Dipstick® 2277 Road Profiler Operator's Manual

with

RoadFace® Data Collection Program 6.7x
And RoadFace 6.1x
April 2017

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OVERVIEW OF THE DIPSTICK® 2277

Operation
The Dipstick® 2277 is the latest in the 2200 series of Dipsticks®. It has all the benefits of the earlier 2000, 2200 and 2272, plus some important new features.

The Dipstick® 2277 Road Profiler stands on two support legs. The operator simply "walks" the Dipstick® along a survey line alternately pivoting the instrument about each leg. Two digital displays show the elevation difference between the Dipstick's® two support legs. Audible and visual signals alert the operator when each elevation difference reading is measured and automatically recorded.

Advantages
The Dipstick® 2277 Auto-Read Road Profiler is a totally integrated data collection instrument that provides a fast and accurate method of measuring roads, bridges, and runways.

- Extraordinarily bright tablet screen – brighter and easier to read in sunlight than a smart phone. (NEW)
- Uses an embedded virtual keyboard so there is no chance of getting water or sweat into the keyboard (NEW)
- Instantly calculates IRI on-site
- Instantly produces graphs on-site
- "Drag & Drop" downloading to desktop or laptop computer
- Automatic electronic zeroing
- Print reports to any network or direct printer using the RoadFace analysis program
- Is delivered as a complete kit in a custom Zero Haliburton case – everything you need.

Fast, Easy and Compact
- Measure, analyze and report up to 1200 ft per hour
- Instant on-slab IRI analysis
- Complete kit is sized as carry-on luggage
- Is extremely fast, efficient and accurate — this is the fastest Dipstick® ever

Accurate
- IRI and elevation data proven over millions of measurements
- Class I instrument approved by state, federal and foreign governments
- This instrument is used to calibrate other profiling instruments
- The most accurate floor measuring instrument made
- Comes with QC Test data and instructions on how to self-test, so you never need to send it to us for calibration.

Versatile Road Instrument
- Only Dipstick® can be stepped over cords, rebar and debris
- Only Dipstick® can be used to set forms
- Only Dipstick® can be used to check beams and girders

Everything Included
- LED Voltmeter for measuring Battery Handle voltage is built into the Handle Mount (NEW)
- Much larger and much brighter tablet viewing screen (NEW)
- Windows® CE 6 tablet and Windows® compatible software for your PC included (NEW)
- Rechargeable on-board power system
- Comes equipped with a Windows CE version 6 touch screen tablet computer
- Works with all Windows® operating systems including Windows® 10
- Blazing fast "Drag and Drop" data transfer to your PC
- Print from your PC to any printer - network or local, B & W or color
- Many Reports created for you which can be edited in your favorite word processing software
- Touch screen & virtual keyboard interface
- Includes the latest RoadFace™ analysis program and the 2277 RFCollect™ program
HOW TO USE THIS MANUAL

This manual shows you how to collect data with the Dipstick® 2277, as well as how to process and report the data. It will show you how to manipulate the data on either the 2277 Windows CE 6 touch-screen 2277 Tablet that mounts on the Dipstick®, or on the RoadFace analysis software that resides on your desktop or laptop PC.

The Dipstick's Windows CE tablet runs the RFCollect program (RFCollect) which allows you to collect, edit, and report your data. Because the editing portions of the menu on the Windows CE tablet is virtually identical with the RoadFace analysis program on your desktop PC, the menus and commands are nearly identical. Chapter 5 of this manual will identify any differences and explain how to operate in either the RFCollect program (RFCollect_2277) or the RoadFace desktop analysis program.

This manual is laid out in the order that you will probably use the program - first collect some data, then process and report it.

If you want to collect some new data, and if you have never done this before, you should read Chapters 1, 2, and 3 in this manual. These are quite short – Chapters 1 & 2 are only 4 pages each, with lots of photos & diagrams.

If you just want to process/edit/report some existing data, you can skip to Chapter 5, Processing Data.
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It’s important that you learn to identify each part of the DS2277 Kit.

Please inspect each part carefully. If any parts are missing or appear damaged, call The Face Companies at 1-800-FNUMBER or (757-624-2121) immediately.

Cables, Software, Manuals and the Warranty are all found under the top foam lid of the Dipstick® case.

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The Dipstick® 2277 Case

Behind the Top Foam Lid
READ THIS NOW

The 2277 tablet computer used on the Dipstick® is different from anything you have used before.

Read these two pages before doing anything else, and read Chapter 6 (all about the 2277 Tablet) as soon as you can. Here’s what you need to know right now:

1. **When you turn off the computer, press and hold the On/Off button until you see this icon. This is very important. Remember this and do this.**

   ![Stylus](Image)

   - **RFDC startup Icon**
   - **Power Properties**
   - **Brightness control**
   - **Calibrate Stylus**
   - **Power Indicator (green/red/black)**
   - **Reset Button**
   - **“Get Desktop” Icon**
   - **“Get Keyboard” Icon**
   - **Touch Screen**
   - **Face Co. SD Card (on side)**
   - **Rubber Port Cover**
   - **AC Power Socket (on side)**
   - **On/Off Button**

   If you simply press and release the ON/Off button, the tablet will close the screen *but will keep running and will burn up power while it does this.* The next time you try to turn it on, it will be dead. If you try to turn it on but it does not come on when you press the On/Off button, almost certainly you have not actually turned it off, but you have only turned off the screen. **Press and hold the On/Off button until you see this icon.**
Introduction to the 2277 Tablet Computer

2. **The 2277 Tablet is brighter than anything you have ever used before.** You can read it easily in bright sunlight. It takes power to keep the screen this bright, so you’ll need to keep track of the power in the computer battery and the Handle Battery. You can check the computer’s power by double-tapping the **Power Properties** icon, and you can see the power in the Handle Battery by watching the **LED voltmeter**. You can get a quick check on the computer power by looking at the **Red/Green/Black power indicator**. **Green** means the tablet is fully charged, **red** means that the computer is being recharged from an outside source, (the AC Adaptor or the Handle Battery) and **black** means that the tablet is running on its own power. (no external power available) The Power Properties and the LED voltmeter provide the details. The Red/Green/Black power indicator is only a rough quick check.

3. **You should adjust the brightness** by double-tapping the **Backlight Control**. Turn it all the way up for use outside in bright sunlight, and turn it down for use indoors. Turning it down will greatly extend the life of the computer battery and Handle Battery.

4. **The most important thing to remember is to press and hold the On/Off button until you see this icon.**

5. Any time you remove and replace the Face Company SD card, **be sure to put the card in as shown in the photos below, with the face of the SD card towards the ground.**
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ASSEMBLING THE DIPSTICK® 2277

BEFORE YOU START:
• Ensure that the Face Company’s Data Collection program SD card is in the slot on the right side of the 2277 computer. Be sure the Dipstick® and the 2277 Tablet are both fully charged. (See Chapter 7, Maintenance)

SET UP THE DIPSTICK®
• Extend the kickstand from underneath the Dipstick® unit and let the Dipstick® rest on the kickstand.

TURN ON THE DIPSTICK®
• Flip the on/off switch at the start end of the Dipstick® up to turn on the Dipstick®. As the Dipstick is coming on, you will notice the L.C.D. screens blink. The L.C.D. screens will then display readings. If the computer connector cable (“coily” cord) is connected to the Dipstick before turning the Dipstick on, the beeper will sound 3 beeps to let you know that the connections are good from the Dipstick to the handle mount.
• The Dipstick should be warmed up for at least 5 minutes before zeroing (Chapter 2) or collecting data. (Chapter 4) Turning the Dipstick on now will ensure that it is fully warmed up by the time the Dipstick is completely assembled and is ready to collect data.
CHAPTER 1  ASSEMBLY

ASSEMBLE THE HANDLE, THE 2277 TABLET COMPUTER, AND CLAMP

- The handle section with the black ball is the top section. The other section is the lower section or Battery Handle. It contains a set of rechargeable batteries to provide power for the 2277 Tablet computer.
- Screw the lower section onto the Dipstick body stud and snug it down.
- Place the computer clamp assembly over the threaded stud on the bottom handle section. Be sure the beeper and LED Voltmeter on the computer clamp are facing up.
- Align the Tablet so that it is over the “Start” end of the Dipstick.
- Screw the top handle section onto the threaded stud on the bottom handle section sticking through the computer clamp assembly and snug it down.

ADJUST THE COMPUTER CLAMP ASSEMBLY
The computer clamp assembly functions as a rotary desktop as well as a clamp that holds the computer to the Dipstick®. The two 1/8” set screws on the side of the Handle Mount provide the friction that holds the desired angle for the desktop. Once the desired position is obtained, tighten up the set screws enough to provide adequate friction, but do not overtighten.
CHAPTER 1 ASSEMBLY

VERIFY THAT THE 2277 TABLET IS CONNECTED TO THE SERIAL CABLE
The serial cable underneath the handle mount needs to be connected to the left side of the Tablet. You can leave it connected, even when it is in the case.

CONNECT THE POWER CABLE TO THE TABLET
Connect the clear power cord from the lower handle section to the side of the Handle Mount and connect the black power cord from underneath the Handle Mount to the right side of the Tablet as shown in the photo on the previous page. The Handle Battery provides power to the Tablet computer. If the Tablet and the Handle Battery are both fully recharged, you can run it for more than 8 hours on a single charge. Note that the LED Voltmeter measures the available voltage in the Handle Battery (not the voltage in the Dipstick). There is a menu item on the Tablet’s data collection program that allows you to monitor the voltage in the Dipstick.

PLUG IN THE DIPSTICK® COMPUTER CONNECTOR CABLE
Plug one end of the Dipstick® computer connector cable (the black "coily" cord) into the phone jack connector on the Dipstick®, and the other end into the large phone jack on the Handle Mount.

PLUG IN THE TRIGGER CONNECTOR
(All Road Dipstick Profilers come with a "Trigger" handle)
Plug the phone cord "pig tail" cable from the top handle section into the small phone jack connector on the Handle Mount. It will only fit in one of the two sockets.
CHAPTER 1 ASSEMBLY

TURN ON THE 2277 TABLET
Press the <On/Off> key at the lower right corner of the Tablet. The Tablet’s screen will show a “Windows Smart” picture with a green bar below it, then a white line will cross the screen from left to right, and the Data Collection program will start automatically.

- Starting from the Windows CE Desktop
If the Tablet is on but the Data Collection program is not running, you may start the program from the Windows CE Desktop by double-tapping the red and blue “Face” icon for the RFDC program. (near the left side of the screen)

- Starting from the Executable
You may start the program by double-tapping the "My Device" icon, then double-tapping the "NandFlash" Folder, then double-tapping the "RFDC2277" folder, then Doubletapping the RFCollect.exe icon.

At this point, the Dipstick 2277 is assembled and ready. Zeroing and elementary data collection are covered in the next two chapters.
CHAPTER 2 - ZEROING

ZEROING THE DIPSTICK®

WHAT IS ZEROING?
Zeroing is the process that insures that a Dipstick® reads accurately by making it read the same when it is turned “end-for-end.” It is similar to the zeroing process done with precision “bubble” type levels.

WHEN TO ZERO THE DIPSTICK®
The Dipstick® should be either checked for zeroing or zeroed before each data gathering session – every time you turn it on. If you shut your Dipstick® off for more than a couple of hours, you should rezero. You do not need to rezero between Runs.

MANUAL OR COMPUTERIZED ZEROING
Your Dipstick® can be zeroed from within the Data Collection Program by using the zeroing routine. It can also be zeroed without the computer attached by using the electronic zeroing button. There is no difference in accuracy between the two methods. We'll show you both ways.

PREPARE THE DIPSTICK® AND THE SURFACE
Be sure that the Dipstick® unit is fully charged and has warmed up for at least 5 minutes. Turn the Dipstick® on as soon as you open the case. This way, it will be fully warmed up when you are finished assembling it and are ready to zero it.
Assemble the Dipstick® as described earlier.
Place the Dipstick® on a firm, flat, smooth, solid surface and extend the kickstand.
Use a felt tip marker or “keel” (provided) to draw one long straight line (longer than the Dipstick®) and a shorter line perpendicular to the long line at one end. You may also use an intersection of sawcut joints or the joints between ceramic tiles.

Lines made with marker or “keel” or two intersecting sawcut joints

Place Moon Feet here

One of the “Moon Feet” will be placed tangent to both lines, and the other moon foot will be placed tangent to the long line. In this way, you will be able to relocate the Dipstick® to the exact same position during the zeroing process.
CHAPTER 2 - ZEROING

A “Moon Foot”

Place the Dipstick® Moon Feet Tangent to the Two Lines as shown below.

ZEROING USING THE 2277 COMPUTER

Turn On the 2277 Tablet Computer and start the RFDC program. Tap the "Collect" header, then hold the Dipstick® still with the handle straight up and down and tap the menu item “Zero”.

The L.C.D. screens on the Dipstick® will flash “CAL - CAL - CAL” as shown here.

Once the reading is taken and stored in the Dipstick®, the L.C.D. screens will turn back on and the computer will show this statement:

Please Rotate the Dipstick and click OK

Lift and rotate the Dipstick® 180 degrees (end for end) placing the Moon Feet tangent to the two lines again, and press <Enter>. The Dipstick® will flash “CAL - CAL - CAL” again. Once the second reading is taken and stored, the Dipstick® is zeroed.
CHAPTER 2 - ZEROING

You may check the Zero if you like:
Set the Dipstick® on two fixed points and note the L.C.D. readings. (You may use the two lines you already have drawn.) Then pick up the Dipstick® and reverse it end for end, taking care to place the feet down on the exact same spots where they were before. Now check the L.C.D. reading values again. If the L.C.D. readings are the same with the Dipstick® in either position, then the Dipstick® is zeroed. If the zeroing is not within .003” (0.1mm) it should be rezeroed before data is collected.

If zeroing is not within +/- .003” (0.1mm):
- Check for loose feet or a loose jam nut.
- Also check for dirt or other debris on the bottom of the feet or the surface,
- Ensure that you are placing the Dipstick® in exactly the same location.

Repeat the zeroing process until both L.C.D. screens measure the same reading (within +/- .003” or 0.1mm) with the Dipstick® in either position.

ZEROING WITH THE BUTTON
The Dipstick® unit may be zeroed using the black zeroing button located on the switch end of the unit. This method can be used even if the 2277 Tablet is not attached or is not turned on.

Place one Moon foot tangent to both lines, and place the other Moon foot tangent to the other line. Press the zeroing button.

The L.C.D. screens will flash “CAL - CAL - CAL” Once the reading is taken, the L.C.D. screens will turn back on and the Dipstick® may be rotated. Lift and rotate the Dipstick® 180 degrees (end for end) placing the “Moon Feet” tangent to the two lines again. It is very important to get the Dipstick® aligned exactly as it was before.

Press the zeroing button again.
The Dipstick® will flash “CAL - CAL - CAL” again. Once the Dipstick® has finished zeroing itself, the L.C.D. screens will turn back on.

Something to Remember: After zeroing by using the zeroing button, you cannot re-zero until you turn the Dipstick® off and then back on. Turning the Dipstick® off momentarily and then back on resets the zeroing algorithm stored on a microchip inside the Dipstick®. This enables you to re-zero with the button.
CHAPTER 2 - ZEROING

Important:

You should understand that the "Zeroing" process does not result in the Dipstick® showing "0.000" or "Zero" as a reading.

The Dipstick will always show the difference in elevation between the two feet, no matter where they are placed on the floor. It is almost impossible to find a location where two points that are 12 inches (300mm) apart are at exactly the same elevation. It just doesn’t happen. On a real floor, one end will always be a few thousandths of an inch (a few tenths of a mm) higher than the other.

The zeroing process simply ensures that the Dipstick® will give the same reading at a particular location, regardless of which end of the Dipstick® is "forward". When you think about it, this makes sense.

Note that after the Dipstick is Zeroed, it will read the same after you turn it 180° and put it back in the same place on the floor.
CHAPTER 3 QUICK START

QUICK START

This “QUICKSTART” section of the manual will tell you how to do basic data collection and elementary analysis and reporting from the Dipstick® and its Tablet. After you have practiced and are comfortable with this, you will want to learn about the advanced features that are built into the Dipstick® and will make data collection and analysis easier and more informative. These advanced techniques are covered in Chapter 4 "Collect" and Chapter 5 "Process" of this manual.

By following along with the instructions in this section you will be able to collect and process data. If this is the first time you have used a Dipstick®, we suggest that you collect and process some data for practice in your office, hallway, driveway, or parking lot before going to a job site.

Before you collect data, you must first:
Assemble the Dipstick, (Chapter 1) Zero the Dipstick, (Chapter 2) turn on the 2277 Tablet, and start the Data Collection Program (RFCOLLECT2277).

TO START THE DATA COLLECTION PROGRAM:

Turn on the 2277 Tablet and start the RFCOLLECT program. There are three methods to start the program: Please be sure that the Face Company's SD Card is in the slot on the right side of the computer before you start.

- **Auto Startup**  Any time you reboot the computer, the program will start automatically. You don’t need to do anything but reboot.
- **Starting from the Windows CE Desktop**  You may start the program from the Windows CE Desktop by double-tapping the icon for the RFCollect program.
- **Starting from the Executable**  You may start the program by double-tapping the "My Device" icon, then double-tapping the “NandFlash” folder, then double-tapping the "RFCOLLECT2277" folder, then double-tapping the "RFCollect.EXE" icon.

When the Data Collection program starts, it will automatically open the last Job you had open. You may continue to collect data in this Job if it is appropriate, or you may wish to open a different Job or make a New Job before collecting data.

USING THE TOUCH SCREEN:

If you touch (lightly tap) the screen with the stylus provided, the cursor will snap to that point. If you double-tap, you'll get the same response you normally get when you double-click. We have provided you with a spare stylus in the foam in the case next to the Dipstick® unit, in case you should lose a stylus. You may use your fingernail or other similar object, but be careful not to scratch the screen. Obviously, you won't want to touch the screen with a pencil or pen. This manual will not describe where to tap for each menu item, because it works exactly like using a mouse on your desktop PC.
WITHIN THE MENUS:
Using the stylus, just tap the menu item you want to use, then tap a command on the drop-down menu, just as if you were using a mouse on a desktop PC. If you fail to fill out some required information, the window will not close until you enter the required information.

OPENING AN EXISTING JOB AND MAKING A NEW JOB:
The program will automatically open your last job. If you want to open a different Job, this is similar to opening a file in any other program. Tapping FILE/OPEN will open a selection window, showing all folders on the storage card where data are stored. Folders that contain RoadFace data are shown with a blue folder icon instead of the normal tan color. This makes it easy to find data, because the program has "X-Ray Vision" that allows it to know which folders have RoadFace Data in them. You can open any Job by double-tapping it or by single-tapping, then tap OPEN JOB on the dialog box.

Sometimes you'll want to start a new Job, rather than collect data in an old Job. (Be sure to start a new Job every time you go to a different Job site.) To do this, just tap FILE/NEW, then type in the name of the new Job. Let the program choose where to store the data - on the SD (storage) Card.

CHECKING THE DIPSTICK® VOLTAGE:
After the Dipstick is assembled fully, you should check the Dipstick's voltage before you start collecting data. Tap COLLECT/VOLTAGE to check voltage in the Dipstick® itself.
- If you get a “Dipstick Not Responding” message, you do not have the Dipstick connected to the Handle Mount or there is a bad connection.
- When fully charged, the Dipstick voltage will be over 13V. Anything over 11V is OK.

The Dipstick will operate properly and collect data until the voltage drops to about 10.5V. Whenever the Dipstick® voltage drops below about 10.7 Volts, you'll see a "LOW BAT" warning in each of the Dipstick's two LCD screens. This means that you have a short time left to collect data before recharging the Dipstick. You'll be able to collect one or two more Runs when you get the "LOW BAT" warning, but don’t expect to be able to collect all day long after you get a "LOW BAT" warning. If the voltage drops below 10.5 Volts, the Dipstick will beep 3 times and display "OFF." At this point, the Dipstick will no longer collect data, and you must recharge it or exchange batteries. Please note that if the Dipstick allows you to collect data, it will be good data. The Dipstick will shut itself down before the voltage gets too low to collect good data.

CHECKING HANDLE BATTERY VOLTAGE:
It is important to keep the Dipstick® Handle Battery fully charged and to always use the Handle Battery to power the 2277 Tablet. Otherwise, you'll only be using the 2277 Tablet’s battery, and you run the risk of losing power to the 2277 Tablet while collecting data. This is particularly important if you have the screen brightness turned up on the 2277 Tablet. Charging the Handle Battery is covered in Chapter 7, Maintenance. If you charge the Handle Battery and the 2277 Tablet properly, it will give you more than a full day’s service. If you charge the Handle Battery every night before using it the next day, you will not run out of battery power. Do NOT risk having the 2277 Tablet shut down during data collection because it has no power. The green LED on the Handle Mount shows the voltage in the Dipstick's Handle Battery. Remember, this is the Handle Battery voltage, and it supplies extra power to the Tablet. When the Handle Battery voltage drops below 10.5V, the Dipstick will shut itself down before the voltage gets too low to collect good data.
Battery is fully charged, it should show about 13.5 volts. As the Tablet uses up the power available in its’ internal computer battery, the Tablet will “Top itself off” from the Handle Battery. This means that the Handle Battery will get drained first. So long as the power in the Handle is over 8-9 volts, the Handle Battery will supply power to the Tablet. Below 8 volts, the Handle Battery will still supply power to the Tablet, but not the total amount that the Tablet needs, so at this level, the Tablet begins to start to drain its internal battery. The LED just above the Tablet’s “On/Off” button will be both green and red when it is fully charged. When the Tablet is being fed by the Handle Battery, this LED will be red. This LED will stay red so long as the computer is getting more than about 5 volts from the Handle Battery. When the Handle Battery drops below about 5 volts, this LED will turn black.

CHECKING THE VOLTAGE IN THE TABLET:

You can see the voltage in the Tablet’s internal battery by going to the Tablet’s desktop and tapping the shortcut to Power. This will take you to the computer’s "Power Properties" window, Where you can see the percentage of power remaining in the computer’s internal battery. To open the battery power window, tap the icon in the Tablet’s lower right corner that looks a little like a series of folders stacked one behind the other. When you tap this icon, a menu item “Desktop” will appear. Tap this “Desktop” icon, and the RFCollect program will disappear behind the Tablet’s desktop. Now double-tap the “Shortcut to Power” and you’ll see the Tablet’s power properties. The important thing is the Remaining Power %. This tells you the percentage of a full charge that exists in the Tablet’s internal battery.

ZEROING:

Zeroing has been covered in detail in Chapter 2. Be sure that your Dipstick® is Zeroed before collecting data.

HARDWARE AND RUN INFORMATION SETTINGS:

Tap SETTINGS/HARDWARE to open the Hardware Settings screen. This screen allows you to change the Dipstick parameters before you start collecting data. You’ll learn more about RPH, Type, Averaging, Beeper, Foot Spacing, and Allowable Difference in the COLLECT DATA chapter later on.

