node is now at the top of the tree, shifting other types down.

Save Sorting Save the current sorting under a name you give, so that it may be returned to with a single click.

Default Sorting Sort the tree in the default order, Farms first, then fruit type, fields, dates, and finally lots.

Export Data Send data to a spreadsheet-readable file.

Post Process (fast) Reprocess data. This command is only used for converting data from older versions of the MDT software.

- Tools

Save Report Save a Microsoft Word document in RTF format that gives an summary and distribution for the selected test level.

Save Batch Report Generates the same sort of report as Save Report, but can generate multiple reports for lower levels of the sort hierarchy than the selected hierarchy.

Select Report Template Select the template RTF document to use to generate reports.

Show Average Creates and displays an average, or composite apple for the selected tree node. More details, and an alternate method for ‘Show Average’ is to right-click directly on the item and select ‘Show Composite’ from the pop up menu.

Print Average and Print Average(fax) These items use the same averaging system as ‘Show Average’. Both of these items print out a description the composite to the default printer, in standard or fax format. An alternative way to print a composite is to directly right-click on the item and select ‘Print Average’ or ‘Print Average (FAX)’.

10.4 Show Average

A composite is an average result for all of the tests below a particular point in the tree. Right-click on any node of the tree other than an individual test. Select ‘Show Composite’ from the pop-up menu that appears. The composite is generated based on all the children of the node that was clicked. Averages of numerical results are displayed as are averages of the data and FFT graphs.

10.5 Print Average

Make sure your default printer is on, then right-click on an appropriate node as in section 10.4. Select 'Print Composite' to generate a page with the composite graphs and numerical results. The page will be automatically opened into your default web browser. This page can be customized by changing the HTML code used in `template.htm`. The file is found in Digi-Test installation directory.

10.6 Sorting the Tree

The Windows software always builds the data tree in a particular order. Farms come before fruit type, fruit type before field, field before date and date before lot. This order can be altered from the Data menu. When a particular item is selected, the data tree is resorted so that item is at the top of the tree. This can be done any number of times.

A particular sorting of the tree can be saved by selecting 'Save Sorting' from the sort by menu. You will be prompted for a name, and the new sorting will now appear at the bottom of the menu.

Select 'Default Sorting' from the same menu to return to the original order.

10.7 Renaming Nodes

Right click on a farm, field, fruit type, and lot number, then select 'Rename' from the pop-up menu. For farms and fields, you will be able to type in a new name. For fruit type, a list of all the available options appears in a menu. Left click on one fruit type to change the name.

10.8 Exporting Data

To create a spreadsheet filled with test data, select 'Export Data' from the Data menu. A window appears with two lists. On the left, a copy of the data tree is displayed. On the right is a list of items to be exported; it should be empty. The tree opens and closes as normal. Find the items you want to include in the spreadsheet and select them with the left mouse button. Click

the export button in the middle of the window. You can fill the list with as many items as you desire. If you need to delete an item off the list, double click on it.

Items can be selected as a group. For example, if a farm is selected, and the ‘field’ button is pressed, all fields contained in the selected farm are added individually for export.

When finished, click on the tab at the top of the window labeled ‘Export Options’. Several check boxes appear, representing different columns to put into the spreadsheet.

Press the ‘Finish’ button when done. You will be asked to give a name for the file, press OK.

10.9 Opening an Exported File in Microsoft Excel

Select ‘Open’ from the Excel File menu. Set the file type to ‘All files’ locate your exported file. It will have a ‘.out’ extension (last three letters). Double-click on your file. When the importing window appears click finish.

Alternatively, find the files in Windows Explorer, and right click on it. A pop up menu appears. If “Open With...” is available, choose that, otherwise choose “Open”.

Select Microsoft Excel to open the program and press “OK”. “.out” files will now be associated with excel, so in the future only a double click on a “.out” file is needed to open it.

10.9.1 export headers

The following list is a description of the column headers of the “.out” spreadsheet export files created by the Mohr Digitest Winapple software. Some groupings of these columns can be included or excluded from exported files using the check boxes in the second tab of the “Export Data” window in the Winapple software.