WARNING

Be sure you know what you are doing before changing the Dipstick® between Imperial and Metric, or changing the footspacing. For now, just leave the Dipstick® footspacing set how it was when you got it. Tap OK to accept the settings, or Cancel if you don’t want to change anything.

Tapping SETTINGS/RUN INFORMATION will open a dialog box that allows you to set some default settings for the individual sample measurement line (“Run”) of data that is to be collected. For now, just leave the Run Information set how it was when you got it, and insert your name as the operator. You’ll learn more about Data Collection Bias, Design Slope, Start Point Elevation, and Elevation Tolerance in the COLLECT DATA chapter later on. The “Operator” field identifies who is taking the data. Be sure to change the Operator Name every time a new operator uses the Dipstick®. This is an optional field, but we do recommend that you use it. For now, leave everything else alone.
CHAPTER 3 QUICK START

START A NEW RUN

To begin data collection, tap COLLECT/NEW RUN. Type in a run name that will identify this run of data for you. Choose a name that will help you remember where this data came from, perhaps a station number and direction of travel. Verify that the other information (from SETTINGS/RUN INFORMATION) is correct. Change anything that you need to change, and tap OK to bring up the Data Collection Screen.

When the next screen appears, you are ready to collect data. Place the Dipstick® battery end foot on the start point of the survey line with the start arrow (the switch end of the Dipstick®) pointed forward.

WALK THE DIPSTICK® DOWN THE TEST LINE

Single-tap the "Start" button on the screen and hold the Dipstick steady, then press the Trigger and wait until the Dipstick® takes the first reading. You always press the trigger from front to rear. Once a reading has been captured, the beeper will sound. This is the signal for you to rotate the Dipstick. The large reading number tells you how many steps you have taken. You must press the Trigger button before the Dipstick will attempt to collect the next reading. The Dipstick will produce a graph from any length line, as small as 1 step (normally 1-ft, 300mm, or 250mm) but you must collect at least 37 ft or 11.1 meters of data for the Dipstick to have enough data to produce an IRI.

END THE RUN

To terminate data collection and view the graphic display and IRI for the run, tap the "Stop" button on the screen. The 2277 will automatically display a graph of the data you have just collected. The name of the Run is shown at the top of the graph and the IRI is shown at the bottom of the graph.

Tap the "Close" box at the upper right corner to close the graph display.
CHAPTER 3 QUICK START

START ANOTHER RUN
You may now start a new run the same way you did the last one.

TO VIEW REPORTS ON THE 2277 COMPUTER
You can get any and all reports right on the RFCOLLECT menu on the 2277 computer. Single-Tap the Run you are interested in to make it dark. Tap the REPORT Menu header with your stylus, then tap the Run report you want to see. You can view the Readings and elevations of all points on the Run by using REPORT/DATA POINT LISTING. You may read any Notes that you collected during the Run, or you may bring up a Graph of the Run profile. These report features are covered in detail in Chapter 5 (PROCESSING DATA) of this manual.

Once you download this data to your desktop PC, you'll be able to print any of these reports from the RoadFace program on your PC to any printer connected to your PC, either local or network.

TO EDIT DATA THAT YOU HAVE ALREADY COLLECTED
You can EDIT Runs right on the RFCOLLECT menu. Just Tap EDIT, then the Edit feature you want.

When you are familiar and comfortable with basic data collection and reporting, you should learn about the other features built into the Dipstick®. These include Editing data, collecting data in "Boxes" for longitudinal profiles, and more. These editing features are covered in detail in Chapter 5 (PROCESSING DATA) of this manual.

If you had any problems collecting data, you will want to do it again for practice. Chapter 8 is "TROUBLESHOOTING" for when you get stuck.
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COLLECTING DATA

WHAT THE ROADFACE™ DATA COLLECTION PROGRAM DOES
The RoadFace Data collection program, known as RFCollect, will allow you to collect, store, edit and report profile data. This section will explain how to set up the Dipstick®, and collect data.

UNDERSTAND THIS BEFORE YOU START:
HOW & WHERE THE DATA ARE STORED
Your data is kept for you in folders on the 2277 Tablet's “Storage Card” (Face Company SD Card). This database is in a special format that makes it easy to store, display, process, and compare data. When the Data Collection program starts, it will automatically open the last Job you had open. You may continue to collect data in this Job if it is appropriate, or you may wish to open a different Job or make a New Job before collecting data. When you create a job, the program will prompt you for the folder name for the new job. It is important for you to go to the "FILE" menu and start a new Job for each different project. If you do not create a "New Job" when you start a new job, all your data files will be stored in the same folder.

TERMINOLOGY
The program will keep track of your data for you, in one folder for each construction site, or "Job." Within the RoadFace program, the term "Job" will refer to the folder where all the data from one project is stored. A "Run" is a straight test line that must be at least 37 steps long to calculate an IRI.

There are just a few things you need to know about using the RoadFace® Data Collection Program on the HP720. If you read this section carefully, you won't have any problems using the Dipstick®.

USING THE TOUCH SCREEN:
If you touch (lightly tap) the screen with the stylus provided, the cursor will snap to that point. If you double-tap, you'll get the same response you normally get when you double-click. We have provided you with a spare stylus in the foam in the case next to the Dipstick® unit, in case you should lose a stylus. You may use your fingernail or other similar object, but be careful not to scratch the screen. Obviously, you won't want to touch the screen with a pencil or pen. This manual will not describe where to tap for each menu item, because it works exactly like using a mouse on your desktop PC.

WITHIN THE MENUS:
Using the stylus, just tap the menu item you want to use, then tap a command on the drop-down menu, just as if you were using a mouse on a desktop PC. If you fail to fill out some required information, the window will not close until you enter the required information.

Before you collect data, you must first assemble and Zero the Dipstick®, turn on the 2277 Tablet, and start the Data Collection Program. Zeroing has been covered in detail in Chapter 2. Be sure that your Dipstick® is Zeroed before collecting data.
TO START THE DATA COLLECTION PROGRAM:

Turn on the 2277 Tablet and start the RFCOLLECT program. There are three methods to start the program: Please be sure that the Face Company's SD Card is in the slot on the right side of the computer before you start.

- **Automatic Startup** Any time you reboot the computer, the program will start automatically. You don’t need to do anything but reboot. This is the normal method.
- **Starting from the Windows CE Desktop** You may start the program from the Windows CE Desktop by double-tapping the icon for the RFCollect program.
- **Starting from the Executable** You may start the program by double-tapping the "My Device" icon, then double-tapping the "NandFlash" folder, then double-tapping the "RFCOLLECT2277" folder, then double-tapping the "RFCollect.EXE" icon.

CHECKING THE DIPSTICK® VOLTAGE:

After the Dipstick is assembled fully, you should check the Dipstick's voltage before you start collecting data. Tap COLLECT/VOLTAGE to check voltage in the Dipstick itself.

- If you get a “Dipstick Not Responding” message, you do not have the Dipstick connected to the Handle Mount or there is a bad connection.
- When fully charged, the Dipstick voltage will be over 13V. Anything over 11V is OK. The Dipstick will operate properly and collect data until the voltage drops to about 10.5V. Whenever the Dipstick voltage drops below about 10.7 Volts, you'll see a "LOW BAT" warning in each of the Dipstick's two LCD screens. This means that you have a short time left to collect data before recharging the Dipstick. You'll be able to collect one or two more Runs when you get the "LOW BAT" warning, but don’t expect to be able to collect all day long after you get a "LOW BAT" warning. If the voltage drops below 10.5 Volts, the Dipstick will beep 3 times and display "OFF." At this point, the Dipstick will no longer collect data, and you must recharge it or exchange batteries. Please note that if the Dipstick allows you to collect data, it will be good data. The Dipstick will shut itself down before the voltage gets too low to collect good data.

CHECKING HANDLE BATTERY VOLTAGE:

It is important to keep the Dipstick Handle Battery fully charged and to always use the Handle Battery to power the 2277 Tablet. Otherwise, you'll only be using the 2277 Tablet's battery, and you run the risk of losing power to the 2277 Tablet while collecting data. This is particularly important if you have the screen brightness turned up on the 2277 Tablet. Charging the Handle Battery is covered in Chapter 7, Maintenance. *If you charge the Handle Battery and the 2277 Tablet properly, it will give you more than a full day’s service.* If you charge the Handle Battery every night before using it the next day, you will not run out of battery power. Do NOT risk having the 2277 Tablet shut down during data collection because it has no power. The green LED on the Handle Mount shows the voltage in the Dipstick's Handle Battery. Remember, this is the Handle Battery voltage, and it supplies extra power to the Tablet. When the Handle Battery is fully charged, it should show about 13.5 volts. As the Tablet uses up the power available in its’ internal computer battery, the Tablet will “Top itself off” from the Handle Battery. This means that the Handle Battery will get drained first. So long as the power in the Handle is over 8-9 volts, the Handle Battery will supply power to the Tablet. Below 8 volts, the Handle Battery will still supply power to the Tablet, but not the total amount that the Tablet needs, so at this level, the
Tablet begins to start to drain its internal battery. The LED just above the Tablet’s “On/Off” button will be both green and red when it is fully charged. When the Tablet is being fed by the Handle Battery, this LED will be red. This LED will stay red so long as the computer is getting more than about 5 volts from the Handle Battery. When the Handle Battery drops below about 5 volts, this LED will turn black.

CHECKING THE VOLTAGE IN THE TABLET:
You can see the voltage in the Tablet’s internal battery by going to the Tablet’s desktop and tapping the shortcut to Power. This will take you to the computer's "Power Properties" window, Where you can see the percentage of power remaining in the computer’s internal battery. To open the battery power window, tap the icon in the Tablet’s lower right corner that looks a little like a series of folders stacked one behind the other. When you tap this icon, a menu item “Desktop” will appear. Tap this “Desktop” icon, and the RFCollect program will disappear behind the Tablet’s desktop. Now double-tap the “Shortcut to Power” and you’ll see the Tablet’s power properties. The important thing is the Remaining Power %. This tells you the percentage of a full charge that exists in the Tablet’s internal battery.

SAFE DATA COLLECTION
The key to safe data collection is to download daily. This gives you two copies of the data, stored on two different computers, so you have some redundancy in case something happens to one of the computers.

OPENING AN EXISTING JOB AND MAKING A NEW JOB:
As stated earlier, the program will automatically open your last job. If you want to open a different Job, this is similar to opening a file in any other program. Tapping FILE/OPEN will open a selection window, showing all folders on the storage card where data are stored. Folders that contain RoadFace data are shown with a blue folder icon instead of the normal tan color. This makes it easy to find data, because the program has "X-Ray Vision" that allows it to know which folders have RoadFace Data in them. You can open any Job by double-tapping it or by single-tapping, then tap OPEN JOB on the dialog box.

Sometimes you’ll want to start a new Job, rather than collect data in an old Job. To do this, just tap FILE/NEW, then type in the name of the new Job. Let the program choose where to store the data - on the SD (storage) Card.

HARDWARE AND RUN INFORMATION SETTINGS:
Tap SETTINGS/HARDWARE to open the Hardware Settings screen. This screen allows you to set the survey speed, select or deselect the Trigger, set your Beeper louder or quieter, and choose how you want the Dipstick to capture data. We’ll cover these one by one below.
CHAPTER 4 COLLECT

RPH (Survey Speed, in Readings Per Hour)

- **600**
- **750**
- **900**
- **1050**

The Survey Speed setting changes the length of time between successive Dipstick readings while in the Auto Read Mode. As soon as the Dipstick starts to move to the next reading position, the LCD screens will go blank and the 2277 Tablet stops polling the output for a preset period of time determined by the selected survey speed. This blanking period allows the operator to rotate the unit without any chance of taking a false reading. After this preset pause, the 2277 Tablet again starts to poll the internal sensor. Horizontal lines across the L.C.D. screens indicate “Blank” out time, or “Sleep” time. When a single short vertical line appears, the Dipstick is “polling” the sensor. (trying to get a Reading) When you first start using the Dipstick, you should start with the “600 readings per hour” setting. After you gain some experience, if you find yourself waiting for the Dipstick to collect a reading, you should switch to 750 readings, and then 900 readings per hour, and even to 1150 readings per hour as you get even faster. **Again, if you are using the Trigger, you can ignore RPH.**

√ TRIGGER

Putting a check mark (√) into this box means that you are going to control data acquisition by using the Trigger. **This is the normal method for collecting data using a Road Dipstick.**

- **Imperial**
- **Metric**

This field allows you to change your Dipstick from **Imperial** mode to **Metric** mode. You can change between Metric and Imperial and use different foot spacings in either mode. Make sure that this setting corresponds to the type and spacing that you are using to collect data.

**WARNING**

Be sure you know what you are doing before changing the Dipstick between Imperial and Metric, or changing the footspacing.

FOOT SPACING

This field tells the computer what distance you set between the Dipstick’s feet. It is only changed when you actually move the feet to other spacings from the original configuration. **Do not change this setting without knowing the exact footspacing or you may collect bad data.** Entries are made in inches (for the Imperial Dipstick) or in mm (for the Metric Dipstick). When you change the foot spacing in the RFCollect Program, the software will automatically adjust the Dipstick readings to match the newly set footspacing.

**Here’s how Foot Spacing works:** You screw the “Feet” into the holes on the underside of the Dipstick, or to the Variable Spacer Bar. There are three pairs of holes built into the metal bar on the bottom of the Dipstick. There is one pair that is exactly 12.000 inches apart, one pair that is 300.0 mm apart, and one pair that is 250.0 mm apart. Each one of these holes is marked, either “12”, “300”, or “250”.

- Screw the Moon Feet into the appropriate pair of holes and tighten them securely. (Your Dipstick came from our lab already set up for the Foot Spacing your company asked for)
- Using SETTINGS/HARDWARE, verify that the Type (Imperial or Metric) and Foot Spacing (12”, 300 mm, or 250 mm) matches the actual foot spacing on the Dipstick.
CHAPTER 4  COLLECT

- Tap “OK” and you are ready to go. It’s that simple.

But you must remember to change the Foot Spacing under SETTINGS/HARDWARE if you ever move the Moon Feet to different holes.

And if you use the Variable Foot Spacer Bar, you must be certain to use the correct pairs of holes in the bar, and you must change the Foot Spacing under SETTINGS/HARDWARE to match the actual Foot Spacing. The Variable Foot Spacer Bar has several different pairs of holes at smaller spacings for you to use when you want a shorter data interval.

Low  BEEPER SETTING
Medium
High
No Beep

This allows you to determine the duration of the “Beep” that sounds after a reading has been captured. You may set the beeper from “Low” to “High,” or you may select “No Beep” if you need to collect data silently. The longer the beep, the louder it sounds. The recommended normal setting is “Low.” Even at the “Low” setting, it is loud enough to hear under ordinary conditions. If there is a lot of background noise, you can use the higher settings. The “Beep” at the higher settings lasts considerably longer than at the “Low” setting, so if there is a momentary noise, it will not obscure the “Beep”. Note: You do NOT need to wait until the end of the beep to turn the Dipstick. You can start turning as soon as you hear the beep.

2 Identical  AVERAGING
2 Avg
4 Avg
8 Avg

- 2 Identical  (This is the normal mode.)

When using 2 Identical, you can skip over the Averaging and Allowable Difference boxes. This selection will cause the Dipstick to capture data from the internal sensor after it has settled down and two identical readings in a row are produced. When the Dipstick's internal sensor sends two identical readings in a row, the computer then knows the Dipstick is stationary and "captures" that reading. This is the normal method for collection data. You should use this method unless the surface is unstable or moving, such as on a bridge deck moving in the wind.

- Averaging  (This is for swaying or vibrating structures)

The Dipstick polls the internal sensor for a reading many times per second. When the surface is vibrating or the building is swaying (for example in the case of a bridge), the sensor inside the Dipstick will pick up these motions and change the readings on the L.C.D. screens. These motions may be quite small but because the Dipstick is able to measure them, variations as small as a thousandth of an inch will change the values between successive readings and not be captured in the traditional "2 successive identical readings" mode. If you collect data on bridges or similar structures, particularly when the wind is blowing or if there is heavy earthmoving equipment or jackhammers working nearby, your Dipstick may have trouble collecting data in the "2 Identical" mode. This is because the bridge or structure is swaying or moving. The movement may be so slight that you cannot feel it or see it, but since the Dipstick's sensor will detect motion as small as a thousandth of an inch, if the structure is moving even slightly, the sensor will see slightly different readings and will try to wait until the movement stops. If the structure
never stops swaying, the Dipstick will only be able to collect data very slowly, and only at those instances when the structure stops and changes direction.

Under these circumstances, you'll want to use the “Averaging” mode of data collection. You select the number of internal readings to average (either 2, 4, or 8) and you select the “allowable difference,” and the Dipstick does the rest. By doing this, the Dipstick will “damp out” the vibrations or swaying.

**Here's how “Averaging” works:**

The Dipstick collects a series of “internal readings” and holds them in its internal memory. It does this very quickly, many times per second. Then it averages these readings to get a “mean” or “average” value. It then checks to see how far each of the internal readings is from the mean or average. If all the readings are close to the average, it knows that this is a valid reading and stores it in memory, then Beeps to let you know it is time to turn the Dipstick and collect another reading. If any one of the 2, 4, or 8 readings is farther from the average than the “allowable difference” you specify, the Dipstick knows that the average may be skewed by the “bad” reading, and discards it. The Dipstick discards only the “bad” internal reading and any internal readings collected before the “bad” reading, retaining the readings that came in after the bad one, and collects however many readings it needs to get the 2, 4, or 8 that you have asked for. When it has collected a total of 2, 4, or 8 readings (whatever you specified) it will re-average those readings, then check each of those readings to see whether they are all close to the average. If they are close to the average, it saves the average reading as the next “reading” in the Run, and Beeps again to tell you it is time to turn the Dipstick. This all happens very very quickly.

**Data collected using the AVERAGING mode have been shown to be essentially identical to the data collected using the “2 identical” mode, particularly if you use a reasonably small number for the “allowable difference.”** Similarly, selecting a larger number of readings to average will also reduce the variability of a profile. There is no hard and fast rule about what number of readings to average and what value of “allowable difference” to use. It depends on how much the building or structure is swaying, and how quickly you can get an average reading that meets the criteria you set.

**We recommend that you try 0.004 as an allowable difference, averaging 4 readings.** This means that each of the four readings must be within 0.004” of the average. The worst reading can only be 0.004” away from the average. Because it is averaging 4 readings, the reading that is stored on the computer is likely to be within 0.0015” of the correct value, or even closer. If the Dipstick collects data rapidly using 0.004 and 4 readings, the structure is only swaying a small amount and this is a good setting. If the structure is moving rapidly, and the Dipstick is still slow collecting data, try using a larger “allowable difference" and collect 4 readings. For example, try 0.008 allowable and 4 readings. If it is still slow to collect readings because the structure is moving a lot, use a larger “allowable" value, but average more readings. You'd use 8 readings instead of 4. If you are working on a bridge or if there is excessive vibration in the road due to construction, averaging is probably the better way to collect data. If you are on a stable road where sway and vibration are non-existent, then “2 identical” readings will probably be a better choice.

**Number of Readings to Average**

When you select the averaging mode, you must also select how many readings in a row the Dipstick must average. You can select 2, 4, or 8 readings. You must also determine the allowable difference in the readings. Averaging 4 readings is a good choice and is the recommended normal setting.
CHAPTER 4 COLLECT

Allowable Difference
The allowable difference is the range that you allow the readings being averaged to vary from one another and still be valid. For example, if you set the averaging for 04 readings and set the allowable difference to .004" (.1mm), then the Dipstick will read the sensor output 4 times, compute the mean reading (average reading), and determine if any of the 4 readings vary more than .004" (.1mm) from the mean. If none of the four readings is farther from the mean than your allowable difference, the Dipstick will save that averaged reading to the SD Card. If one of the readings is more than .004" (.1mm) away from the mean, the computer will reject it and any readings that precede it. In this case, the Dipstick will collect readings to replace those that were rejected, will average the new set, and will compare each of the 4 readings to the new mean. The desired dimension, in inches for Imperial operation, or in millimeters for metric operation, is entered into the window. For example, the recommended settings would be entered as “0.004” in Imperial operation, and “0.1” in metric operation.

We suggest that the first time you try averaging, you select 4 readings to average, and an allowable difference of .004" (.1mm). You may wish to try different settings later.

RUN INFORMATION SETTINGS:
Tapping SETTINGS/RUN INFORMATION will open a dialog box that allows you to set some default settings for each individual sample measurement line ("Run") of data that you collect.

DATA COLLECTION BIAS
You normally leave this blank. This optional field is where you can enter the Data Collection Bias for the surface you are measuring. If a fixed Data Collection Bias is to be applied to all runs, it may be entered here. To learn more about Data Collection Bias, see Chapter 9, DATA COLLECTION BIAS. This is an optional entry item. You should normally leave this blank until after you have collected data in a Box, and the program will calculate the Bias and apply it automatically for you.

DESIGN SLOPE
You normally leave this blank. This optional field is where you can enter the Design Slope for the surface you are measuring. If a fixed Slope is to be applied to all runs, it may be entered here. This feature is only used when you are measuring a surface that has a uniform tilt, for example, a ramp or a drainage pan. This input causes the program to remove (mathematically) the design slope of an inclined (tilted) surface so you can measure the levelness as if it were horizontal.

The Design Slope input requires input in units of "inches per step or mm per step". If the project specifications are written in other units, they must first be converted to "inches per step" for the Imperial version of the Dipstick or "millimeters per step" for the Metric version. Be sure to use the correct foot spacing when computing this value. See page for a conversion table between percent slope and inches or mm per step.

You must be careful to ensure that only runs which run straight up or down the slab (the steepest way) carry the full design slope. You must also be sure to apply the correct sign (+/-) to each run. Runs that go uphill will require a positive (+) design slope. Runs that go downhill require a negative (-) design slope. Runs that go across the tilted slab, neither going up nor down, do not require any design slope. Runs that go up a tilted slab on a 45 degree diagonal will require .707
times the design slope. If you are measuring a tilted slab, you will find it convenient to measure all runs up the slab first, using the design slope, and then change the design slope to zero and make all the transverse (horizontal) runs. Be sure to remove the design slope from the Run Settings screen before you collect data on the next slab. This is an optional field, so you may leave this field blank unless the surface has a known uniform fixed slope.

Note: If you use the menu item CALCULATE/SLOPE, the program will calculate and remove the actual slope of the run for you. (The slope will be calculated from one end of the Run to the other) The program will automatically enter the calculated slope in this window for you. Again, you normally leave this field blank and let the program do the work.

START POINT ELEVATION
If you know the Start Point Elevation of a run, you may enter it now. The Start Point Elevation controls the elevations on the graph, but has no effect at all on IRI or any other roughness index. If no Start Point Elevation has been set, then the computer will best fit the graph on the Tablet’s screen by centering the profile about zero. (The profile will not start at zero, but the overall profile will be centered on zero.)

If you will be comparing elevations between points on a line for an engineering study, you may wish to select a Start Point Elevation of zero for the first line. If you are collecting data in sets of lines that touch each other, the Start Point Elevation of each line may be referred to a single point so that all lines reference a common datum. When you “UnBox a Run” (discussed later) the program will automatically calculate and set the start points for you.

If you are just collecting data to get an IRI, no Start Point Elevation is required. You may leave it blank, or use a start point elevation, whichever you desire. It will not change the IRI.

OPERATOR
This field identifies who is taking the data. This is an optional field, but we recommend that you do use it, because you may find it useful later to know the name of the operator who collected each Run. If you have a record of who collected the data, you can consult with the operator to resolve any questions about the weather conditions, the road surface, or anything else regarding the data that was collected.

NOW YOU ARE READY TO START A NEW RUN
To begin data collection, tap COLLECT/NEW RUN. Type in a run name that will identify this run of data for you. Choose a name that will help you remember where this data came from, perhaps a station number and direction of travel. (No spaces or funny characters are allowed, but you may use an underscore or a dash in addition to letters and numbers. Verify that the other information (from SETTINGS/RUN INFORMATION) is correct. Change anything that you need to change, and tap OK to bring up the Data Collection Screen.

When the next screen appears, you are ready to collect data. Place the Dipstick battery end foot on the start point of the survey line with the start arrow (the switch end of the Dipstick) pointed forward.
WALK THE DIPSTICK DOWN THE TEST LINE

Single-tap the "Start" button on the screen and hold the Dipstick steady, then press the Trigger and wait until the Dipstick takes the first reading. You always press the trigger from front to rear.

Once a reading has been captured, the beeper will sound. This is the signal for you to rotate the Dipstick. The large reading number tells you how many steps you have taken. You must press the Trigger button before the Dipstick will attempt to collect the next reading. The Dipstick will produce a graph from any length line, as small as 1 step (normally 1-ft, 300mm, or 250mm) but you must collect at least 37 ft or 11.1 meters of data for the Dipstick to have enough data to produce an IRI.

Readings will be recorded as the Dipstick is "walked" along the survey line by pivoting the instrument about its forward point. If the Hardware Setting has been set for the Trigger, you must press the Trigger before the Dipstick will capture the reading. If the Hardware Setting has been set for Automatic, the readings will be taken automatically, as determined by the 2277 Tablet, using the capture mode you selected earlier.

CHECKING FOR FALSE READINGS

As you walk the Dipstick to take readings, check the 2277 Tablet's screen periodically. If you are collecting very long runs, mark spots on the survey line periodically with the reading numbers for reference using the lumber crayon or "keel". Check to be sure that the reading number on the Tablet's screen is an odd number when the start end of the Dipstick is forward after a reading has been taken, and an even number when the battery end of the Dipstick is forward after a reading has been taken. If it shows an even number after beeping with the “start” end forward, you may have either collected a “false reading”, or you may have skipped a reading. For more information on identifying and correcting false readings, see the "False Readings" section of the TROUBLESHOOTING Chapter 8 and also in the "Edit Readings" section of the PROCESS Chapter 5.

END THE RUN

To terminate data collection and view the profile graph and IRI for the run, tap the "Stop" button on the screen. The 2277 will automatically display a graph of the data you have just collected.
CHAPTER 4 COLLECT

The name of the Run is shown at the top of the graph and the IRI is shown at the bottom of the graph.

Tap the "Close" box at the upper right corner to close the graph display.
You can bring the graphs up again, either one at a time or in several on one page, by using REPORT/GRAPH.

START ANOTHER RUN
You may now start a new run the same way you did the last one.

TO VIEW REPORTS ON THE 2277 COMPUTER
You can get reports right on the RFCOLLECT menu on the 2277 computer. Single-Tap the Run you are interested in to make it dark. Tap the REPORT Menu header with your stylus, then tap the Run report you want to see. You can view the Readings and elevations of all points on the Run by using REPORT/DATA POINT LISTING. You may read any Notes that you collected during the Run, or you may bring up a Graph of the Run profile. These report features are covered in detail in Chapter 5 (PROCESSING DATA) of this manual.

Once you download this data to your desktop PC, you'll be able to print any of these reports from the RoadFace program on your PC to any printer connected to your PC, either local or network.

TO EDIT DATA THAT YOU HAVE ALREADY COLLECTED
You can EDIT Runs right on the RFCOLLECT menu. Just Tap EDIT, then the Edit feature you want.

When you are familiar and comfortable with basic data collection and reporting, you should learn about the other features built into the Dipstick. These include Editing data, collecting data in "Boxes" for longitudinal profiles, and more. These editing features are covered in detail in Chapter 5 (PROCESSING DATA) of this manual.

If you had any problems collecting data, you will want to do it again for practice. Chapter 8 is "TROUBLESHOOTING" for when you get stuck.
COLLECTING ELEVATION PROFILES IN WHEELPATHS

The best way to collect elevation profile data in wheelpaths is to use a series of "boxes" that are collected end-to-end.

OVERVIEW OF COLLECTING DATA IN WHEELPATHS

You will walk a "box" pattern on a test site, starting on the right wheel path, walking down the right wheel path in the direction of traffic some convenient distance (we suggest 250 steps), turn left, walk across the lane to the left wheel path, turn left again, walk back in the left wheel path against the direction of traffic flow, and turn left once more to walk back to finish the run at the same spot where you started it. You go all the way around the “Box” on one run. This is absolutely (by far) the best way to collect longitudinal profile data. Here’s what it looks like:

Arrows show the path taken by the Dipstick operator as data is collected.

COLLECTING IN BOXES - DETAILS:

Collecting the first Box

1. Mark the start/end point of the box by drawing a circle around the "moon" foot on the pavement. You can use chalk or crayon to do this. Write the name of the box on the pavement next to this small circle. Draw an arrow in the direction you will walk. This information will be useful to you if you need to return to this spot later to correct errors or gather additional data.

2. Now draw a 1-ft (300-mm) circle around the start/end point. You can do this by just setting the Dipstick foot on the start/end spot and holding a crayon next to the other foot of the Dipstick and turn it in a circle. After you do this process several times, you will find
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that you really only need to make a half-circle, or even a quarter-circle, if you make it in
the correct location.

3. Start a new Run and collect data along the right wheelpath. We suggest you name this Run
"B1" or "Box1", or use the station name of the starting location followed by a “1” When
you have completed the 250th step, stop turning the Dipstick for a moment and
and tap the letter “C” on the screen.

The Dipstick will beep to
tell you that it has marked
this step as a corner of the
box. Now draw a circle
around the front foot at the
250-step point and write "B1 250" on the pavement. This will locate the 250th point on
Box 1 if you need to find it later. Note: There is nothing magic about collecting data in
boxes that are exactly 250 steps long; over time, but we have found that this works very
well. We recommend keeping the boxes no longer than approximately 250 steps on a side.
You can use shorter boxes, but we have found that boxes that are 250 steps long are quite
efficient.

4. Without stopping the Run or closing the program, turn 90° to the left and walk straight
across to the left wheelpath. This is normally ~6 steps. Stop turning the Dipstick for a
moment and press “C” again. The Dipstick will beep to tell you that it has marked this step
as a corner of the box, in the Run Notes for this run. Now draw a circle around the front
foot at the 256-step point and write "B1 256" on the pavement. This will locate the 256th
point on Box 1 if you need to find it later.

5. Without stopping the Run or closing the program, turn 90° to the left and walk back down
the highway in the left wheelpath. You will be walking against the flow of traffic, which
will allow you to see if any vehicles are not keeping clear of your measurement path.
When you are back at the "start" end of the box, normally at step ~506, stop turning the
Dipstick for a moment and press “C” once more. The Dipstick will beep to tell you that it
has marked this corner in the Run Notes. Now draw a circle around the front foot at the
506-step point and write "B1 506" on the pavement. This will locate the 506th point on
Box 1 if you need to find it later.

6. Without stopping the Run or closing the program, turn 90° to the left and walk straight
across to the start point of the Box. This is normally ~6 steps, so this should be your
~512th step. You need to hit exactly on the point where you started. Stop the Run by
Tapping “STOP”. The computer will show you a graph of the complete run. You have
now collected the first Box on the highway, and are now ready to collect the second Box.
(You will "UnBox" the Runs later and link the longitudinal profiles together to form the
right and left wheelpaths.)
7. Go to the point you marked on the pavement called "B1 250". Set the Dipstick down with the rear "moon" foot directly on top of the circle at step 250. Draw a 1-ft (300-mm) circle around the start/end point. You can do this by just setting the Dipstick foot on the start/end spot and holding a crayon next to the other foot of the Dipstick and turn it in a circle. When you have finished making this circle, walk across to the left wheelpath and make a similar 1-ft (300-mm) circle at "B1 256".

8. Collect a new Run called "B2" just like the first box, but taking you another 250 steps down the highway.

9. Continue to collect additional Boxes in a similar manner until you reach the point on the highway that you want to use as the "end" of today’s data. The boxes do not have to be 250 steps long, nor do they all need to be the same length. However, we have found that it is easier to keep track of what you are doing if you always try to use a standard collection "box", and make notes whenever you vary from the standard.

10. Note that if the highway bends around a curve instead of staying perfectly straight, one of the wheelpaths will be longer than the other is. In this case, continue to always use 90° angles when you go around a corner. The short transverse legs will all be the same lengths because the wheelpaths are a constant distance apart, but the left (or right) wheelpath may be a few steps longer than the other wheelpath.

You may have wondered why you need to draw the 1-ft (300-mm) circles around the corners of the boxes. These circles will help you to match up the wheelpath profiles so they hit exactly on the correct point. When you are "closing the loop" by making the last step on Box1, if the highway is not perfectly straight, or if you have turned at 89° instead of 90°, or if the distance between wheelpaths is not an integer multiple of 1 ft, (300 mm) then the last step will not land exactly on the start point. If you need the two long legs of the box to be parallel at an arbitrary distance apart, (not an integer number of steps apart) say for measuring in wheelpaths, here's how to make the short transverse legs land exactly on top of the opposite wheelpath:
When you reach the end point (~250 steps) on the right wheelpath and after you have marked a circle around the Moon foot at that location, pick up your Dipstick and go across and mark the desired location directly opposite. Don’t stop the Data Collection program, just don’t press the Trigger and the Dipstick will not collect data. Make a circle around the Moon foot at the desired location, and also draw a 12” (300 mm) circle around this point. You can use the Dipstick to draw a circle around this point on the pavement. Draw the circle so it is tangent to the outer edge of the Moon foot as shown in the drawing. Then go back to where you stopped collecting data and carefully put the Dipstick down exactly on the Moon foot circle at the end of the right wheel path.

Now you can continue your Run from this point. Collect data towards the circle across the lane toward the left wheel path. At the point where you would step across the circle, don’t step over the circle, but put the foot down exactly tangent to the circle. (Anywhere on the circle) This will require that you "step off" at an angle as shown in the picture above. Your next step will always put you exactly on the desired spot at the center of the circle. You will also have to use this procedure to get exactly back on to the starting point of the Run. On the next to last reading, set the foot down anywhere on the 1-ft (300-mm) circle and you will be assured of being exactly 12” (300 mm) from the starting point for the final reading. Rotate the Dipstick back to the starting point to take the final reading. Be sure to take the final reading exactly on the original starting point. (Use the 12”/300 mm circle to compensate for any discrepancy on the next to last reading.) This is very important. You should always do this “stepping off onto the 12” circle” on the short transverse runs that will not be part of the longitudinal profiles.

**PROCESSING THE DATA**

Processing the data that you have collected in Boxes is covered in Chapter 5, PROCESS. You can do this on the Dipstick's on-board computer, or you can do this on your desktop PC. The software works the same in both programs.

**TO VIEW REPORTS ON THE 2277 COMPUTER**

You can get reports right on the RFCOLLECT menu on the 2277 computer. Single-Tap the Run you are interested in to make it dark. Tap the REPORT Menu header with your stylus, then tap the Run report you want to see. You can view the Readings and elevations of all points on the Run by using REPORT/DATA POINT LISTING. You may read any Notes that you collected during the Run, or you may bring up a Graph of the Run profile. These report features are covered in detail in Chapter 5 (PROCESSING DATA) of this manual.

Once you download this data to your desktop PC, you'll be able to print any of these reports from the RoadFace program on your PC to any printer connected to your PC, either local or network.

**TO EDIT DATA THAT YOU HAVE ALREADY COLLECTED**

You can EDIT Runs right on the RFCOLLECT menu. Just Tap EDIT, then the Edit feature you want. Editing data, including UnBoxing Runs, is covered in detail in Chapter 5 (Processing Data).

Once again, if you had any problems collecting data, see Chapter 8 "TROUBLESHOOTING" if you have any problems.
OTHER SPECIAL DATA COLLECTION FEATURES

MAKING NOTES

While you are collecting data, you may wish to make notes for reference purposes later on. (Locations of sawcuts or cracks in the pavement, corners of a box, etc.) Your RFCollect Program allows you to make and save notes using the 2277 Tablet as you collect data, either by tapping a special letter or by typing the notes.

- To record the location of a corner of a box while you are collecting data, stop turning the Dipstick, press the trigger to collect the reading at this point, and press the keyboard letter “C”. The Dipstick will Beep once to let you know this Corner has been recorded. Then just continue turning the Dipstick and collecting data.

- To record the location of any repetitive event, such as crossing a joint or crack, press the keyboard letter “S”. This will record the step number of this event, whatever it is.

- Another way to record any event is to press the keyboard letter “T”. This will record the step number of this event.

- To record more complex notes, press the keyboard letter “N”. This will open a small window in the middle of the screen. Tap the middle of the screen to activate it, then type whatever text you wish to record. If you have used “C” or “S” or “T” on this Run, you will see any notes that you have already recorded.
  - A note recorded by using "C" will look like this: "Corner Step 57 :"
  - A note recorded by using "S" will look like this: "Note step 23 :"
  - A note recorded by using "T" will look like this: "Turnaround step 23"
  - A note recorded by using "N" will contain whatever text or numbers you typed in from the keypad.

These Notes always stay with the Run that they were collected in. You may open the notes and read them in the RFCOLLECT menu while you are actually collecting data. To see them, you must be at the Run level. Just Tap REPORT/NOTES.

You can use “C” for the corners of Boxes and “T” for the turnaround point on a Test Track Run, or you can use them for anything else that you want to note. For example, you could use “C” to mark the location of cracks, “S” for the location of Sawcuts, and “T” for anything else. Any time you have a complex note to record, just press “N” and type the note. You pay want to press “S” and then open the notes so you will have the step number recorded for you, then you only need to type whatever other information you want to record.
APPEND
Append allows you to collect new readings and add them to an existing run from any point on an existing Run. This is useful when you wish to extend a line that was started earlier but not completed or to remeasure part of a line that was already measured, or to correct a False Reading.

- Select the Run you wish to append to.
- Tap COLLECT/APPEND RUN.
- Enter the number of the last good step on the Dipstick survey line, and tap “OK”.
  Note: Sometimes the last GOOD step is not the same as the last step taken. The program will always prompt you to the last step collected; you must change the number if the last step that you collected was NOT the last good step.
- The dialog will prompt you to put the "start end" or "battery end" foot forward. If the last good reading was an even number, the next step will be an odd number with the “Start” end forward, and vice-versa. Place the back foot on the last good reading spot and place the front end on the next step facing forward.
- Tap “OK”. The Dipstick will look like it is starting a New Run, but it is just restarting from the last good step.
- Hold the Dipstick steady, press the Trigger and wait until the Dipstick takes the reading.
- Continue collecting readings in the normal way until you reach the end of the run. The Run name will be unchanged, and all the new readings will be "appended" to the Original Run at the point where you indicated.

Using Append to fix a False Reading:
If you know where the False Reading is, and you don't want to re-do the entire Run, you can use COLLECT/APPEND. This will allow you to just re-do the portion of the Run that comes after the mistake. For example, if you are collecting a Run that is 107 steps long, and you make a mistake at step number 95, you can place the Dipstick with the battery end at the location for step number 94, and from the COLLECT menu, use APPEND. The computer will ask you "Last Good Step 95?" and you type in "94". (Since the mistake was on step 95, then the 94th step is the last good one.) Then you collect the rest of the readings, starting with reading # 95 in the normal way until you reach the end of the run. The key to doing this is to STOP immediately after you get the False Reading. This way it is easy to go back one or two steps as needed.

MANUALLY COLLECTING DATA
Certain circumstances, such as extreme weather conditions (See “Operating Temperature Range,” in Chapter 7, Care & Maintenance), may require you to collect data manually, using the Dipstick unit itself without the 2277 Tablet.

- Remove the computer and collect data with the Dipstick manually, writing down each reading taken, or verbally recording the data using a tape recorder.
- When all readings have been taken, these readings will be entered into the RoadFace™ 6 Program by inserting a "new" record and then using EDIT/READINGS to enter the data manually. The details of how to do this are covered in Chapter 5, Process Data.
NON-STANDARD SPACING or NON-STANDARD DATA COLLECTION

The Dipstick you purchased can be used without any other attachments to measure at any of three different data spacing intervals – 250 mm, 300 mm, and 12". Note that 300 mm is not exactly the same as 12". There are 3 pairs of holes in the bottom "tang" of the Dipstick. Each hole is marked either "12", "250", or "300". If your moon feet are in the two holes marked "12", you are measuring at 12.000 inch data spacing intervals. Similarly, if you place the moon feet into the holes marked "300", you are collecting data at 300mm intervals, or 250mm intervals, if you use the holes marked "250". Don't forget to zero the Dipstick any time you replace or adjust the feet. When you move the feet to different foot spacings, you MUST also change the Hardware settings in the data collection menu. SETTINGS/HARDWARE then FOOT SPACING.

If you wish to collect data at smaller intervals than 250mm or 300mm, you may do this with the Variable Foot Spacer bar. Remove the kickstand, washer, and spacer. Install the variable foot spacer bar by screwing it onto the "tang" at the bottom of the Dipstick with the 2 screws provided. The variable foot spacer has many holes on the bottom. Measure the distance between any two holes in the bottom of the variable foot spacer bar. (Do this centered on the bar, so both feet are approximately equal distance from the center of the bar.) Choose the two holes that have the desired data spacing. Install the Moon Feet into these two holes in the variable foot spacer bar. Don't forget to zero the Dipstick any time you replace or adjust the feet. When you move the feet to different foot spacings, you MUST also change the Hardware settings in the data collection menu. SETTINGS/HARDWARE then FOOT SPACING. Don't forget to change the Hardware Settings back to your normal settings after you move the Moon Feet back to their normal spacing, and rezero again.

MERGING DATA FROM DIFFERENT DIPSTICKS

When you need to evaluate data collected by different Dipsticks on the same project, you may use TOOLS/MERGE to get all the data into one job for convenient analysis. (Note: The TOOLS/MERGE function is only available in the RoadFace program, not the RFCollect program.) When you use the Merge feature, you actually make a copy of the second job and place it in the first job. (You still have the second job, unchanged, in addition to the first, merged Job, which now contains the data from both jobs.) The details are covered in Chapter 5, Process Data.

STEPPING OVER WIRE MESH OR REBAR

The Road Dipstick kit contains two "leg extensions" which will help you collect data through potholes or over wire mesh or rebar. Simply screw these extensions into the proper holes on the bottom of the Dipstick and screw the Moon Feet into the leg extensions. Don't forget to re-Zero whenever you remove or install Dipstick feet.
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CHAPTER 5  PROCESS

PROCESSING DATA

Both RoadFace 6™ and the RFCollect Program will allow you to analyze and edit data that have been collected earlier. Since most of the menu items in RFCollect are almost identical in use to the RoadFace™ program on your desktop PC, this chapter will describe how to process data with either RFCollect (the RoadFace Data Collection Program) or the RoadFace 6 analysis program. Any differences between the two programs will be spelled out.

Before you can use the RoadFace 6 analysis program, you need to download your data from the onboard 2277 Tablet to your laptop or desktop PC. After you have downloaded the data, you will have two copies of the data – one on the 2277 Tablet pocket computer, and one on your laptop or desktop.

Transferring data from the 2277 Tablet to another computer

This is easier than ever with the SD Card Reader supplied with the Dipstick 2277. You should download your data daily as a means of "backing up" your data. This way you will have copies of the data in two places on two different storage media, and will minimize the risk of losing data. Most users also prefer to use a Desktop PC or a color laptop computer to do final processing of the data and printing, because the screen and keys on your desktop is much larger. In any case, to print the reports, you must use a PC.

Just remove the SD Card from the right side of the 2277 Tablet, and stick it into the SD Card Reader, then plug the SD Card Reader to the USB port on your desktop or laptop PC. Your desktop or laptop PC will automatically install the drivers for you. This needs to be done only once, is automatic, and takes just a minute or two.

From this time on, any time you plug the SD Card Reader in to your computer, it will automatically open a window to the SD Card. You may now use the SD Card Reader on your desktop PC as if it were a separate disk drive. Use your mouse to open the drive that represents the SD Card Reader, find the Data folder, and “drag and drop” or “copy and paste” the data folders you want from that location to wherever you want on your desktop PC. (Presumably, to something like C:\Dipstick.) We recommend keeping all your Dipstick data folders as subfolders in the main folder where you have installed the RoadFace program. The SD Card Reader is extremely fast. You can copy a job in just a second or two.

What you can do with the Data after Downloading:

Once you have downloaded the data to your hard drive, you may produce single graphs with the cumulative IRI shown at the bottom, or you can produce a graph showing multiple runs at the same time. This is useful in viewing longitudinal road profiles, where you typically display both the left and right wheelpaths simultaneously. You can also produce a graph showing the change in IRI vs. distance, calculate the difference between two runs or the average of two runs, and do all sorts of useful editing functions, such as segmenting, editing readings, rotating, reversing, and linking two runs together. You can report the Run Notes collected during data collection, and calculate Data Collection Bias or the Slope of a Run. You can also calculate the difference between two Runs or the average elevations between two Runs. Additionally, you may rename and edit Runs if necessary. The readings or elevations can also be exported for use in other programs in ASCII (text) format.
SELECTING RUNS

To Process data, you'll need to know how to select Runs, either one at a time or in groups of two or more, so you can process them. Selecting multiple Runs is easy, but is slightly different between doing it on a PC and on the Tablet.

- **To select a single Run**, just single-click (desktop PC) or single-tap (2277 Tablet) the item you want to work with. The key is to get the item you want to work with highlighted. **DO NOT DOUBLE-CLICK. The program does not respond to double-clicking Runs.**

- **To select two or more adjacent entries in a list on a desktop PC**, single-click on the first one you want, then, while holding down the <Shift> key, click or tap on the farthest item in the list that you want to select. You may also use the up or down arrow keys to highlight all the items of interest, so long as you hold down the <Shift> key. All the items between the first and last will be selected. **To do this on the 2277 Tablet**, first tap the “Multiselect” box at the lower left corner and tap the Runs that you want to select.