Pos Index of the exported sample. Refers to the table at the top of the .out file.

Num Test number.

- Type** Variety index number. Refers to "fruits.txt".
- Y** Year sample was taken.
- M** Month sample was taken.
- D** Day of month sample was taken.
- Diam(in)** Diameter of the fruit.
- Mod** Bulk Modulus (unused).
- OMH(lb)** Overall Maximum Hardness, the largest pressure recorded.
- OAH(lb)** Overall Average Hardness, average pressure for the entire test.
- M1(lb)** Maximum region 1, maximum pressure recorded in the first 0.32 inches from the top of the fruit. Corresponds to industry standard pressure test.
- A1(lb)** Average reading in region 1, average pressure through 0.32 inches.
- M2(lb)** Maximum region 2, maximum force measured between 0.32 inches into the apple and the core.
- A2(lb)** Average region 2, average force measured between 0.32 inches into the apple and the core.
- E2(lb)** End of region 2, measured pressure at the boundary of the core.
- M3(lb)** Not used (maximum in core).
- A3(lb)** Not used (average in core).
- MCR** Not used (core ratio).
- C0(in)** Creep 0, 10 pound creep force for 0.5 seconds at 0.32 inches.
- C1(in)** Creep 1, not used.
- Sug** Sugar, must be manually entered in Winapple software.
- Stch** Starch, must be manually entered in Winapple software.

WC Watercore, must be manually entered in Winapple software.

Cn Crispness measurement.

QF Quality Factor, a combination of M1, A2, E2, C0 and Cn.

sM1 M1's contribution to quality factor.

sA2 A2's contribution to quality factor.

sE2 E2's contribution to quality factor.

sC0 C0's contribution to quality factor.

sCn Cn's contribution to quality factor.

Color Color, must be manually entered.

BGColor Background color, must be manually entered.

Shape Shape, must be manually entered.

Boxsize Box size.

Rowsize Cherry packing size measurement.

10.10 Moving Farms Between Directories

Each fruit is stored into a set of files named for the farm setting for the fruit. These files can be directly copied from one directory to another. There are four files associated with each farm. `<farmname>.far`, `<farmname>.rfd`, `<farmname>.rcd`, `<farmname>.rft`. These four files can be copied using any method.

In Windows Explorer, you can drag and drop these files into a new folder. Make sure to keep all four files together.

Follow these steps to copy the files using the command prompt:

- Load the dos prompt. Change to the directory you are copying from.
- Type `copy <farmname>.* <destination directory>`
- Replace `<farmname>` with the farm you wish to copy and replace `<destination directory>` with the name of the folder you wish to copy to and hit enter.

10.11 Moving Tests From One Farm to Another

Tests may be moved in groups from one farm to another. This can only be done with hierarchical groups. For instance, if Farm1 had tests from August 1 and August 2, we could separate these tests by moving all fruit from August 1 to a new farm. We would accomplish this with the following steps:

Go to the sort by menu and select 'Farms' to make sure that the farms are the uppermost level of the data tree.

Go to the sort by menu again and select 'Dates' to make sure that dates are now the upper most level of the data tree, and farms are next.

Open the tree item August 1, so that it displays its branches. Right click on the branch labeled 'FARM1', then select rename.

Enter a new name, and all the fruit from 'FARM1' dated August 1 will be moved to the new farm, while all the 'FARM1' fruits from August 2 remained unchanged.

10.12 Edit Individual Fruit

Right click on an Icon for an individual fruit test and select 'Edit fruit' from the pop up menu. Most variables associated with a test, including starch, sugar and water core, can be changed in the window that pops up. Click the 'save changes' button when done, or click the cancel button if you decide not to save the changes.

Chapter 11

Key Layouts

On the following pages are several diagrams of the MDT keypad. A key may have different uses that depend upon what screen is visible. A diagram is laid out for each of the most important screens, and each key on the diagram is labeled by its use for that screen. The effects of the keys are described below the diagrams.