- **To select two or more entries that are not adjacent, on a desktop PC**, click on the first one you want, then press and hold <Ctrl> and click or tap the next item. Only the specific items you selected will be highlighted. You may repeat this process to select as many items as you like. You may use the arrow keys instead of clicking or tapping. Move the highlight to the first item, then press and hold the <Ctrl> key. While holding the <Ctrl> key down, move the cursor with the arrow keys, then press the <Spacebar> after you have reached the second item. You may repeat this process to select as many items as you like. **To do this on the 2277 Tablet**, first tap the “Multiselect” box at the lower left corner and tap the Runs that you want to select. (The same process as above)

- **To deselect a single run on a desktop PC**, (after it has already been selected), press and hold the <Ctrl> key, then click or tap the item you wish to deselect. You may do the same thing by using the arrow keys: while holding down the <Ctrl> key, move the highlight to the one you want to de-select, then press <Spacebar>. Only the specific item you de-selected will be removed from the highlighted list. You may repeat this process to de-select as many items as you like.

- **To deselect multiple runs** (after they have already been selected), click or tap any other item, or press the arrow key. All the runs except the one at the cursor will be de-selected. (One item will always remain selected)
TO PROCESS DATA IN EITHER PROGRAM:
To use any of the routines in RFCollect or in RoadFace 6, you must first open a Job.

OPEN A JOB
When you start either the RoadFace program for Windows laptops and desktops or the RFCollect program on the 2277 Tablet, the program will always automatically open your last Job, whether you want to use it or not. If you want to open a different Job, use FILE/OPEN JOB. To open a Job on your desktop PC: If the Job you want to open is in a subdirectory (sub-folder) below the top level, the folder above the Job will show a "plus mark" (+).

To open these folders so you can see your Job folder that is hidden below, you must either click on the "plus sign" or press the right arrow. Either method will open the top folder, allowing you to see the Job folder you want to open. The plus mark will change to a minus sign as shown in these pictures.

RUN NAMES
The original Run Names are the names you supplied when you started to collect each run. You should try to choose names that will mean something to you later. A name such as "Run_1" doesn't convey very much information. If a run has been edited, the name is automatically changed by the program to give you a hint as to the nature of the change. You may also change the names of the runs by using EDIT/RUN HEADER.

The name extensions automatically added by the program after editing include:

- ^E = Dipstick® readings were EDITed on this Run
- ^L = Two Runs were LINKed together
- ^S = This Run was SEGMENTed
- ^A = Two Runs were AVERAGEd
- ^F = The DIFFERENCE between two Runs was calculated
- ^R = This Run was REVERSEd
- ^U = This Run was ROTATEd
- _A _B _C _D = This Run was UNBOXed into its four legs.

You can see that the name extensions are sort of a shorthand "history" for what happened to the Run during editing.

RUN FLAGS
The "Run Flags" at the right of each row also provide useful information about each Run.

O = This is an ORIGINAL Run. It has not been Edited. The program will not allow you to delete or make a permanent change to an original run. Whenever you edit an original run, a copy of the run will be created automatically, and it will be given a name extension as shown above.
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The original Run will be unchanged. Minor, reversible changes can be made using the EDIT/HEADER routine, but any permanent change will result in the creation of a new run.

B = This run has an individual Run Data Collection BIAS applied to it.
P = This Run has had a Start Point Elevation applied to it.
N = This run has embedded "Notes" that were written during data collection.
S = This run has been adjusted by the design Slope so you can see profile detail on a run taken on a sloped surface.
T = This run has an "Elevation Tolerance" applied.

PROCESSING AND EDITING DATA

Select any Run or Runs you are interested in. click or tap the REPORT Menu, then select the report you want to see, or arrow down to the Report you want and press <Enter>. Some reports are for single Runs only, and others can be used with multiple Runs.

REPORTS

Graph
Click or Tap REPORT/GRAPH to display the profile graph of the Run or Runs you have selected. If you have only one Run selected, the IRI for this Run will also be displayed below the graph. If you have selected more than one Run, the profile of each Run will be superimposed on the same graph axes. The Run names and the color code for each Run will be displayed below the graph.

Data Listing
You can view the readings and elevations at all points on the Run by using REPORT/DATA POINT LISTING. The step number, distance, Reading, and Elevation will be shown for each point on the profile. If you are collecting at a 12" spacing, the step number will be equal to the distance in feet. At any other foot spacing, the step number will not be the same as the distance. The Data Listing file will be saved in the active Job folder with the name of the Run. The file name will look like this: Runname.RTF. The "RTF" stands for "Rich Text Format", which can be opened from any word processing program, like MS Word or Wordpad.
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ASCII Elevations
You may create ASCII Elevation Files from the data you have already collected by using REPORT/ASCII ELEVATION FILE. The Elevation file will be saved in the active Job folder with the name of the Run, as shown in the picture below. The file name will look like this: Runname.ELV
Don't be disturbed by the file extension ".ELV". You can open this file in MS Excel or in MS Word or Wordpad or any other spreadsheet or word-processing program. If you prefer, you can change the extension from "RDG" to "TXT" or even "XLS".

ASCII Readings
You may create ASCII Reading Files from the data you have already collected, by using REPORT/ASCII READING FILE. The Readings file will be saved in the active Job folder with the name of the Run. The file name will look like this: Runname.RDG
Don't be disturbed by the file extension ".RDG". You can open this file in MS Excel or in MS Word or Wordpad or any other spreadsheet or word-processing program. If you prefer, you can change the extension from "RDG" to "TXT" or even "DOC".

IRI
If you select one Run and use REPORT/IRI, you will get a graph which shows the cumulative value of IRI at each point on the profile, as well as the 50-ft running IRI. As the profile gets longer and longer, the cumulative IRI becomes very stable and does not react strongly to discontinuities in the pavement surface. If the profile is very long, even a bad pothole will not affect the cumulative IRI very much. But the 50-ft (15 m) Running IRI will show the "local roughness" at each point on the profile. Because it only calculates the IRI based on the last 50 steps, any change in surface roughness will really stand out.

The IRI is based on the motion of a single wheel of a notional automobile, so it is sometimes called the "Quarter Car IRI".
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Half-Car IRI
If you select two Runs and use REPORT/IRI, you will get a graph which displays the cumulative value of the "Half-Car IRI" at each point on the profile, as well as the 50-ft running Half-Car IRI. The half-Car IRI is based on the motion of the center of a transverse axle, at a point halfway between the left and right wheelpaths. It is almost always lower than the quarter-car IRI because the surface irregularities under the left and right wheels tend to be at least slightly out of phase. Because it emulates the motion of the front "half" of the car, it is called "Half-Car IRI".

![Graph showing the difference between Half-Car and Cumulative Half-Car IRI](image)

The Running IRI is based only on the last 50 steps
So it is more sensitive to individual flaws

The Cumulative Half-Car IRI is based on all data
So it tends to smooth out after many steps.
It represents the "overall roughness" of the profile
and is much less sensitive to a single flaw

Notes
If you select a Run and use REPORT/NOTES, you may read any Notes that you collected during the Run. If you have pressed the “S” or “C” or “T” keys while you collected data, these will generally be in the form

Note Step 27 : or
Corner Step 113 or
Turnaround Step 50

These "Notes" can serve to remind you of particular features that you want to remember about the pavement surface - such as the locations of cracks or other features, or the locations of the "corners" of the boxes where you collected the data, or where you turned around in an "out-and back" Run. If you have marked them, the "Corner" Notes will be used automatically when you "Unbox" a Run, and the "Turnaround" points will be automatically used for any "Test Track" Runs you have collected.

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These digital “notes” can be a handy way to make note of features on the pavement surface. Think of this as just another way to make notes for your use later. You can write notes on your hand or on a small scrap of paper, and this might work in the short run, but sooner or later you’ll need to wash your hands, and you’ll eventually lose that little scrap of paper. But these electronic notes stay with the original run forever, and cannot be lost.

RUT DEPTH  [Only available on the desktop program - RoadFace 6.X only]

The RoadFace program will automatically calculate the depth of any transverse Runs that you have collected. This report is not available on the RFCollect program. Just highlight the Run you want to analyze, and use REPORT/RUT DEPTH. Then you must choose whether to make a graphical or a tabular report, and the program will estimate the number of lanes that you have crossed. You should correct the number of lanes if the program guesses wrong.

This is the transverse profile across two traffic lanes

The Rut Depth Graph shows you a transverse profile, rotated so the coordinate axes are parallel to the overall slope of the road. It also shows you the straight line between two high spots on each side of every "Rut". This makes it easy for you to visualize the depth of the ruts.

The tabular Rut Depth Report gives you the location and depth of the deepest ruts, along with the contact points of a Straightedge over the rut.

<table>
<thead>
<tr>
<th>Rut Depths</th>
<th>Job Name:</th>
<th>Run Name:</th>
<th>Renorut1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>Dist (feet)</td>
<td>Depth of Rut (in)</td>
<td>L SE Support (feet)</td>
</tr>
<tr>
<td>5</td>
<td>5.00</td>
<td>-0.332</td>
<td>1.00</td>
</tr>
<tr>
<td>11</td>
<td>11.00</td>
<td>-0.093</td>
<td>8.00</td>
</tr>
<tr>
<td>18</td>
<td>18.00</td>
<td>-0.035</td>
<td>16.00</td>
</tr>
<tr>
<td>24</td>
<td>24.00</td>
<td>-0.154</td>
<td>20.00</td>
</tr>
</tbody>
</table>
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GAP UNDER THE STRAIGHTEDGE or "1/8 in Ten"
[Only available on the desktop program - RoadFace 6.X only]

To Make a Report using a "Gap Under a Straightedge" type Spec:
At the Run level, select the Run that you want to analyze, then use REPORT/GUSE
(The Acronym “GUSE” is short for GAP UNDER STRAIGHTEDGE)

There are two types of report: Graphical and Tabular.
Now you get to choose between a Tabular Report - listing all the failing locations, and a Graphic Report, showing the profile and the Straightedge.

In either case, you will be required to choose the length of the Straightedge and the maximum allowable Gap. You can also choose whether to count only gaps between contact points or any Gap under the Straightedge. If you choose the Tabular Report, the report will be saved as a .RTF file that can be opened by any word-processing program. You will be asked to name the file. The program will suggest a name for you based on the Run Name.

The Tabular Report lists the worst "Gap" under a Straightedge at every point along the line. The table also points out wherever the gap is larger than the specified allowable maximum gap. In other words, it tells you wherever the pavement fails, and by how much. In addition, it lists the three largest gaps and highlights their locations.

<table>
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<th>Dist (ft)</th>
<th>Gap</th>
<th>Defect (in)</th>
<th>L End (ft)</th>
<th>L Sup (ft)</th>
<th>R Sup (ft)</th>
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</thead>
<tbody>
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</tr>
</tbody>
</table>
CHAPTER 5 PROCESS

The Graphic Report shows a profile graph, with the bottom edge of the Straightedge shown in pink, and a line that shows the maximum allowable Gap under the straightedge in red. You can move the Straightedge across the graph by using the " > " and " < " arrows that are just to the right of the "M" on your keyboard. If you use <Shift> " > ", the Straightedge will move all the way to the right edge of the graph. If you use <Shift> " < ", the Straightedge will move all the way to the left edge of the graph.

Here is an example of the Graphic Report. This picture corresponds to the first large defect found - the defect is at 6 ft, and the Straightedge is resting on the ends at 1 ft and 11 ft. You can easily see that the "Gap" under the Straightedge exceeds the maximum allowable gap.

Here is another example of the Graphic Report. This picture corresponds to the second large defect found - the defect is at 16 ft, and the Straightedge is resting at 12 ft and 20 ft.

Note that the Straightedge does not always rest on its ends.

The Graphic Report is an easy way to visualize the flaws in a pavement surface. You can see how a straightedge will react to the humps and bumps in the pavement surface, and you can see everywhere it fails the spec. If someone doesn't believe your report, just put a real Straightedge down on the pavement precisely where the report says it fails, and you'll see exactly what the report shows.

You can print these graphs, too. Just get the graph the way you like it, then use FILE/PRINT.
EDITING RUNS

To Edit a Run Header:
Select a single Run or multiple Runs and use EDIT/RUN HEADER. You may change whatever information you need to correct. Be very careful not to change the footspacing or Metric/Imperial information unless you are sure of what you are doing. The most common Run Header changes are to the Run Name, Start Point Elevation, and the Operator Name. If you select many Runs at once, you may make "batch editing" changes, such as changing the slope or operator's name.

To Reverse a Run:
Select a Run, and then use EDIT/REVERSE. This will have the effect of "reversing" the Run so that it appears that you collected it in the opposite direction. The IRI and elevations are not changed at all by this action. This is useful for when you have collected several Runs in opposite directions and you want to graph them together, all facing the same direction, to see how they compare.

To Rotate a Run:
Select a Run, and then use EDIT/ROTATE. This will have the effect of "rotating" the Run so that it becomes parallel to the X axis. This makes it much easier to visualize the roughness of the profile, by removing the elevation change from one end to the other. The graph display will now be "Zoomed in" to allow you to see minor variations in the profile better. This won't help very much with extremely long Runs that go all the way over small hills and valleys, but it is very useful in helping you to visualize the roughness of short runs on a slope.

TO EDIT A RUN'S READINGS:
- Select a Run, then use EDIT/READINGS.
- Scroll down to the reading you want to change and click on it. The reading you select will be displayed at the top of the screen where you may change it as appropriate. Type in the desired reading, being sure to include a "-" sign, if required, and tap “Update” (on the Tablet) or press <Enter> (on your desktop PC) and the cursor will move down to the next lower reading on the list. **Readings are assumed to be positive unless you place a minus "-" sign in front of the reading.**
- Scroll down and click on the next reading you want to change. Continue entering your readings in the same manner until all are entered. (You may make corrections by using the arrow, backspace, and delete keys.) When you have finished with this reading, tap “Update” or press press <Enter>, and the cursor will move down to the next lower reading on the list.
- To insert a reading: Select (highlight) the place where you want to insert a Reading, then click the INSERT button. A blank Reading will be inserted just above where the cursor is located. All you need to do is enter the correct value of the reading.
- To delete a reading: Select (highlight) the Reading you want to delete and press the “DELETE” button. The old Reading disappears. Be sure you want to do this. If you want to delete a False Reading, use "Remove False Reading" (see below)
CHAPTER 5  PROCESS

FIXING FALSE READINGS

There are two steps to **Remove a False Reading**:

- Select (highlight) the False Reading and press the “DELETE” button. The old Reading disappears and all the subsequent readings automatically move up to fill the hole where the deleted reading used to be. The cursor will stay in the same place.

- Then without moving your cursor, click “Change Sign” and this and all subsequent readings will change sign. All the + readings will become – readings, and all the – readings will become + readings. This will only change the signs of the readings after the deleted False Reading.

To **Add a Skipped Reading**: Select (highlight) the place where you want to insert a Skipped Reading, then click the INSERT button. The new reading appears, and all you need to do is enter the correct value of the reading.

Once you have finished editing Readings, press the “OK” button at the bottom of the window. If this is an Original Run, the program will automatically create a new Run, with the same name and the suffix "^E". (to indicate that it has been edited) If this is a non-original Run, a confirmation screen will appear and ask if you wish to create a New Record. With non-original Runs, you get a choice whether to make a new Run with the edited data, or to simply save the changed data in the same Run.

**Important Note:**
*You should never edit, delete, or add readings unless you have a valid reason to do so. Valid reasons include deleting “False Readings” and adding data that was collected manually.*
CHAPTER 5  PROCESS

HAND-ENTERING DATA
[Only available on the desktop program - RoadFace 6.X only]

If you wish to enter data from manually collected runs, first open an existing Job, or create a new Job and go to the Run level. If there are no runs in the new Job, it will display a blank screen. If there are already some Runs in this Job, they will be shown on the Run List.

Create A Run  [Only available on the desktop program - RoadFace 6.X only]

- Press <Alt> <E>dit <I>nsert, or just press the <Insert> key.
- Type in the name you wish to give your run and then press <Tab>.
- Enter the footspacing. Press <Tab> again and enter the rest of the required information including Imperial or Metric. The foot spacing is normally 12 for Imperial; and either 250 or 300 for metric. You may continue to tab through the remaining options or you may press <Enter> at any time to accept the entries as shown on the screen.
- The Readings Editor screen will appear. Type in your first reading, being sure to include the "-" sign, if required, and press <Enter>. Readings are assumed to be positive unless you place a minus "-" sign in front of the reading.
- Continue entering your readings in the same manner until all are entered. (You may make corrections by using the arrow and backspace keys.)
- Once you have typed in all your readings, press the "OK" button to close the readings editor.

The screen will return to the Run Listing window. The number of readings entered will appear in the "Readings" column. There will be no Run Flags for this run.

The manually entered run may now be processed just like one collected normally.
CHAPTER 5  PROCESS

PROCESSING ELEVATION PROFILE DATA IN WHEELPATHS

The best way to collect elevation profile data in wheelpaths is to use a series of "boxes" that are end-to-end. These boxes each consist of 4 sequential straight lines, 90° to the adjacent lines, with the 4th line ending at the same location as the start point.

Details on how to collect the data have been provided in Chapter 4, COLLECT.

Note: Arrows show the path taken by the Dipstick® operator as data is collected.

PROCESSING BOX DATA - OVERVIEW

You will "UnBox" the first box, separating the four legs of each box. **UNBOX** creates four smaller records from a larger one. This routine assumes that you have walked a "box" pattern on a test site and you finished the run at the same spot where you started it.

_The program will automatically calculate and apply data collection Bias, and will automatically reverse the third and fourth legs._

_The program will automatically adjust the start point for each leg so that the elevations on each leg will be correct relative to the start point elevation of the box._

_The program will automatically name the four legs Box_A, Box1_B, Box1_C, and Box1_D._

_After the legs are separated, the computer will automatically calculate the IRI of each leg. (Assuming the legs are long enough to get an IRI)_

You will then unbox each of the other boxes in turn to create Box2_A, Box2_B, and so on. Finally, you will link all the _A legs together to form a single run along the right wheelpath, and you will do the same with all the _C legs to form a single run along the left wheelpath. **The computer will automatically calculate the IRI of any runs that are long enough to get an IRI.**

You can do this on the Dipstick's on-board computer, or you can do this on your desktop PC. The software works the same in both programs.
CHAPTER 5 PROCESS

PROCESSING BOX DATA - DETAILS

UnBox the first Box

You can view the Run Notes by highlighting the first Box and using REPORT/NOTES to display the Run Notes. You will NOT need to write the numbers down. Highlight the first Box and use EDIT/UNBOX to unbox the Run. You will need to type in the step numbers at each of the three corners of the box, then tap “OK” or press <Enter>.

But then tap “OK” or press <Enter>.

The computer does the work for you, creating Box1_A, (250 steps); Box1_B, (6 steps); Box1_C, (250 steps) and Box1_D (6 steps).

Note: Arrows now show the profile layout after UNBOXing. Since you will probably want to compare the A and C legs (The two long runs) and perhaps the B and D legs (the two transverse runs), the program automatically reverses the C and D legs so they correspond to the direction of the A and B legs.

UNBOX SUBSEQUENT BOXES

- Now UnBox Box2 in the same way you did Box1 above. Continue UnBoxing in this fashion until you have UnBoxed all boxes into their legs.
CHAPTER 5  PROCESS

LINKING RUNS

Any two or more runs may be joined together to create one long continuous run by using the Link routine within the Edit header.

1. Select the first Run, (Box1_A) then select the second Run. (Box2_A) Be sure you select the Runs in the sequence you want them linked. You want the second Run to be linked onto the tail end of the first Run, so select them in the order you want them to link.

2. Tap or click EDIT/LINK to link these two Runs.

   The program will now join the two runs you highlighted, using the first run as the "base" run and linking the second run to the end of it.

   The new record will have the same name as that assigned to the first run but will have a ^L suffix attached to it, showing that it was Linked. In this example, it will be named Box1_A^L, and which will now be 500 steps long.

   The computer will automatically calculate the IRI of the new Linked run.

3. Select the newly Linked Run Box1_A^L. (This now actually represents both Box1_A and Box2_A, linked together.) Now select the Run named "Box3_A", and use EDIT/LINK to link these _A legs together.

   Again, the computer will automatically calculate the IRI of the new Linked run.

   You have just created the profile and IRI, for the right wheelpath for all three boxes combined.

4. Select leg _C of the first Box (Box1_C) then select the corresponding leg from the second Box. (Box2_C) Tap or click EDIT/LINK to link these two Runs. Do the same for Box3_C, and you will have the left wheelpath profile and IRI.

You are finished. If you select both wheelpaths, you may now calculate the half-Car IRI for the whole length if you wish, or you may use REPORT/GRAPH to see both wheelpaths overlaid on one another. If this is a very long profile, you may wish to use SETTINGS/GRAPH SETUP (on the 2277 Tablet) or TOOLS/GRAPH SETUP (on your desktop PC) to limit the graph to fewer steps per page. We suggest that you try using either 100 steps or 250 steps. This will make the details of the profile easier to see.

Note: Arrows show the profile after UNBOXing and Linking.

If there are more than three Boxes, just continue UnBoxing and Linking as described above until you have linked all the Runs in all the right wheelpath sections, and the same for all the Runs in all the left wheelpath sections.
TEST TRACK
"Test Track" creates two smaller records from a larger one. This routine assumes that you have walked a line “out-and-back” and you finished the run at the same spot where you started it.

Why do it?
Use this menu item when you want to check the performance of the Dipstick, after walking the Dipstick carefully on your Test Track. By splitting the data in half and reversing the second half, the "Out" leg can be compared with the "Back" leg. This is a special kind of Bias Run, done only to check to see if the Dipstick is working correctly. You normally do this on a marked floor indoors, so the “Test Track” will not change with the weather.

Note: Arrows show the path taken by the Dipstick® operator as data was collected.

Select your “Test Track” Run and use EDIT/TEST TRACK.

The "Test Track" window will appear. You will need to know the step number at the Turnaround point. Note:

If you wish to change the step number for the Turnaround point, or if you are manually entering the Turnaround point, just type the step number for the Turnaround point in the box, then press <Enter>.

The program will now automatically calculate a Bias, Segment the run at the Turnaround point, Reverse the second leg and assign a Start Point for each of the two Runs that is in relationship to the original Start Point.

The legs will have an "A" and "B" letter added as a suffix to the name of the original run. These letters correspond to the legs of the box as shown below.

Since you may want to compare the "Out" and "Back" legs, the program automatically reverses the B leg so it corresponds to the direction of the A leg.
CHAPTER 5  PROCESS

Here's what an "out-and-back" Run looks like before using the "Test Track" Routine:

It's 100 ft long, and it is symmetric about the Turnaround Point at 50 ft.

After using EDIT/TEST TRACK, here's what it looks like when you graph both parts of the line:

Now we have two separate 50-ft lines, and the profiles lie on top of each other. The only place the profiles show some minor deviation is where the operator walked off line for a short distance but eventually got back on line.

This shows that the “Out” portion of the Run matches the “Back” portion of the Run almost exactly. You should now compare this data to data that you collected in the past on this same “Test Track”. If today’s data matches the data collected several years ago, this means that three things have happened:

1. The floor where your Test Track is located has not changed because of an earthquake, expansive soils, or thermal effects.

2. You measured along the same line. If you measure only as little as ¼ or ½ inch off line, the profile will be different because the elevations on the floor will be different at different locations.

3. The Dipstick is still working exactly the same as it was two years ago when you last measured the Test Track.
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The 2277 tablet computer used on the Dipstick® is a Windows CE 6 computer with Samsung 6410 processor, touch screen, a slot for an SD card, and two USB ports. It comes from the FACE® Companies with an SD card installed, which has been pre-loaded with the RFCollect program.

The 2277 tablet has a built-in ROM chip that contains the Windows CE 6.0 operating system and a built-in Flash drive ("NandFlash"). If you ever lock up the computer, and if pressing the "reset" button doesn’t work, you can unplug the battery and start from scratch. None of your settings will be lost because the RFCollect program and settings are saved on the Flash Drive. The data you collect are stored on the tablet’s removable SD card, which is non-volatile Flash Memory.

**Four Quick Notes:**

1. **When you turn off the computer, press and hold the On/Off button until you see this icon. This is very important. Remember this and do this.**

   If you simply press and release the ON/Off button, the tablet will close the screen *but will keep running and will burn up power while it does this.* If you try to turn it on but it does not come on when you press the On/Off button, almost certainly you have not actually turned it off, but you have only turned off the screen and the Tablet has used up the battery accidentally. **To turn it off, press and hold the On/Off button until you see this icon.**

2. **Use the "reset" button frequently.** This ensures that the computer restores all its RAM and the programs will run more smoothly. You will **NOT** lose any data or programs when you reset the tablet. Resetting the tablet is like rebooting your desktop PC.
3. Because the On/Off button is so soft, it is very easy to turn the Tablet computer on. This can happen accidentally, which can cause you big problems. Store the 2277 Tablet computer in the case with the On/Off button **UP** as shown in the photo on this page. This is important. You can put the tablet into the case with the button up or down, but you always want the button **UP**. If you put it into the case with the button down, it might accidentally turn on and use up the battery while it is sitting in the case.

4. If the tablet doesn’t turn on, follow the procedure on the page 6-5 to get it to turn on.

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**STARTING THE RFCOLLECT PROGRAM**

There are several methods to start the program: Please be sure that the Face Company's SD Card is in the slot on the right side of the computer before you start.

- **Starting from Boot Up:**
  The program will start automatically when you boot up the computer. It will automatically open the last Job that you had open. This is the simplest way and the normal way to start the program.

- **Starting from the Windows Desktop**
  You may start the program from the Windows Desktop by double-tapping the icon for the RFCollect program (on the left side of the screen)

- **Starting from the Executable**
  You may start the program by double-tapping the "My Handheld PC" icon, then double-tapping the "NandFlash" icon, then double-tapping the "RFCollect" folder, then double-tapping the RFCollect Application.
TRANSFERRING DATA TO ANOTHER COMPUTER

Transferring data from the SD Card to the hard drive of your PC or laptop is called "downloading" or "backing up" the data. Regardless of what you call it, you should always do it daily, so you will have two copies of your data - one on the SD Card, and one on your laptop or PC. This is quite easy and fast using the SD Card Reader supplied with the Dipstick. This way you will have copies of the data in two places on two different storage media, and will minimize the risk of losing data. Most users also prefer to use a Desktop PC or a laptop computer to do final processing of the data and printing, because the screen and keys on your desktop are much larger.

You can use the SD Card Reader on your desktop PC as if it were a separate disk drive. Just pull out the SD Card and plug it into the Flash Reader. Connect the SD Card Reader to the USB port on your PC. The first time you use the SD Card Reader on your laptop or desktop PC, it will take a minute to automatically load the drivers, then it will open the drive so you can see the data on the SD Card; after the first time, it will open almost instantly.

The SD Card will usually be named "Removable Disk E" or something like that. Drag and drop the data folders you want from the named "Removable Disk E" to wherever you want on your desktop PC. We recommend keeping all your Dipstick data folders as subfolders in the main folder where you have installed the RFCollect program, such as C:\Dipstick\Data. The SD Card Reader is extremely fast. You can copy several jobs in a few seconds.

When you are finished copying the data to your hard drive, always click on the “Safely Remove” icon as shown in this image. Some versions of Windows® have different icons, but they all work the same.

Saving your data:

It's best to save your data on a desktop or laptop PC. If you download daily and save a copy of your data in two different places (on two different media) you will never lose your data. You might save your data on the hard drive of your PC, and zip a copy of the data to save on a thumb drive or a different computer. That way, if the hard drive of your desktop PC ever crashes, you'll have a backup copy of the data on a thumb drive or on a different computer. There is plenty of space on the SD Card to store 10 or 20 years worth of data. However, we do not recommend that you retain all your data files on the SD Card forever, just because it makes it harder for you to find what you want when there are hundreds of Job folders.

IMPORTANT NOTE: If you download the data from a single project to your PC more than once, your computer will see that you are downloading data from the same folder and it will ask you if it is OK to overwrite data files. NEVER allow it to overwrite data files. If you download the same Job folder more than once, make sure that you rename one of the folders to a slightly different name before you download. If your Job Name is “KMART”, rename one of the folders to “KMART1” or something like that before you download the second time, so there will be no conflict.
HANDY TIPS FOR USING THE 2277 TABLET:

USING THE HANDLE BATTERY TO POWER YOUR 2277 TABLET:
Always (ALWAYS) use the Dipstick's Handle Battery or the AC Adapter. If you use the 2277 Tablet’s built-in Lithium-Ion battery to power the tablet, it will work fine, but will only last a few hours. The AC Adapter works great at a desk, and will power the Tablet forever. For collecting data, use the Dipstick's Handle Battery. If you charge the Handle Battery properly, it will give you many hours of service. If you charge the 2277 Tablet and the Dipstick Handle Battery every night before using it the next day, you will never risk having the 2277 tablet computer shut down during data collection because it has no power. It is very important to keep the Tablet and the Dipstick® Handle Battery fully charged and to always use the Handle Battery to power the 2277 Tablet. Charging the Handle Battery is covered in Chapter 7, Maintenance. If you charge the Handle Battery properly, it will give you many hours of service and you won’t run out of battery power. Do NOT risk having the Tablet shut down during data collection because it has no power.

CHECKING THE 2277 TABLET’S VOLTAGE:
You can use the Power Indicator on the right side of the screen to get a “quick check” of the tablet’s power status. If it is green, this means that the tablet’s internal battery is being recharged from an external source (AC Adapter or Handle Battery) and is already fully charged. If it is red, this means that although the tablet’s internal battery is NOT fully charged, the tablet is receiving external power from an AC Adapter or from the Handle Battery. If the Power Indicator is black, this means that the tablet’s internal battery is NOT receiving external power. Red is good, and Green is better. Black does not mean “Bad,” just that it is running on its own internal battery.

To see the status of the Tablet’s internal battery, tap the “Shortcut to Power” icon on the tablet’s screen. This will tell you what percentage of full power is remaining.

CHECKING THE HANDLE BATTERY’S VOLTAGE:
The LED Voltmeter on the Handle Mount displays the voltage in the Handle Battery.

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</tr>
<tr>
<td>4V</td>
</tr>
</tbody>
</table>
Chapter 6    The 2277 Tablet Computer

CHANGING THE SCREEN BACKLIGHTING:
The number of hours of operation that you can expect to get will depend in part on how bright you set the Tablet’s screen backlighting. For outdoors in full sunlight, set the backlighting to max. If you are operating indoors or in shade, you can set the backlighting to a lower setting, which will greatly extend the number of hours of operation you can get from the Tablet. To change the amount of backlighting, tap the “Shortcut to Backlight Ctrl” on the Tablet’s desktop screen.

You can switch between the DFDC program and the Tablet’s “desktop” screen by tapping the “Multiple Folders” icon in the bottom right corner of the screen.

This will allow you to change the backlighting and power level, and switch back to the DFDC program quickly and easily.

OPERATING DURATION
With a fully charged Handle Battery and a fully charged Tablet battery, and with the screen backlighting at 100%, you can expect to get more than 8 hours of operation.

If you use a lower backlighting level, you can double the length of time. If you will only be measuring for a few hours, you can use max brightness. But in most cases, you don’t really need max brightness. Use your head and change the backlighting level to whatever level you need.

The Tablet computer alone, without Handle Battery, will give from 3 to 6 hours of operation. That's OK if you only need to collect a small amount of data, but you'll be much safer if you use the Handle Battery. You don’t want to run out of power for your Tablet computer.

When you plug the Dipstick Handle Battery into the Tablet computer, does the small "Power Indicator" change from black to red? If does, that means your Handle Battery is providing power to the Tablet computer.

The computer will not start and run on a nearly depleted battery. If you deplete the battery, then put it on charge, the computer must be charged for a long time before it will turn on. For this reason, you cannot run a 2277 computer using only the Handle Battery for power, unless you are willing to wait a long time for it to charge up. If you change the battery in a flashlight, hand-held radio, or GPS, the device will instantly work. If your Cell phone goes completely dead, once you connect it to an AC Adapter, it will turn on, even if it only has 1% or less power in the battery. The 2277 computer will not. It needs to get something of a charge before it will start.

On the other hand, if the computer turns on, it will indeed run on a partially discharged battery, and it will run until the computer’s battery is very very low. As stated above, the Handle battery can extend the life of the computer battery. The computer does not like to boot up and start on a nearly depleted battery, but once started, it will run just fine until the battery is completely dead.
STARTING A “DEAD” TABLET COMPUTER:
If your computer just won’t turn on, it is likely that the battery may be dead. Maybe you forgot to recharge it or maybe it was turned on accidentally and ran itself down. Even if you connect it to a Handle Battery or an AC Adapter, if it is completely dead, it will take a good bit of charging before it will start up. Think about starting a car with a dead battery in below-freezing temperatures. The car will not start, even connected to jumper cables or a recharging power supply until the battery has absorbed sufficient power. You need to wait a few minutes for a sufficient charge to build up before the car will start. The Tablet computer works the same way.

If you have connected it to the AC Adapter and have waited a long time and it still will not start, you can get it to start by removing the battery, waiting 10 or more minutes, then replacing the battery. To remove the battery, unscrew the single button-head socket cap screw that holds the Tablet to the turntable. This screw is at the bottom center of the screen. Then unscrew the two #1 Phillips head screws on the bottom of the Tablet. You will need a #1 Phillips head screwdriver to do this. Remember to wait at least ten minutes before replacing the battery and the three screws.

One nice feature of the 2277 Tablet computer is that since it has an internal Flash memory, even if all the batteries die completely, your program and your data and your tablet’s settings are safe and secure. You never need to reset the settings for the 2277 Tablet.

“PROBLEM OPENING THE SERIAL PORT”
If your Tablet gives you this error message, it means that you have two or more copies of the DFDC (Data Collection) program open at the same time and they are competing for the Tablet’s serial port. The solution is to close all but one DFDC program, or close them all, then start the DFDC program one time.

USING THE STYLUS:
Keep the stylus in its sleeve at the right rear of the tablet. If you always put the stylus away after using it, you’ll know where it is the next time you need it.

The Stylus belongs in one of only two places:
- In your hand, or
- In the groove or sleeve on the back of the Tablet.

We have hidden a spare stylus in the kit for you. If you lose yours, look around the case carefully and you may find the hidden stylus. If you don’t find it, call us up and we’ll tell you where it is. In case you lose both of them, as a temporary replacement, you may also use anything relatively hard but not sharp. If you have long fingernails, they will work nicely. You may also use the plastic corner of a (closed) pen. Do not use anything metal or sharp, as it may damage the touch screen. Do not use a pencil or pen, because they will leave marks on the screen.
CALIBRATING THE TOUCH SCREEN
If the tablet does not seem to recognize your stylus taps, you may need to recalibrate the touch screen. To do this, close or minimize the DFDC program by tapping the icon in the lower right corner. See the picture near the top of page 6-5. This will show you the Desktop. Double-tap the Shortcut to Control Panel, then Double-tap “Stylus”. Tap the “Calibration” Tab, then tap “Recalibrate”. You will see a “+” sign in the middle of the screen. Carefully press and briefly hold the stylus on the center of the plus sign. Repeat this 4 more times as the target moves around the screen. After you have successfully calibrated the touch screen, the screen will be blank, without any “+” signs. To close the calibration window, tap anywhere on the screen. Your touch screen is now recalibrated. Close all open windows and either reboot the tablet or tap the DFDC6.0 icon at the bottom of the desktop screen.

TEMPERATURE RANGE
If you must operate in extremely hot or extremely cold conditions, the Dipstick itself will operate properly under pretty much whatever temperature range you can stand, but the tablet computer may not function properly at extreme temperatures. The tablet’s working temperature is listed as 32° - 122° F or 0-50° C. There are several ways to collect data at extreme temperatures:

- Collect data normally and take frequent breaks in a very warm (or very cool air conditioned) space. If the temperature is cold, but not bitterly cold, (or if it is hot but not blistering hot) you can operate normally. The computer’s screen is the first thing to stop working at extreme temperatures. If it is very cold, the screen will gradually turn white and you won’t be able to read it. If it is very hot, the screen will gradually turn black and you won’t be able to read it. But if the Dipstick still beeps when you turn it, the Dipstick is still collecting data, and the data will be good. When you have finished the Run, take the Dipstick back to your truck or to a heated or air conditioned space. The screen will appear in a moment or so after you re-enter a space that is at normal temperature.

- Put a lightweight clear bag over the tablet, and put one or two “handwarmers” into the bag. You can buy these lightweight chemical handwarmer or pocket warmer packets that you shake to activate at convenience stores. They do not get very hot but they do get pretty warm. If you throw a couple of these into the bag, then seal it up with duct tape or similar so the warm air cannot get out, the computer won’t get very cold and will still display properly. Use a lightweight flexible bag so you can use the touch screen and virtual keyboard through the bag.

- Collect data manually. This is your last resort, because it’s more work, but since the Dipstick will operate properly at extreme temperatures where the computer will not work, you can always do this even in very extreme conditions. Just read the numbers on the Dipstick windows and either write each reading down or read them into a pocket recorder. Be sure to read the minus sign if appropriate and speak clearly if you use a recording device. Later, someone will need to create Runs from this data using the RoadFace program as described in Chapter 5.
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DIPSTICK® CARE AND OPERATION

The Dipstick requires very little in the way of maintenance but there are a few things to remember that will help prolong the Dipstick’s life and accuracy.

MOISTURE

The Dipstick has been sealed at the factory and will resist humidity and a few drops of water; however it is not completely waterproof. The unit must never be allowed to get wet during operation. If it gets wet, the water may destroy components inside of the Dipstick unit and render the Dipstick inoperable. Water and moisture damage are not covered under warranty.

The 2277 TABLET Computer is more sensitive to water damage, dirt and dust. Keep it covered whenever possible. Do NOT allow rain or liquid of any kind to get into the openings.

TEMPERATURE RANGES

The Dipstick® has been designed for use under a wide range of environmental conditions. However, the Tablet mounted on the Dipstick is limited to a temperature range of 0ºC to 50ºC (32º to 122ºF). You may use the Dipstick outside of this temperature range, but you’ll need to take care of the computer, and keep it as close as possible to the nominal temperature range. The data you collect will be good, so long as the computer is able to capture and store the readings coming from the Dipstick. It should be noted that temperatures in direct sunlight or within a closed automobile can be significantly higher than the local outside air temperature. Therefore, avoid direct sunlight on extremely hot days.

If the Dipstick and Tablet must be used outside of the specified temperature range, follow the instructions in Chapter 6 for doing this.

SHOCK AND VIBRATION

The Dipstick has been designed for use in industrial applications. However, it is a sensitive electronic instrument. Protect the unit from shock and severe vibration, particularly during transportation and storage. Excessive shock to the computer may damage the unit.

ELECTRICAL NOISE

The computer is susceptible to electromagnetic noise and strong magnetic fields. Be especially careful if you must collect data near operating heavy-duty electrical equipment such as welding machines and transformers.

CLEANING THE DIPSTICK® BODY

The main body of the Dipstick and the computer connector attached to it are chrome plated. Fingerprints and oil may be easily removed with a clean soft rag or tissue.

The other shiny parts are clear powder-coat over polished aluminum. Do not use any solvents on these parts or the finish may be destroyed.
Chapter 7   MAINTENANCE

The black parts are coated with a very hard flat black powder coating with a textured finish. Small nicks may be easily touched up with an indelible black felt-tipped marker.

Never use water or detergent on the Dipstick. If it gets wet inside, the water may destroy components inside of the Dipstick unit and render the Dipstick inoperable. Water and moisture damage are not covered under warranty.

CLEANING THE SWIVEL "MOON" FEET
Grit and dirt can get underneath the ball and swivel joint of the swivel foot causing the feet to “stick”, resulting in erratic readings.

Clean the ball/swivel joint with degreaser or alcohol, being sure to work out all the dirt from the under side of the ball and swivel. Allow the swivel foot to dry.

Use an anti-seizing lubricant to coat the ball and swivel. You can buy a small tube or bottle of this at any auto parts store. The smallest size you can buy will last many years. Work the lubricant to the under side of the ball and swivel. Remove any excess lubricant from the outside of the swivel feet.

BATTERIES

NOTE THAT THERE ARE 3 DIFFERENT SETS OF BATTERIES
There are 3 different sets of batteries in the Dipstick kit. They are:
  1. The Ni-Cad battery pack in the body of the Dipstick unit itself.
  2. The Dipstick Handle Battery. This Ni-Cad battery pack is contained within the lower handle section, and is used to provide power for the 2277 Tablet computer while collecting data.
  3. The 2277 Tablet battery. This Lithium-Ion battery is located in the underside of the 2277 Tablet computer.

- The 2277 Tablet does not need or have a “backup” battery. All the settings are stored in non-volatile Flash memory.

Each different battery is described in detail below, and instructions are provided for replacing batteries where appropriate.

NOT USING THE DIPSTICK® FOR AN EXTENDED PERIOD
Note: If you do not use your Dipstick for a long period of time, you should charge all three rechargeable batteries once a month or so, even if you do not use the Dipstick. Allowing the batteries to go dead can cause premature battery failure and corrosion due to leakage of battery acid.
DIPSTICK® BATTERY
Your Dipstick 2277 is powered by a rechargeable Ni-Cad battery pack that is contained in the body of the Dipstick® unit. You can expect 10 hours or more of operation before recharging is necessary. The computer will monitor the voltage in the Dipstick® as you use it. (Collect/Voltage gets you the Dipstick voltage)

LOW BATTERY (LOBAT)
The Dipstick LOBAT indicator will engage at 10.7 volts. (A full charge will yield 13.2 or more volts of battery power.) You can check the voltage from by using COLLECT/VOLTAGE. This will report the current voltage reading within the Dipstick.

AUTO-SHUTDOWN (OFF)
The Dipstick itself will let you know when the battery voltage is too low to collect data. The Dipstick will give a series of 3 short beeps to let you know that the batteries need to be recharged and will automatically shut down if the voltage drops below the critical voltage. (10.5 volts) When it does this, the screen will display the word OFF.

At this point, you cannot collect data and need to recharge the Dipstick batteries. While you are doing this, recharge the Handle Battery and the Tablet too.
Chapter 7  MAINTENANCE

HOW TO RECHARGE THE DIPSTICK® BATTERY PACK

WARNING! NEVER ATTEMPT TO RECHARGE ALKALINE, "RECHARGEABLE ALKALINE" OR CONVENTIONAL BATTERIES IN THE DIPSTICK®. THEY MAY EXPLODE AND SERIOUS DAMAGE TO THE DIPSTICK® MAY RESULT WHICH WILL NOT BE COVERED UNDER WARRANTY.

Charge the Dipstick by using the Dipstick AC adapter provided in the case. This is the one that has the same “Face” label that matches the “Face” label on the Dipstick. The recharge port is on the underside of the Dipstick®.

• Turn off the Dipstick unit by flipping the on/off switch down. The Dipstick will not charge if it is turned “on”.

• Turn the Dipstick over and plug the Dipstick AC adapter supplied with the kit into the recharge port, then plug the AC adapter into a wall outlet. (The AC adapter works with any voltage from 100V 50 Hz to 240V 60 Hz) You may need to use a plug adapter.

• Verify that the unit is charging. If the Dipstick is charging, the light next to the recharge port will light up. If the light does not come on, you may have used the wrong AC adapter. Do not attempt to use the 2277 Tablet computer's AC adapter to charge the Dipstick. You can tell which AC adapter belongs to which device by matching the “FACE” logo on the AC Adapter to the “FACE” logo on the Dipstick.

• The Dipstick will fully recharge overnight. Be sure to leave the Dipstick turned off and plugged in overnight. A full recharge will yield 13.2 or more volts of battery power. The Dipstick Low Bat light will engage at 10.7 volts and the Dipstick will shut down automatically at 10.5 volts.

USING OTHER TYPES OF BATTERIES WITH YOUR DIPSTICK®

If you forget to charge your Dipstick and still need to gather data, you may use 1.5 volt (AA size) alkaline batteries. Never mix alkaline and Ni-Cad batteries in the battery pack and never try to recharge the alkaline batteries.

If you place alkaline or other conventional batteries in the Dipstick, put a piece of tape over the charging port to remind you not to plug in the charger while conventional batteries are in the Dipstick.
Chapter 7  MAINTENANCE

As a temporary measure, you may also use "rechargeable alkaline" batteries in the Dipstick. "RECHARGEABLE ALKALINE" BATTERIES ARE NOT THE SAME AS NI-CAD BATTERIES and must never be charged in the Dipstick. Also, "NICKEL METAL HYDRIDE" BATTERIES AND Li-Ion BATTERIES ARE NOT THE SAME AS NI-CAD BATTERIES and must never be charged in the Dipstick®. You must use your own specific recharger if you have this kind of battery.

DRAINING THE NI-CAD BATTERIES:
After years of operation, Ni-Cad batteries will only recharge to a certain level of efficiency after repeated recharging. They develop a "memory" of discharge patterns. This means that they will not hold full voltage. You can help to curtail this by draining the batteries completely on a yearly basis. Do not do this every day, every week, or even every month.

Leave the Dipstick on over a weekend without the computer or any other adapters plugged in. This should completely drain the Ni-Cad Battery pack; then recharge the Dipstick overnight to restore full capacity.

HOW TO CHANGE THE DIPSTICK® BATTERIES

- Turn the Dipstick off and turn it over.
- Using the Allen wrench provided, remove the 2 cap screws and the Battery End Cap from the Dipstick. (Note: This is on the opposite end from the On/Off Switch)
- Remove the Battery Pack from inside the Dipstick.
- Replace the batteries within the battery pack.
- Replace the Battery Pack inside the Dipstick.
- Replace the End Cap on the Dipstick.
- Replace the cap screws using the Allen Wrench.
- If using other than NICAD batteries, place a piece of tape over the recharge port and mark on it "ALKALINES IN - DO NOT RECHARGE".

NOTE: Nickel-Metal Hydride or Lithium Ion batteries ARE NOT the same as Nickel-Cadmium (Ni-Cad) batteries. You can use them, but DO NOT RECHARGE them in the Dipstick. If you use them, place a piece of tape over the recharge port and mark it "Nickel-Metal Hydride batteries in – do not recharge!"

Warm Up the Dipstick unit and rezero prior to use.
HANDLE BATTERY (for powering the 2277 Tablet computer)

The Face Companies have developed a rechargeable power supply which fits in the lower Dipstick handle section. When properly charged, this Handle Battery Pack will provide many hours of power to the computer, so you are able to collect a large amount of data without needing to recharge the tablet computer's own battery. Whenever you collect data, and whenever you are at a desk but are not able to use the AC adapter, you should use the handle battery. This will greatly prolong the life of the battery in the back of the 2277 Tablet. This special handle battery is not user-serviceable. If anything should ever go wrong with it, return it to the Face® Companies for repair or replacement.

WHEN TO USE THE HANDLE BATTERY

Use it to power the 2277 Tablet whenever you can't use the AC adapter. This means whenever you are collecting data and whenever you are processing data but for some reason cannot use the 2277 Tablet's AC adapter.

When the handle battery pack is in use, the battery inside the computer will actually be recharged by the handle battery.

HOW TO RECHARGE THE HANDLE BATTERY

You recharge the Dipstick and the Handle at the same time, using only one AC adapter.

- Lay the Dipstick on its side on a smooth clean surface, or a paper towel.

- Plug the DS 2277 AC adapter into the wall and plug the jack into the bottom of the Dipstick®.

- There are two AC Adapters in the Dipstick® kit. Be sure you use the Dipstick2277 AC adapter, NOT the 2277 Tablet AC adapter. If you are charging properly, the green indicator light on the bottom of the Dipstick® will light up. You can tell which AC Adapter belongs to which device by matching the “FACE” logo on the AC Adapter to the “FACE” logo on the Dipstick or Tablet computer.
HOW TO CHARGE THE HANDLE BATTERY:

- On the Handle Battery, take the wire that normally powers the 2277 Tablet and plug it into the Dipstick Switch End Cap right above the zeroing button.

- Let the kit charge overnight. You can get a good charge in about 5 hours, but overnight is better.

Here's what the Dipstick looks like while you are charging it:

Note that the AC Adapter is plugged into the bottom of the Dipstick next to the green light, and the light is "on." Also note that the Handle Battery is plugged into the front of the Dipstick Switch End Cap, right above the Zeroing button. The Dipstick gets its charge from the AC Adapter, and the Handle Battery gets its charge from the Dipstick Switch End Cap.

Note: if you own a DS2277 that has been converted from an earlier model, you may need to use a short "Pig-tail” wire with a plug and a jack to match your Dipstick’s port. The version shown above is a new Dipstick 2277, which does not need a "Pig-tail” connector.

The "Pig-tail" is shown in the photo to the right. **If you have a "Pig-tail", you must always use it!** The "Pig-tail" is designed to allow you to mate the Handle Battery’s connector (which must fit the Handle Mount) to your old Dipstick body, which has a port for the older model computer that you used to have before it was upgraded. An upgraded Dipstick 2272→2277 does not need a pigtail because the connectors on the 2272 and 2277 are the same.
Chapter 7  MAINTENANCE

HOW TO DETERMINE THE CHARGE IN THE HANDLE BATTERY

It is very important to keep the Dipstick® Handle Battery fully charged and to always use the Handle Battery to power the 2277 Tablet. Otherwise, you’ll be using the Tablet’s rechargeable battery every day, and you run the risk of losing power to the 2277 Tablet while collecting data. If you charge the Handle Battery properly, it will give you many hours of service. If you charge the Handle Battery every night before using it the next day, you will never run out of battery power. Do NOT risk having the 2277 Tablet computer shut down during data collection because it has no power.

You can check the status of the Handle Battery just by looking at the LED Voltmeter, and by looking at the Tablet computer’s Power Indicator. If the Tablet’s Power Indicator is red, it is recharging from the Handle Battery and the Tablet thinks the Handle Battery is an AC adapter.

With a fully charged Handle Battery and a fully charged Tablet battery, and with the screen backlighting at 100%, you can expect to get more than 8 hours of operation. If you use a lower backlighting level, you can double the length of time. If you will only be measuring for a few hours, you can use max brightness. But in most cases, you don’t really need max brightness. Use your head and change the backlighting level to whatever level you need.

The Tablet computer alone, without Handle Battery, will give from 3 to 6 hours of operation. That’s OK if you only need to collect a small amount of data, but you’ll be much safer if you use the Handle Battery. You don’t want to run out of power for your Tablet computer.

<table>
<thead>
<tr>
<th>Handle Battery Voltage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.5V</td>
<td>Fully Charged</td>
</tr>
<tr>
<td>12V</td>
<td>Partial Charge, sufficient to power the Tablet</td>
</tr>
<tr>
<td>9V</td>
<td>Still useful in powering the Tablet</td>
</tr>
<tr>
<td>6V</td>
<td>Low Battery</td>
</tr>
<tr>
<td>4V</td>
<td>Too low to be useful</td>
</tr>
</tbody>
</table>

IF THE HANDLE BATTERY EVER FAILS

The special Handle Battery Pack provides power for the 2277 Tablet computer. The Handle Battery Pack contains special batteries that are not readily available and is not user-serviceable. If anything goes wrong with the Handle Battery, E-mail or call us.

BACKUP BATTERY:

Unlike the HP720 computer, the 2277 Tablet computer does not need a backup battery, so you don’t need to worry about this. The settings on the 2277 Tablet are saved on non-volatile Flash memory inside the Tablet.
There are only a few problems that come up from time to time with the Dipstick® or its 2277 tablet computer. However, any one problem that prevents you from collecting data or reporting results is potentially a big problem and needs to be resolved. The list (below) describes the common problems and their solutions.

<table>
<thead>
<tr>
<th>2277 tablet or Desktop PC Problems</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2277 Tablet fails to turn on</td>
<td>• This is almost always because the 2277 Tablet was turned on inside the case, or you failed to turn it all the way off. You'll need to recharge it for a while before it turns on. To turn it off properly, follow the instructions on page 6-1.</td>
</tr>
<tr>
<td>2277 Tablet Screen Is Too Dim</td>
<td>• Follow instructions on page 6-5 to adjust screen brightness.</td>
</tr>
<tr>
<td>Tablet runs out of power too fast</td>
<td>• Don’t use full brightness on the screen unless you need it. Follow instructions on page 6-5 to adjust screen brightness.</td>
</tr>
<tr>
<td>Need to know how much power is left on the 2277 Tablet</td>
<td>• Follow instructions on page 6-4 to get the percentage of power left in the 2277 Tablet.</td>
</tr>
<tr>
<td>Error message: Can’t find RFCollect (or one of its components). Make sure the path and filename are correct and that all required libraries are available.</td>
<td>• This error message tells you that the shortcut on the tablet may be corrupted or that you may have deleted one of the program files. • First try resetting the computer. • If that does not work, go to the Storage Card, highlight the RFDCHP720.EXE file, and use EDIT/COPY. Then go to Windows/Desktop and use EDIT/PASTE SHORTCUT. • If this does not solve the problem, use the card reader to copy the RFCollect program and 3 DLL files from your Face Co. CD to the Storage Card.</td>
</tr>
<tr>
<td>Error message: Problem Opening the serial Port 1</td>
<td>• You have more than one copy of RFCollect open and they are competing for the Serial Port. Close all but one copy of the RFCollect program. If in doubt, reset the tablet.</td>
</tr>
<tr>
<td>Can’t open an existing Job</td>
<td>• Verify that the Job actually exists (Verify that you have not deleted this Job) • Verify that the Job contains both (<em>.FRD) data files and (</em>.SAF) key files. If there are no .SAF files, rename the three .BAC files to .SAF. Just change the three extensions from .BAC to .SAF</td>
</tr>
<tr>
<td>Can’t find the “backup” battery</td>
<td>• The 2277 Tablet does not need or have a “backup” battery. Your tablet setup is saved on non-volatile Flash memory.</td>
</tr>
<tr>
<td>There is no IRI for this run.</td>
<td>• You need at least 36 readings to calculate IRI. • IRI can only be calculated from data collected at 12”, 250 mm, or 300 mm. The footspacing or Metric/Imperial switches may be wrong. Fix them with EDIT/RUN HEADER.</td>
</tr>
<tr>
<td>Printer related Problems:</td>
<td><strong>The RFDC Program does not print.</strong> Use the SD Card Reader to download your data and then print your reports from your desktop PC. RoadFace will print from your PC to any printer connected to your PC, local or network.</td>
</tr>
</tbody>
</table>

8-1
**CHAPTER 8 - TROUBLESHOOTING**

<table>
<thead>
<tr>
<th>Dipstick® Related Problems</th>
<th>Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dipstick® will not turn on</strong></td>
<td>• Plug in the Dipstick® AC adapter and verify that the &quot;charging&quot; light comes on. Open and re-seat batteries in the Dipstick® battery pack. If the Dipstick® still does not come on, replace batteries with Alkaline Batteries. Put tape over the charge port to prevent accidental charging of alkaline batteries.</td>
</tr>
<tr>
<td><strong>Dipstick® not collecting data</strong>&lt;br&gt; This is a hardware problem. If the computer can't communicate with the Dipstick, the Dipstick can't collect data.</td>
<td>• Ensure that the serial cable from the handle bracket is securely attached to the 2277 Tablet. &lt;br&gt; • Ensure that the coiled cable from the handle bracket to the Dipstick is securely attached at both ends. &lt;br&gt; • Ensure that the Dipstick is turned on, and is not reporting a low battery condition.</td>
</tr>
<tr>
<td><strong>Dipstick® Is Slow Capturing Readings</strong>&lt;br&gt; <em>Check the Hardware Settings.</em>&lt;br&gt; <em>Which mode of data collection (automatic or trigger) is being used? Check the Dipstick voltage.</em></td>
<td>• You may be on a vibrating structure. Try Averaging. &lt;br&gt; • If you are using the Averaging algorithm, select a larger &quot;allowable difference&quot;. Try 0.004 first, then 0.010. &lt;br&gt; • If you have a trigger model, select Trigger. &lt;br&gt; • If you do not have a trigger on your handle, or if your trigger is inoperative for any reason, select Automatic. &lt;br&gt; If the voltage is lower than 10.5 V, recharge the Dipstick® overnight.</td>
</tr>
<tr>
<td><strong>Dipstick® Batteries Not Giving Enough &quot;On&quot; Time</strong>&lt;br&gt; <em>If you are sure the batteries were properly charged, but they still don't give enough &quot;on&quot; time:</em>&lt;br&gt; <em>If this fails to give at least 10 hours of &quot;on&quot; time:</em></td>
<td>• Be sure that you have the original Ni-Cad batteries in the Dipstick® and they are not loose or out of position, and that you have charged them properly overnight. &lt;br&gt; • Drain the batteries for a weekend and then recharge them overnight. (See Chapter 7, Maintenance.) &lt;br&gt; • Purchase 10 AA-size Ni-Cad batteries and install them in the battery pack, or return the Dipstick to the Face Company for replacement of the Ni-Cad batteries. &lt;br&gt; Recharge the Ni-Cad batteries within the Dipstick® unit. See Chapter 7, Maintenance. You can use alkalines temporarily.</td>
</tr>
<tr>
<td><strong>&quot;Off&quot;</strong>&lt;br&gt; When the Dipstick L.C.D. screens display “OFF”, the Dipstick® has lost all power and has shut itself down.</td>
<td>Recharge the Ni-Cad batteries within the Dipstick® unit. See Chapter 7, Maintenance. You can use alkalines temporarily.</td>
</tr>
<tr>
<td><strong>&quot;Lo Bat&quot;</strong>&lt;br&gt; When the Dipstick® L.C.D. screens display “LO BAT”, the Dipstick®'s batteries are nearing the point where they cannot provide enough voltage to collect data properly.</td>
<td>Recharge the Ni-Cad batteries within the Dipstick® unit. See Chapter 7, Maintenance. You can use alkalines temporarily. If the Dipstick allows you to collect data, it will be good data.</td>
</tr>
<tr>
<td><strong>Handle Batteries not giving enough &quot;on&quot; time to the tablet computer</strong>&lt;br&gt; <em>If the Handle Battery was charged overnight and still does not provide enough “on” time:</em>&lt;br&gt; <em>If this fails to give at least 8 hours of “on” time:</em></td>
<td>• Be sure you have charged the handle properly overnight. &lt;br&gt; • Turn the screen Brightness down. &lt;br&gt; • Drain the batteries in the handle for a weekend, then recharge them overnight. &lt;br&gt; • Return the handle to the Face Company for replacement. You will not be able to replace the batteries in the Handle yourself.</td>
</tr>
</tbody>
</table>
## CHAPTER 8 - TROUBLESHOOTING

### False Readings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Action Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the Start end of the Dipstick® is forward, but the sequential reading number is even,</td>
<td>- You must keep track of which end of the Dipstick (battery or start end) is forward after a reading has been taken. The sequential number displayed by the computer should be an odd number when the Switch/Start End of the Dipstick is in the forward position after that Reading has been taken. If it is not an odd number, then a false reading has been taken or a reading has been skipped. If the Start End of the Dipstick is forward after an odd number reading has been taken, then the sequential order is OK. The same is true if the Battery End of the Dipstick is forward after an even number reading has been taken. <strong>As you collect data, every once in a while, check to verify that the Switch/Start end is forward when it beeps and an Odd step Number is shown.</strong>&lt;br&gt;- If there is a very large step UP in the graph, where there should not be one, <strong>this is a False reading.</strong>&lt;br&gt;- If the IRI is really really bad, check the graph for a False reading.&lt;br&gt;- When a false reading occurs, the numbering of the survey line gets out of order and the polarity of the signs (+ or -) on the Dipstick will be reversed. This will cause your profile to be turned “upside down” from the point of the error.</td>
</tr>
<tr>
<td>If the trigger is in the wrong position,</td>
<td>- The trigger should always be pressed from front to back to collect data. <strong>If you have to press from rear to front, you are out of sequence.</strong>&lt;br&gt;- If you see a large step UP in the graph where there should not be one, this is a False reading.&lt;br&gt;- If the IRI is really really bad, check the graph for a False reading.&lt;br&gt;&lt;br&gt;<strong>TO FIX A FALSE READING LATER:</strong>&lt;br&gt;- If you have been going either up or down hill, or if the False Reading is large enough to see easily:&lt;br&gt;- Use REPORT/GRAPH, and estimate within 5 steps or so where the profile suddenly jumps up.&lt;br&gt;- Then use EDIT/READINGS, scroll down to the bad reading. It will be very large. Delete the False Reading.&lt;br&gt;- Then press “Change Sign” to change the +/- sign of all subsequent readings.</td>
</tr>
<tr>
<td>If there is a very large step UP in the graph, where there should not be one,</td>
<td>- If the IRI is far worse than you have ever seen before, <strong>check the graph for a False reading.</strong>&lt;br&gt;- If part of the profile is “upside down” <strong>you must keep track of which end of the Dipstick (battery or start end) is forward after a reading has been taken. The sequential number displayed by the computer should be an odd number when the Switch/Start End of the Dipstick is in the forward position after that Reading has been taken. If it is not an odd number, then a false reading has been taken or a reading has been skipped. If the Start End of the Dipstick is forward after an odd number reading has been taken, then the sequential order is OK. The same is true if the Battery End of the Dipstick is forward after an even number reading has been taken.</strong> <strong>As you collect data, every once in a while, check to verify that the Switch/Start end is forward when it beeps and an Odd step Number is shown.</strong>&lt;br&gt;- The trigger should always be pressed from front to back to collect data. <strong>If you have to press from rear to front, you are out of sequence.</strong>&lt;br&gt;- If you see a large step UP in the graph where there should not be one, this is a False reading.&lt;br&gt;- If the IRI is really really bad, check the graph for a False reading.&lt;br&gt;- When a false reading occurs, the numbering of the survey line gets out of order and the polarity of the signs (+ or -) on the Dipstick will be reversed. This will cause your profile to be turned “upside down” from the point of the error.</td>
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<td>If the IRI is far worse than you have ever seen before,</td>
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</tr>
<tr>
<td>If part of the profile is “upside down”</td>
<td>- If part of the profile is “upside down”, <strong>check the graph for a False reading.</strong>&lt;br&gt;- When a false reading occurs, the numbering of the survey line gets out of order and the polarity of the signs (+ or -) on the Dipstick will be reversed. This will cause your profile to be turned “upside down” from the point of the error.</td>
</tr>
</tbody>
</table>

### To correct a False Or Skipped reading:

- If you are collecting data in long lines, you should mark the pavement with the keel provided in the kit occasionally to show that a good reading was taken at a particular point. If you have occasionally marked locations along the survey line with sequential reading numbers, it will be possible to continue with data collection from the last point that was marked by using APPEND. If there are no known points marked on the pavement, then it may be necessary to redo the whole line if a false reading was taken.

A "Skipped Reading" is where you turned the Dipstick without taking data. (You did not wait for the beep)

### IF YOU CATCH IT WHEN IT HAPPENS:

- **STOP!** Tap “Stop” to stop collecting data.<br>- Do not move the Dipstick.<br>- Get back to the main menu and use COLLECT/APPEND and “Last Good Step” from two steps back. (2 steps less than that shown on the screen)<br>- Collect the rest of the run normally

### TO FIX A FALSE READING LATER:

- If you have been going either up or down hill, or if the False Reading is large enough to see easily:<br>- Use REPORT/GRAPH, and estimate within 5 steps or so where the profile suddenly jumps up.<br>- Then use EDIT/READINGS, scroll down to the bad reading. It will be very large. Delete the False Reading.<br>- Then press “Change Sign” to change the +/- sign of all subsequent readings.

### TO FIX A SKIPPED READING:

- There is no easy way to find the place where you skipped a reading, so you’ll need to do the Run over.
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CHAPTER 9 - BIAS

DATA COLLECTION BIAS

WHAT IS BIAS?
Data Collection Bias is a small, relatively consistent error which may be introduced when taking measurements on a Dipstick. Bias will have no effect at all on Roughness Indices like IRI, but will have a very small effect on the slope of the profile, and a larger effect on point elevations, particularly on long runs. The error is manifest in the form of a very small tilt upwards of the profile – approximately 1/1000 inch per foot, or about 0.0047°. This error can be introduced several different ways – by the texture of the pavement, by the dirt and dust on the pavement, and to a much smaller degree, from very minor variations in the electronic circuitry of each Dipstick.

Data Collection Bias is measured in inches (or mm) per step and entered in 5 place decimals (.00000”). Data Collection Bias can vary from near zero to over .003” or more per reading, and is always positive.

The source of bias cannot easily be distinctly separated and measured. However, the total data collection bias is automatically removed by “Unboxing” any data collected in “boxes,” and can easily be measured and compensated for in other cases by performing a bias check and selecting "Apply to all Runs”.

It is not always necessary to measure and compensate for data collection bias. If the sole purpose of measurement is to calculate IRI, correcting for Data Collection Bias is rarely needed. However, if the purpose of measurement is to establish exact point elevations, or to produce high-quality longitudinal profiles, it is prudent to collect the data in “boxes” and let the program correct for bias when “UNBOXing”. For greatest accuracy, box runs should be terminated and restarted whenever surface texture changes. For example, if you were measuring an asphalt highway and came to a concrete bridge, it would be prudent to terminate one “Box” at the point where the highway transitions to concrete, and restart a new “Box” at this point.

NOTE: When data is collected in “boxes” and “unboxed” prior to analysis, the Data Collection bias is automatically removed and no other action is required of the user. Otherwise, a single “Bias Run” may be collected and the resulting Bias applied to all Runs collected on a road with the same texture and amount of dust/dirt.

Surface Roughness Bias and Bias from Dust or Grit
These are by far the largest two sources of Bias. Although Surface Roughness Bias and Dirt or Dust Bias are the largest contributors to Data Collection Bias, it is practically impossible to separate these two sources.

The very small amount of bias inherent in using the swivel or “Moon” feet results from when the rough sandpaper pads on the bottom surface of the swivel foot come in contact with a rough or
CHAPTER 9 - BIAS

dirty surface. When the foot is placed down and a reading is taken, the sandpaper grains do not necessarily mesh perfectly with the surface texture imperfections on the pavement. When the Dipstick is pivoted around this foot, the grains in the sandpaper tend to mesh better with the imperfections on the pavement. The result is that the Dipstick’s rear foot is being “screwed into the ground”, and the Dipstick always seems to be climbing uphill a very small amount.

How much are we talking about?

A grain of sand is 5-15 thousandths of an inch thick. A human hair is more than a thousandth of an inch thick. The total Bias that we are talking about is typically 0.001” (0.0254 mm) to about 0.003” (0.0762 mm) Some people might say that worrying about this degree of precision is overkill. But remember, this is a constant (fixed) error, so it accumulates as more and more data are collected. If you have a Bias of 0.003” (0.0762 mm), then after 10 steps, the elevations will be off by 10 X 0.003” = 0.03” (0.762 mm) If you collect 100 steps of data, the elevations will be off by 100 X 0.003” = 0.3” (7.62 mm). On very long Runs, the total Bias can add up to the point where it makes a significant difference in the elevations of a Run. Once again, this makes no difference whatsoever in the IRI.

Visualizing Data Collection Bias:

Here’s an easy way to visualize how Data Collection Bias works. Imagine collecting data with a Dipstick on a beach volleyball court that has been raked smooth. The surface you will be walking on is clean dry sand, and the dry sand layer is quite thick.

- When you first set the Dipstick down, it will sink into the dry beach sand a little at both ends. Let’s say it sinks down into the dry sand 0.25 inch. (6mm) The Dipstick is balanced, so it will sink 0.25 inch at both ends. You start the Run and need to turn the Dipstick to get the next reading.
- When you turn the Dipstick, you need to push the handle forward a little, so the back foot will come off the ground. The instant that you do this, the front foot will sink deeper into the sand, because now ALL the weight of the Dipstick is on the front end. Maybe it will sink another 1/8 inch, (3mm) so now the front foot is 3/8 inch below the top surface of the sand.
- As you turn the Dipstick, you are effectively “screwing the Dipstick into the ground, so the foot you are swiveling around will sink even more into the sand.
- When you have finished turning the Dipstick and set the new front end down, it will sink into the sand – but only a little. Can you see that the end of the Dipstick that is in front will be higher than the end of the Dipstick that is in the back? The Dipstick will be tilted “uphill”.
- When you turn the Dipstick again to collect a new reading, the same thing will happen again. Every time you turn the Dipstick and set it down to collect a reading, the front end will be higher than the rear end. Because it is always tilted “uphill,” the Dipstick will
report that it is going “uphill” every step, even though it really is not. The profile produced by this run will show a pronounced uphill slant because of the artificial tilt.

Of course, you will probably never measure the surface of a beach volleyball court, so the description above is a gross exaggeration of what really happens when you walk the Dipstick on pavement. But the principle that is demonstrated in this example is the same as what really happens on pavement—except that the Bias on pavement is only about 0.001” (0.025 mm) to 0.003” (0.076 mm) per step.

Why can’t we just compensate for that automatically in the software? The reason you can’t do this is because the amount of Bias varies with the amount of texture and the amount of dust or grit on the surface. The Bias can be two or more times higher on a rough textured or dirty surface, and it can be half or less on a smooth, clean surface.

“Moon Feet”
We have conducted experiments with many different types and designs of “feet” for the Dipstick, to include different configurations and sizes, pointed feet, rounded pointed feet, different size swivel feet, and different contact surface material. The 2 ½” diameter “Moon” feet on your Dipstick are designed to minimize the effects of both Surface Roughness Bias and Bias from grit and dust. These are the best choice for measuring on almost any surface of any texture.
CHAPTER 9 - BIAS

HOW TO DETERMINE DATA COLLECTION BIAS

You can easily determine how much Bias there is on a particular pavement surface by knowing either

- The true elevations of the start and end points, or
- The relative elevations of the start and end points, or by
- Starting and ending a Run at the exact same location.

Since Bias is a constant with each step, if you know the total elevation error, you can simply divide the total error by the number of steps to get the Bias error per step. You could subtract this small error from each Reading, and the result would be a true profile with no Bias.

How To Calculate and Remove Data Collection Bias Using A "Box" Run

Collect the data in a "Box" as shown in Chapter 4, COLLECT.

[Diagram of a box with arrows indicating the data collection path and direction of traffic flow]

UNBOX the data as shown in Chapter 5, PROCESS.

[Diagram of the data collection path with arrows indicating the box's four legs labeled A, B, C, and D]

The Data Collection Bias will automatically be calculated and removed from all 4 legs. It's that easy. The key is to "close the loop" very precisely by hitting on the exact same spot where you started. This is the Normal way to remove Data Collection Bias.
CHAPTER 9 - BIAS

How To Determine Data Collection Bias Using An "Out-And-Back" Run

To determine Bias, the Dipstick must be walked in a closed loop, where the first reading and the last reading finish on the exact same spot. This can be a box, circle or straight line.

Here’s how to do it using an “Out and Back” Run:

- The surface must be uniformly clean and have no obstructions on it.
- Mark a line ~50 feet long down the surface.
- At one end of the chalk line, carefully mark a starting point using the crayon provided in the Dipstick Kit.
- Assemble and zero the Dipstick.
- Start a new run.
- Place the Battery end foot of the Dipstick on the starting point of the line and begin collecting data, walking the Dipstick along the line.
- After the Dipstick beeps at the ~50 foot (15 m) mark and a reading is taken, pick up one end and set it back down in exactly the same place, then collect a second reading in exactly the same place.
- Continue taking readings going back down the same chalk line in the opposite direction. Rotate the Dipstick back to the starting point to take the final reading.
- **Be sure to take the final reading exactly on the original starting point.**
- Tap “STOP” at the end of the run.
- This will produce an Elevation Graph and the IRI for the run (if 37 or more steps have been collected). Tap the “Close” box to clear the graph.
- Use CALCULATE/BIAS.

Remember, the normal way to deal with Bias is to collect the data in “Boxes”.
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Appendix A  Collecting Elevation Profile Data in Wheelpaths

This is an excerpt and synopsis from Chapters 4 and 5, COLLECT and PROCESS.

The best way to collect elevation profile data in wheelpaths is to use a series of "boxes" that are collected end-to-end.

OVERVIEW OF COLLECTING DATA IN WHEELPATHS
You will walk a "box" pattern on a test site, starting on the right wheel path, walking down the right wheel path in the direction of traffic some convenient distance (we suggest 250 steps), turn left, walk across the lane to the left wheelpath, turn left again, walk back in the left wheelpath against the direction of traffic flow, and turn left once more to walk back to finish the run at the same spot where you started it. You go all the way around the "Box" on one run. *This is absolutely (by far) the best way to collect longitudinal profile data.* Here’s what it looks like:

Arrows show the path taken by the Dipstick operator as data is collected.

COLLECTING IN BOXES - DETAILS:
Collecting the first Box
1. Mark the start/end point of the box by drawing a circle around the "Moon" foot on the pavement. You can use chalk or crayon to do this. Write the name of the box on the pavement next to this small circle. Draw an arrow in the direction you will walk. This information will be useful to you if you need to return to this spot later to correct errors or gather additional data.
2. Now draw a 1-ft (300-mm) circle around the start/end point. You can do this by just setting the Dipstick foot on the start/end spot and holding a crayon next to the other foot of the Dipstick and turn it in a circle. After you do this process several times, you will find that
you really only need to make a half-circle, or even a quarter-circle, if you make it in the correct location.

3. Start a new Run and collect data along the right wheelpath. We suggest you name this Run "B1" or "Box1", or use the station name of the starting location followed by a “1” When you have completed the 250th step, stop turning the Dipstick for a moment and tap the letter “C” on the screen.

The Dipstick will beep to tell you that it has marked this step as a corner of the box. Now draw a circle around the front foot at the 250-step point and write "B1 250" on the pavement. This will locate the 250th point on Box 1 if you need to find it later. Note: There is nothing magic about collecting data in boxes that are exactly 250 steps long; over time, but we have found that this works very well. We recommend keeping the boxes no longer than approximately 250 steps on a side. You can use shorter boxes, but we have found that boxes that are 250 steps long are quite efficient.

4. Without stopping the Run or closing the program, turn 90° to the left and walk straight across to the left wheelpath. This is normally ~6 steps. Stop turning the Dipstick for a moment and press “C” again. The Dipstick will beep to tell you that it has marked this step as a corner of the box, in the Run Notes for this run. Now draw a circle around the front foot at the 256-step point and write "B1 256" on the pavement. This will locate the 256th point on Box 1 if you need to find it later.

5. Without stopping the Run or closing the program, turn 90° to the left and walk back down the highway in the left wheelpath. You will be walking against the flow of traffic, which will allow you to see if any vehicles are not keeping clear of your measurement path. When you are back at the "start" end of the box, normally at step ~506, stop turning the Dipstick for a moment and press “C” once more. The Dipstick will beep to tell you that it has marked this corner in the Run Notes. Now draw a circle around the front foot at the 506-step point and write "B1 506" on the pavement. This will locate the 506th point on Box 1 if you need to find it later.

6. Without stopping the Run or closing the program, turn 90° to the left and walk straight across to the start point of the Box. This is normally ~6 steps, so this should be your ~512th step. You need to hit exactly on the point where you started. Stop the Run by Tapping “STOP”. The computer will show you a graph of the complete run. You have now collected the first Box on the highway, and are now ready to collect the second Box. (You will "UnBox" the Runs later and link the longitudinal profiles together to form the right and left wheelpaths.)
COLLECTING THE REMAINING BOXES

7. Go to the point you marked on the pavement called "B1 250". Set the Dipstick down with the rear "moon" foot directly on top of the circle at step 250. Draw a 1-ft (300-mm) circle around the start/end point. You can do this by just setting the Dipstick foot on the start/end spot and holding a crayon next to the other foot of the Dipstick and turn it in a circle. When you have finished making this circle, walk across to the left wheelpath and make a similar 1-ft (300-mm) circle at "B1 256".

8. Collect a new Run called "B2" just like the first box, but taking you another 250 steps down the highway.

9. Continue to collect additional Boxes in a similar manner until you reach the point on the highway that you want to use as the "end" of today’s data. **The boxes do not have to be 250 steps long, nor do they all need to be the same length.** However, we have found that it is easier to keep track of what you are doing if you always try to use a standard collection "box", and make notes whenever you vary from the standard.

10. Note that if the highway bends around a curve instead of staying perfectly straight, one of the wheelpaths will be longer than the other is. In this case, continue to always use 90° angles when you go around a corner. The short transverse legs will all be the same lengths because the wheelpaths are a constant distance apart, but the left (or right) wheelpath may be a few steps longer than the other wheelpath.

You may have wondered why you need to draw the 1-ft (300-mm) circles around the corners of the boxes. These circles will help you to match up the wheelpath profiles so they hit exactly on the correct point. When you are "closing the loop" by making the last step on Box1, if the highway is not perfectly straight, or if you have turned at 89° instead of 90°, or if the distance between wheelpaths is not an integer multiple of 1 ft, (300 mm) then the last step will not land exactly on the start point. If you need the two long legs of the box to be parallel at an arbitrary distance apart, (not an integer number of steps apart) say for measuring in wheelpaths, here's how to make the short transverse legs land exactly on top of the opposite wheelpath:
Collecting Elevation Profile Data in Wheelpaths

When you reach the end point (~250 steps) on the right wheelpath and after you have marked a circle around the Moon foot at that location, pick up your Dipstick and go across and mark the desired location directly opposite. Don’t stop the Data Collection program, just don’t press the Trigger and the Dipstick will not collect data. Make a circle around the Moon foot at the desired location, and also draw a 12” (300 mm) circle around this point. You can use the Dipstick to draw a circle around this point on the pavement. Draw the circle so it is tangent to the outer edge of the Moon foot as shown in the drawing. Then go back to where you stopped collecting data and carefully put the Dipstick down exactly on the Moon foot circle at the end of the right wheel path.

Now you can continue your Run from this point. Collect data towards the circle across the lane toward the left wheel path. At the point where you would step across the circle, don’t step over the circle, but put the foot down exactly tangent to the circle. (Anywhere on the circle) This will require that you "step off" at an angle as shown in the picture above. Your next step will always put you exactly on the desired spot at the center of the circle. You will also have to use this procedure to get exactly back on to the starting point of the Run. On the next to last reading, set the foot down anywhere on the 1-ft (300-mm) circle and you will be assured of being exactly 12” (300 mm) from the starting point for the final reading. Rotate the Dipstick back to the starting point to take the final reading. Be sure to take the final reading exactly on the original starting point. (Use the 12”/300 mm circle to compensate for any discrepancy on the next to last reading.) This is very important. You should always do this “stepping off onto the 12” circle” on the short transverse runs that will not be part of the longitudinal profiles.

PROCESSING BOX DATA - OVERVIEW

You will "UnBox" the first box, separating the four legs of each box. UNBOX creates four smaller records from a larger one. This routine assumes that you have walked a "box" pattern on a test site and you finished the run at the same spot where you started it.

The program will automatically calculate and apply data collection Bias, and will automatically reverse the third and fourth legs.

The program will automatically adjust the start point for each leg so that the elevations on each leg will be correct relative to the start point elevation of the box.

Note: Arrows now show the profile layout after “UnBoxing”. Since you may want to compare the A and C legs (The two long runs) and perhaps the B and D legs (the two transverse runs), the program automatically reverses the C and D legs so they correspond to the direction of the A and B legs.
Appendix A  Collecting Elevation Profile Data in Wheelpaths

The program will automatically name the four legs Box_A, Box1_B, Box1_C, and Box1_D. After the legs are separated, the computer will automatically calculate the IRI of each leg. (Assuming the legs are long enough to get an IRI)

You will then unbox each of the other boxes in turn to create Box2_A, Box2_B, and so on. Finally, you will link all the _A legs together to form a single run along the right wheelpath, and you will do the same with all the _C legs to form a single run along the left wheelpath. The computer will automatically calculate the IRI of any runs that are long enough to get an IRI.

You can do this on the Dipstick's on-board computer, or you can do this on your desktop PC. The software works the same in both programs.

Link Runs

Any two or more runs may be joined together to create one long continuous run by using EDIT/LINK.

1. Tap “Multiselect”, then select the first Run, (Box1_A) then select the second Run. (Box2_A) Be sure you select the Runs in the sequence you want them linked. You want the second Run to be linked onto the tail end of the first Run, so select them in the order you want them to link.

2. Tap EDIT/LINK to link these two Runs. The program will now join the two runs you highlighted, using the first run as the "base" run and linking the second run to the end of it. The new record will have the same name as that assigned to the first run but will have a ^L suffix attached to it, showing that it was Linked. In this example, it will be named Box1_A^L, and which will now be 500 steps long. The computer will automatically calculate the IRI of the new Linked run.

3. Select the newly Linked Run Box1_A^L. Now select the Run named "Box3_A", and use EDIT/LINK to link the last A leg to the first two. Again, the computer will automatically calculate the IRI of the new Linked run. You have just created the right wheelpath profile and IRI.

4. Select leg _C of the first Box (Box1_C) then select the corresponding leg from the second Box. (Box2_C) Use EDIT/LINK to link these two Runs. Do the same for Box3_C, and you will have the left wheelpath profile and IRI.

You are finished.

Note: Arrows show the profile after UNBOXing and Linking.
Appendix B  Road Dipstick® Capabilities

The Dipstick was invented and developed specifically for measuring the roughness of highways and the flatness and levelness of floors. However, because of its inherent ability to measure elevation differences very precisely, the Dipstick has been found to have other uses that can be very valuable. Here is a short list of some of the possible uses of the Dipstick:

1. The Dipstick produces the most accurate and precise elevation profiles possible. Whenever various profiling devices are compared on roads, highways, and bridges, invariably the Dipstick profile is what they are all compared to.

2. The Dipstick and its accompanying software can compute a host of highway roughness indices. You can have the International Roughness Index or IRI, Half-Car IRI, Rut Depth, Gap under the Straight Edge, California Profilograph emulation, Mayes Meter emulation, RMSVA, and others. Many of these reports can be produced directly on the on-board computer. The others can be done on any Windows desktop PC.

3. The Dipstick can quickly and easily measure the actual as-built slope of a tilted surface such as a ramp or drain.

4. The Dipstick can quickly and easily measure the camber of girders and beams both before and after loading. The difference between them is the amount of bending the beam has undergone. The built-in software can calculate this for you instantly and print the results out as a table showing the amount of deflection at every point.

5. The Dipstick can be used to set the elevations of bridge-deck rails. It has been shown that the finished bridge deck surface follows the contours of the temporary rail upon which the bridge deck screeds ride. The smoothness of the finished curved surface depends substantially on the smoothness of the curve of the rails. The Dipstick can provide a table of corrections, either visible on the screen of the Dipstick's computer, or printed out, for the crew to make to bring the rail to the desired curve.

6. The Dipstick can be used to make nondestructive measurements of the thickness of fills and coatings, such as skim coats and asphalt overlays. Since the Dipstick is capable of calculating and displaying the difference between any two lines, if one line is run on the subgrade before the skim coat or filler is applied, and one line is run at the same location afterwards, the difference between the two is equal to the thickness of the overlay. The high degree of precision and accuracy of the Dipstick (better than 0.0005"/0.0127mm) and the fact that the difference or thickness is calculated and displayed every 1 foot/300 mm along the measurement line, makes the Dipstick a useful tool for this purpose.

7. The Dipstick can be used to make precise elevation surveys within a limited area for specialized reasons, such as the mounting of certain types of industrial or laboratory-type equipment.

8. The Dipstick can be used to produce a similar but more detailed elevation survey that produces a 3-D picture of the surface which can be very useful in certain applications.
Appendix B  Road Dipstick® Capabilities

9. The Dipstick can be used to *measure the difference in elevation across construction joints*, where two slabs are supposed to be at the same plane.

10. The Dipstick can be used to *measure the motion of a slab* as a piece of heavy equipment passes over a joint. If the Dipstick is placed so that each end of the Dipstick is resting on a different slab, across a construction joint, and a piece of heavy equipment is driven across the joint nearby, the Dipstick can measure the deflection of the slabs at the joint in real time.

11. The Dipstick can be used to *measure the straightness or "trueness" of any tools* used to strike off or float wet concrete, such as screeds, highway straightedges, floats, and the like. It has been shown that the finish flatness and levelness of cured concrete is directly affected by any bends, "kinks," or dents in these tools.

12. The Dipstick can be used to *measure the elevations of concrete forms before placement* of concrete. It has been shown that concrete is never flatter nor more level than when it is first struck off from the forms, so the shape of the forms can be the limiting factor in the quality of the resulting surface profile.

13. The Dipstick can also be used to *measure the flatness and levelness of floors* using the ASTM E-1155 F-Number system. (F₁ and F₂) The Dipstick is the fastest and by far the most accurate way to measure floor flatness and levelness.

14. Actually, the Dipstick excels at just about any application where very precise elevations or elevation differences are desired.

15. In addition to measuring at a precise 12" interval, all new model Dipsticks can also measure at 300mm and 250 mm spacing without any mods or attachments, and the variable foot spacer bar (standard with the Road model Dipstick) will *allow measurement at any data spacing* between 3" or 75 mm and 12" or 300mm. An optional adapter can be used to measure at 24" or 500mm intervals.

16. The Dipstick's built-in software will provide a *report in editable Rich Text Format* and a *graph of the profile(s)*, either of which can be displayed on the Dipstick computer's screen or printed. Tables of elevations and elevation differences can be viewed on the Dipstick computer's screen, printed, or an ASCII text file can be created from the data which can be exported into any spreadsheet, word processor, or other program. Certain reports can be "batch-processed" that is, many graphs or reports can be sent to the printer at one time, or many ASCII elevation files may be created at one time, or many Runs may be edited at one time.
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Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

1. **Why do it?**
The Dipstick® will enable you to collect elevation data that is much more precise than that available from a Rod and Level. If you need to know exactly how a surface looks in 3-D, or if you need very precise elevations of points on the surface, you can make a 3-D elevation study on your own. Some examples of reasons for doing an elevation study include:

- checking drainage patterns, such as checking for "birdbaths" where water might collect on a nominally flat surface;
- determining exact elevations of critical locations such as mounting pads for a machine that must be mounted exactly level;
- determining exact elevations for a system that interfaces with the surface;
- checking the results of corrective grinding, and other reasons.

2. **What is the Difference between an Elevation Study and a 3-D Map?**
A 3-D Map requires much more data than an Elevation Study. That's the fundamental difference. For an Elevation Study, you can collect a limited amount of data, and you can collect it where you need the data. To make a 3-D Map, you need to collect the data at regular intervals over the entire surface of interest.

3. **What Do You Need?**
- To make an **Elevation Study of a surface**, all you will need for a basic study is your Dipstick®. This will allow you to graph lines (one at a time or many at once) and calculate elevations of each of the points on any of the lines.
- To make a **3-D plot of a surface**, you will also need a 3-D plotting or graphing software program such as Microsoft Excel® or Perspective Jr.® or a specialized graphing program like Harvard Graphics®. These programs take the data and present it as a 3-D plot. What you need to do to make this work will be explained below. We'll demonstrate how to do it in MS Excel®, which most people have access to. Whichever method you want to use, you need to decide the data location and spacing before you start collecting data.

4. **Dirt or Grit on the Surface**
If the surface is excessively dirty, have it swept to remove the dirt/grit that you would otherwise walk over. (A light coat of dust is OK, but not piles of dirt or grit.) This can be important, depending on the desired accuracy of the result, because the Dipstick® can measure to .001 inch, or 1/10 mm. The cleaner the surface, the better your data will be. When you compute the Surface Roughness Bias from the data you collect, check to ensure that it is less than .002”/step. Anything more indicates a problem.

5. **Marking the Surface**
You need to collect the data in lines that are precisely located. You should mark straight lines so you won't wander around while collecting data. There isn't any point in collecting very accurate data that isn't in a regular grid, because the graphing program will place it in a regular grid. Starting at a convenient point near one corner of the surface to be measured, mark this starting point with chalk, crayon, or a dot of paint. Lay out the lines where you will collect data, spacing the lines evenly if you are doing a 3-D Map.

Paint is much better than chalk or crayon, if you need a permanent reference, because when you get the results calculated and graphed, you will be able to go right to the key spots on the surface. As a minimum, mark the 4 corners of the area to be measured. It's best to also mark the measurement lines with a chalk line or similar method. We like to spray paint clear lacquer over the chalk line so it will last for a while, but a temporary method is OK, so long as you can find these lines later from the paint spots at the corners.

5. **Three Ways to Collect Data**
You should collect the data in closed loops, in any of these three methods:
- "Out-and-back" lines
- A "Comb" pattern, or
- A series of "boxes," either overlapping, or tied together by one or more "base" lines.
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

a. "Out-and-Back" lines
This is the simplest method, and is often very satisfactory to achieve the desired result, if all you need is data for certain specific locations. (Why measure the whole surface if you don't need to?) Here's an example showing how this technique might be used: One major aircraft manufacturer measures the deflection of runway and taxiway pavement by starting from a point that is sufficiently remote from the aircraft that it is assumed to be unaffected by the presence or absence of the aircraft. Using a starting point elevation of 0.000, they walk a line from that point to a point right next to one of the wheels, and reverse direction on the same line, returning back to the starting point. Then they remove the aircraft and collect another set of data in the identical location. The only difference is that in the second Run, the aircraft has been removed. After computing the Bias for each of the two Runs, the runs are segmented to retain the first half of each run. These profiles then represent the elevations of the profile between the starting point and the aircraft's wheel location, both before and after removing the aircraft. The two segmented Runs are then selected and the menu item CALCULATE/DIFFERENCE is used. This creates a profile that represents the precise deflection of the pavement due to the weight of the aircraft.

b. The "Rake" or "Comb" pattern
We call it the "Rake" or "Comb" method because the layout pattern looks like the tines of a garden rake, or the teeth of a comb. There is a "Base" line, which is typically the longest line, and there are the "tines" or "Teeth" lines, which all start from the base line. If the tines are short, you won't have to measure the tines "out and back". The base line should always be measured "out and back."

Although the teeth or tine lines do not have to be parallel or the same length, we recommend that you make the pattern symmetric, even, and parallel, unless you have a reason for not doing so. Collecting the data in even, regular patterns will make it much easier to make 3-D graphs.

c. The "Box" method
Boxes are quite a bit more efficient than either the "Rake" or "Comb" in terms of data collection and analysis time, particularly if you need to cover a large area without collecting data at every point.

For covering a large area, you can collect the data in overlapping boxes. The boxes may be touching each other or may be any convenient distance from each other, but you will need to link each of the boxes with a line, in order to get the relative elevations of the several boxes right.

Multiple Linked Boxes

| Box 1 | Box 2 | Box 3 | Box 4 |
The colored “Boxes” above show one way to make a grille or grid of overlapping boxes. Box1 (the red box) is the exterior box; Box2 (the blue box) is concentric and overlaps the red box; Box3 (the green box) is again concentric and overlapping; and finally Box4 is concentric and overlaps them all. The result is the final overlapping black & white box pattern you see on the right above.
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

This is a sample of a “ladder” type of Box arrangement.

The first box goes all the way around the perimeter, and the secondary boxes fill the inside like ladder rungs. Arrows show the direction of data Collection – black for the outer box and Blue for the interior boxes.

The interior boxes do not need to overlap each other, but the narrow ends of the interior boxes should overlap the outer box as shown.

This is the box layout pattern that we use most often.

Decide whether you will use the "Rake/Comb" method, or the "Box" method before laying out the measurement lines. We prefer the "box" method for complex elevation studies and 3-D graphs, and the "comb" method for more simple requirements.

6. Designating Run Names
Designate the runs with names that you can remember, that will mean something to you later. There is nothing worse than labeling all runs numerically from 1 to whatever, with no correlation to the run location on the surface.

Name the area covered by each comb and use the same name for the comb. You might have a comb in bay 18, so call the base line 18B. (B for "base") You could number the teeth from N to S, so you have runs labeled 18B, 18-1, 18-2, 18-3, etc. If some of the combs are aligned N-S and some are E-W, designate the base line 18BNS, or 18BEW. You don't have to carry the NS or EW designations on to the teeth, because you know they are perpendicular to the base line. The important thing is to give each line a meaningful name that will help you remember where it was taken from. If you use boxes, name each box in a way you'll be able to remember later. Each box will be broken into its 4 constituent lines later. The Dipstick® software will automatically name each of these 4 lines with the name of the box and a suffix.

7. Collecting Data
a. Combs
Start the Dipstick® with the rear foot on the paint mark and collect data along the base line. Using a keel or chalk, mark a circle around the foot when you get to any point from which you want to run a "tooth" later. Do not move the Dipstick® off the base line or turn it off; simply draw a circle where you want to start a "tooth". Mark the step number on the surface next to the circle. You will come back to this location later to start your "tooth" runs. When you get to the end of the base line, collect the last reading, then rotate the Dipstick® in a complete circle, setting it back where it was so it can collect another reading. Now continue back along the base line until you get back to the start point. (The details of how to do this are covered in the Hardware Manual under "Bias Run"). Assign a start point elevation of 0 (zero) to the Base Line.

Now collect all the "tooth" runs, starting at the locations where you circled the foot.

b. Boxes
Start the Dipstick® with the rear foot on the paint mark at one corner of the end box, and collect data along a line. For example, if your lines run from West to East as shown in the example above, start at the lower left (Southwest) corner of the Western box, and measure along the South (right) line, going from West to East. (Whichever way you do it is OK, but always start at the outside corner of the outside box, collecting data in the same direction, i.e., going East.)
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

After you have gone as far as you want to, say 50 ft, stop and mark a circle around the front foot. Don't stop the run on the pocket computer, just stop rotating the Dipstick® for a moment while you mark the surface. Now turn the Dipstick® so you march across to the opposite line, stopping when the front foot is on the left (North) line at a point just opposite where you stopped a moment ago. It is important that this point be exactly across from the 50th step, because these are the two points you are going to compare. Mark a circle on the surface around your front foot again. It doesn't matter if the front foot is the switch end or the battery end, so long as it's the front foot. Then turn West and march back on the North line until you are at the end of the line opposite where you started at the beginning. Stop and mark this point by circling around the front foot. Finally, turn South and march back across to where you started from.

It is imperative that you end up with one end of the Dipstick® exactly on top of the paint spot where you started. Terminate the collection of data at this point.

Record the locations of the turning points and the end point on the run Notes by step number, i.e.: 50, 56, 106, 112. In this example, let's assume the box is 6 steps wide. You start at the paint mark, and the 50th reading is taken with the battery end of the Dipstick® over the first turning point. The second turning point is 6 steps later, at 56, and the last turning point is at 106, across from the starting point. The run is ended with the battery end of the Dipstick® forward, with the foot right over the paint mark, at step # 112. You will need these turning points for the analysis later.

Go to the spot on the South line where the circle is on the surface at the 50th step. (The first turning point from the first box) Start a second box here, again going East along the South line for 50 steps. Mark the turning location, turn North, and march to the North line. Finish this box just like the first box. Point # 106 of the second box should be right on top of point # 56 from the first box, and point # 112 (the end point) from the second box should be right on top of point # 50 from the first box, which is at the same point as the start point of the second box. Record the locations of the turning points and the end point on the run Notes by step number, i.e.: 50, 56, 106, 112.

8.  General Info on Collecting Data

If you need the two long legs of the box to be parallel at an arbitrary distance apart, (not an even number of steps apart) say for measuring in wheelpaths, here's how to make the short transverse legs land exactly on top of the opposite wheelpath: When you reach the end point on the first wheelpath, press <Enter> to stop the run, and mark a circle around the Moon foot at that location. Now pick up your Dipstick® and go across and mark the desired location directly opposite. Use the Dipstick® to draw a circle around this point on the surface. Draw the circle so it is tangent to the outer edge of the Moon foot as shown in the drawing. Then go back to where you stopped collecting data and carefully put the Dipstick® down exactly on the Moon foot circle at the end of the first leg.

Now you can "Append" or extend your run from this point. Select the box run you have already started, then use <Collect> <Append> to re-start this run. The computer will tell you which foot should be forward. (In this case, "forward" is to the left, or “up” in the drawing)

Press <Enter> to continue taking data towards the circle across the aisle. At the point where you would step across the circle, don't step over the circle, but put the foot down exactly tangent to the circle. (Anywhere on the circle) This will require that you "step off" at a slight angle as shown in the picture above. Your next step will always put you exactly on the desired spot at the center of the circle. You will also have to use this procedure to get exactly back on to the starting point of the run.
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

9.  Processing the Data

a.  Combs
Download the data to a PC. Calculate the Data Collection Bias from the Base Line, and apply this Bias to all runs. If your "Teeth" runs are long, you may want to calculate the Bias on each run independently and apply that Bias to the run it was collected on. If the "Teeth" runs are short, You won't need to calculate the Bias on anything other than the Base line.

After processing the data, you will need to find the elevations of each of the points where you started the "teeth" from the Base Line, then edit the "teeth" runs to include the correct start point elevation for each of the runs.

You have referred the start point elevations of each "tooth" run to the corresponding elevation at the same point on the "Base" line. The elevations of this Base line are all referred to its start point, which you set at 0 (zero). Therefore, the elevations of any and all points on any of the lines are referenced to each other, and are measured relative to the zero elevation of the start point of the Base line. If you now want to know what the difference in elevation is between any pair of points on any line, all you need to do is subtract the elevation of one from the other. It is just as if you now have a great many bench marks located 12 inches (300 mm) apart.

b.  Boxes
After collecting the data, download it to a PC, and unbox the boxes following the procedure described in the hardware manual. (EDIT/UNBOX)

The start point elevation of the second box should not be zero, but should be whatever is computed for the end point elevation of the first leg of the first box. (The elevation of the 50th point in the example) Similarly, the start point elevation of the third box will be the elevation of the end point of the first leg of the second box, and so on.

You have referred the start point elevations of each leg of each box to the corresponding elevation at the same point on the previous box. The elevations of this Base line are all referred to its start point, which you set at 0 (zero). Therefore, the elevations of any and all points on any of the lines are referenced to each other, and are measured relative to the zero elevation of the start point of the first leg of the first box. If you now want to know what the difference in elevation is between any pair of points on any line, all you need to do is subtract the elevation of one from the other. Once again, it is just as if you now have a great many bench marks located 12 inches (300 mm) apart.

10.  Making a 3-D Graph
We strongly recommend using the "box" technique for all 3-D graphs. You'll want to snap lines to make an outer box that defines the perimeter of the area being measured, and a number of inner boxes to fill in the data inside the outer box. For most purposes, it is not necessary to have all the boxes at 1-ft intervals. A very satisfactory result can be obtained by collecting boxes that are 4 ft apart. To get good results, you need to snap a line or

As an example, let's say that the area you want to measure is 36 x 36 ft.
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

Step 1 – Collecting the Outer Box
You’ll collect the first box that bounds the exterior perimeter, 36 ft on a side. Start at the northwest corner in the drawing to the right (marked Box1 Start/End) and walk the Dipstick south until you reach the end of the area to be measured. As you do this, stop every 4 ft and mark a circle around the Dipstick foot that is 4 ft away from the last marked location. This will make the first Box go slow, but you’ll need these locations later. When you reach the first corner of Box1, wait for the beep, then press the letter “C” on the keyboard of the Dipstick computer. The Dipstick will “beep” at you to let you know it marked this corner. This is not a new reading. (The Dipstick can only make one sound, “beep” so don’t worry, this is not another step.) Do not stop the data collection program. Now turn the Dipstick and walk towards the east as shown above, until you reach the 2nd corner of Box1. Do not mark every 4 ft on this leg. After you hear the beep when you reach the end, press the letter “C” again to mark this corner. Then turn north and walk all the way to the 3rd corner of Box1, again marking a circle around the Moon feet every 4 ft., and press the letter “C” again after you reach the corner. Finally, walk the Dipstick back to the west until you reach the start/end point of Box1. Press <Enter> to stop collecting data. The end of this leg is exactly the same point where you started from. Do not mark every 4 ft on this leg. This completes the first box – the outer black box – in the picture above. You will have walked a big “box” and you will have marked the line every 4 ft on the west and east sides as shown in the picture above.

Step 2 – Collecting the Inner Boxes
Go 8 ft down (south) from the start point of the outer box, and set the back end of the Dipstick on the circle you marked there, with the start end of the Dipstick facing east across the outside Box. Note: this is 8 ft down, not 4 ft down from the start point. You will be at the start/end point of Box2. Start a new run, and collect data from here all the way across to the other side of the large outer box. When you reach the 1st corner of Box2, press the letter “C” on the keyboard, then turn north and walk 4 steps to the 2nd corner of Box2. Again, press the letter “C” here. Then turn the Dipstick toward the west and collect data all the way back across until you reach the 3rd corner of Box2, and press “C” once more, then turn the Dipstick south and collect 4 more steps. You will be at exactly the same point where you started Box2. Press <Enter> to stop collecting data in Box2. Pick up the Dipstick and walk 8 ft farther south (8 ft, not 4) then collect Box3 the same way. Continue collecting data in boxes this way until your inner boxes fill the space inside the outer box as shown above.

Step 3 - Editing the Data
You can do this on the Dipstick computer or on your desktop or laptop computer. Select the first (large, outer) box and use EDIT/UNBOX. If you have pressed the letter “C” each time you reached a corner, the computer will fill in the corner locations for you. If you forgot to type the letter “C” in the corners, you can fill it in now. When you press <Enter>, the computer will calculate and adjust for the bias on this box, and it will break the box into 4 legs. What’s more, the 3rd and 4th legs will be reversed, so they will look as if they had been collected in the same direction as legs # 1 and #2. Now select Box1/A and use REPORT/DATA POINT LISTING to get the elevations of the points that are 4 ft apart on the first leg of the outer box. Write down or print and circle the elevations of the start point, point number 4, point number 8, point number 12, point # 16, and so on. You want the elevations of every 4th point on leg Box1\A.

Now open the Run Header for Box2, and type in the start point elevation for Box2. The elevation of the start point of Box2 is the same as the elevation of point 8 on Box1\A. Now use EDIT/UNBOX for Box2.

Now open the Run Header for Box3, and type in the start point elevation for Box3. The elevation of the start point of Box3 is the same as the elevation of point 16 on Box1\A. Now use EDIT/UNBOX for Box3.

Repeat this process for all the other Boxes.

Step 4 - Making ASCII Elevation files
At the Run level, highlight Box1\A and use REPORT/ELEVATIONS (fle) and it will make an ASCII Elevation file from the Run you have highlighted, and it will store the new ASCII file inside the Job folder. You can do this over and over for each of the runs in the project.

Speed Tip: Instead of making the ASCII files one-by-one, go to the Run level and ensure that all the long runs are marked with the Run Flag “A”, and that no other Runs are marked with a Run Flag “A”. You can mark or unmark Runs by highlighting them in the RFCollect program and using EDIT/RUN HEADER, and checking (or unchecking) the ASTM E-1155 box. After doing this, go up to the Surface Level and choose REPORT / MULTIPLE REPORTS (BATCH) / ASCII ELEVATIONS (File).

This will instantly create and save ASCII Elevation files for all the Runs that were marked with the Run Flag “A”. You will still need to make ASCII files manually for all the short 4-ft runs, since they cannot be marked with the checkmark for ASTM E-1155. This completes the 4th step.
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

Step 5 – Entering the data into a spreadsheet
Open the ASCII files with a spreadsheet program like MS Excel®. If your computer says it cannot open the ELV files, tell it to use MS Excel®, and tell it to always use this program for these kind of files. The ASCII files will always be formed in a vertical column of numbers. Select the column of numbers and use EDIT/COPY. Open the spreadsheet where you will make the graph and paste the ASCII elevation data files you just produced. Copy each long ASCII file to the same spreadsheet, and align the data in the same pattern as it was in on the surface when you collected it. In our example, the elevations along the west side of the outer box (Box1\A) are aligned in a vertical column, so it will be easy to put these in. Likewise, the ASCII file for the data in Box1\C is aligned the same way. But all the other long ASCII files are in vertical columns too, while the spreadsheet needs them in a horizontal alignment. When you paste them in, use “PASTE SPECIAL”, then select “TRANSPOSE.” This will paste the numbers in a horizontal row from left to right. Note that the first elevation point in each of the horizontal points will be the same as the elevation of the points every 4 ft on Box1\A, so you can overlap these points. The top horizontal data set is Box1\D, and the bottom one is Box1\B. Do not paste the short 4-step ASCII files yet, just do the long ones. Paste Box1\C in last, in the column just to the right of the last horizontal entry. Now you should have a spreadsheet with a box of data around the perimeter and many rows of data separated by 4 ft vertically.

Step 6 – QC Checks on your Data
Now go get those little 4-step ASCII files and paste them into the spreadsheet. Theoretically, they should match the data from Box1\A and Box1\C, but they won’t match exactly. Paste these files at the corresponding locations, but one column to the left or right of the data you already have. The purpose of doing this is to see how well you collected the data. Compare the 4 elevations in these little 4-step runs with the elevations on Box1\A and Box1\C. If the elevations match within 0.030”, you will be OK. If the elevations do not match, then you have made a mistake somewhere, either in the outer box (Box1\A & C) or in the smaller inside boxes. If the elevations don’t match, redo the box that doesn’t match up until they do match. If you have collected the data properly and have followed these instructions, they will match up. After you are finished checking the elevations and are satisfied that the data is correct, you can delete the many small 4-ft data sets. Depending upon the spreadsheet you use, you may have to input data into all the blank fields. There must not be any text in the data. For a better-looking plot, you may wish to average the data between columns to fill blank spaces. While this is not strictly correct, in many cases it may be approximately correct, and it may produce a more viewable picture that still represents the surface quite well. (Sometimes the 3-D picture is difficult to discern if there are many empty cells in the data that produce the picture.)
Appendix C  Elevation Studies & 3-D Dipstick Topo Maps

Make a Graph
Finally, make the graph or 3-D plot following the instructions for the spreadsheet or graphing software.

Floor Surface at UCAR before (left) and after (right) Flatcon Grinding
1. You can’t delete an original run.
2. Don’t put alkaline (or other) batteries in your Dipstick body unless you cover the recharge port with tape.
3. Never allow your computer to run out of battery power. The new Tablet is VERY bright, but this takes lots of power. Always keep your Battery Handle recharged too. Make certain to turn the computer all the way off.
4. Use RoadFace MERGE to merge two jobs into one. Do this whenever you have two or more sets of data on the same job and want to consolidate them into one.
5. Do you have very bad IRI Numbers? Check the following:
   - If only one run has an unreasonably high IRI, look at the graph for a single false reading.
   - If all the IRI’s are unreasonably high, look for evidence of bad Zero.
     - Sawtooth profile
     - Loose Moon Feet
6. Make yourself a test track and use it. Save the data and run your Dipstick on the Test Track once a year or so, and compare the data to the first time you ran the Test Track. If you ever question the Dipstick, the test track will tell you if it’s OK or not. If the profile and IRI is the same now as it was 4 years ago, the Dipstick is still working like it did 4 years ago.
7. If you can’t collect data, it is almost always a connection problem. Check all wires and connections, including the pins on the serial cable. We suggest that you keep the serial cable attached to the tablet.
8. If your Dipstick won’t stay on, even though you have charged it:
   - Plug in the charger and verify that you get a green light indicating charging.
   - Remove the Dipstick battery end cap and re-seat the AA batteries – one of them may have come out of its seat.
9. You can’t change Hardware settings while you are in the act of collecting data.
10. **Always** collect longitudinal profiles on roads & bridges by using a box or boxes.
11. Know how to measure in a box when the _A and _C legs are not an even number of steps apart: (Create 1-ft/300 mm circle, then step onto it)
12. Use notes properly - You must know where your corners are!
13. Learn how to Append. (COLLECT/APPEND) It’s easy and helpful, especially in removing False Readings during data collection.
Appendix E - Test Track

Calibration Checks and Your Test Track

We strongly recommend that you make yourself a test track and use it to verify that your Dipstick® is working correctly. If you ever question the Dipstick, the test track will tell you if it’s OK or not.

Making a Test Track:

1. Find a smooth hard surface with about 50 ft of clear space near your office to use as a permanent test track. You want this to be conveniently located so you will use it often. Indoor floors are better than outdoor pavements because they are not affected by temperature changes and soil moisture and you don't have to get wet when it's raining.

2. At one end of the floor surface you want to use as a test track, mark a circle around the BATTERY END moon foot.

3. Using a chalk line, snap a line tangent to the circle you made in step 2. Make the line about 50 ft long. You can do this successfully with a 25-ft or 35-ft line, but we recommend using a 50-ft line if you have the space.

4. Spray-paint the line with clear lacquer to preserve the line. You can use any clear spray paint you can get in a hardware store. Let it dry.

5. Now collect data along this same line, starting with the battery end Moon Foot on the "start" circle. For convenience, use a start point elevation of 0. (Zero) DO NOT STOP the program when you get to the 50-ft mark. At the 50-ft mark, after you have collected 50 readings, press the keyboard letter “T” for “Turnaround”. At this point, we want to collect 50 more readings without stopping, going all the way back to the start point. When you get back to the start point, you should have 100 readings - 50 out, and 50 back. Many people have difficulty right at the 50-ft mark because they skip the 51st reading. Note that the first reading going back towards the start point (the 51st reading) will be exactly in the same place as the last reading going out away from the start point (the 50th reading). So after collecting the 50th reading, walk around the Dipstick where it is sitting on the floor, then after you are facing back towards the “start”, pick up the start end and set it down in the same place to get the 51st reading. Then swivel the Dipstick to get the 52nd reading, etc. until you get back to the start point. You should now have 100 readings, and the battery end Moon Foot should be exactly on the circle you used as the start point. Press <Enter> to stop collecting data. The computer will give you a graph of the profile and the F-Numbers for this run.

The end of the run should be slightly higher than the start, as shown here. This, by the way, is Data Collection Bias.

Read about Data Collection Bias in Chapter 9.
Appendix E - Test Track

6. Tap the “Close” button on the top right of the graph, select the run you just collected, and use CALCULATE/BIAS.

7. The Bias should be small, between 0.0005 and 0.002, but certainly not more than 0.003. The value of the Bias will depend on the surface texture of the floor you are walking on, as well as how clean it is. Smoother texture, less dust = smaller Bias. More texture (like a sidewalk) and/or more dust, grit, etc, on the floor = higher Bias. The Bias should always be positive, not negative, unless it is very small, less than 0.0005.

8. Now use REPORT/GRAPH to look at it again. The profile will start and end at 0.00", and it will be symmetric about the 50-ft point. It may look like a butterfly or a gull-wing, or just sloped one way and then back up. Whatever it looks like, the left half will be a mirror image of the right half. The fact that it is symmetric shows you that the Dipstick is collecting the data exactly the same out and back.

9. Now Re-select the same Run, then use EDIT/TEST TRACK. This will break the Run into two halves. To facilitate comparison between the two halves, the program will automatically reverse the second half of the Run so it also starts at the starting point and runs out to the place where you turned around.

10. Now select both of the 50-ft runs and use REPORT/GRAPH to show both of them together. They should ideally form a single line, with one of the Runs overlapping the other line. If the lines do not overlap completely, it may be that for some distance, you did not walk precisely on the line.

Note how the two runs overlap each other. Since you are now showing only the first half of the run, it will no longer end at an elevation of zero. (The end point elevation is the elevation of the 50-ft point.)
Appendix E - Test Track

11. Close the program and save the Test Track data where you can find it easily.

Checking Calibration

The Dipstick® 2272 is calibrated at the factory. The calibration constant is very stable, so during a normal lifetime of Dipstick® use, it normally never needs recalibration. Occasionally, we run across a Dipstick® that we built in 1986. When we check one of them, it almost always is still calibrated correctly.

Please note that you cannot calibrate the Dipstick®. The Dipstick® 2272 is calibrated by our technicians on a special table under controlled conditions. We guarantee that the calibration of the Dipstick® is so good that it has an expected error of less than 0.001". We are almost always able to achieve an expected error of less than 0.0005". You can check the performance of the Dipstick® on your test track, but you cannot recalibrate the Dipstick®.

Using the Built-In Test Track Software feature:

Any time you want to check the Dipstick, collect a run on the test track and compare the data to the data you collected above. If you do it right, and if the floor has not changed because of temperature or humidity or curling, the IRI will be the same, and the profiles will be the same.

The Dipstick now has a software feature that makes it easy to process the data from a Test Track. Just collect the out-and-back Run as described above, then use EDIT/TEST TRACK. This software feature will calculate and apply the Bias (to this Run only) and will Segment the Run at the Turnaround point, Reverse the second half of the Run, and apply the correct Start point elevation, so you can see how symmetric the two halves of the Run are.

The best way to collect Test Track data is to keep a Job called “Test Track” on your Dipstick’s handheld computer. Any time you want to check the calibration, just open this Job and collect new data so you can compare it to the old data that you previously collected.

If for whatever reason, you collect Test Track data in a different job, you can always use TOOLS/MERGE in the RoadFace 6 program to merge the old data with the new data. When you overlay today's two 50-ft runs on top of the original two 50-ft runs, you should see a single profile instead of 4 separate profiles. They will all lie on top of each other.

If the profiles all lie on top of one another, and if the IRI is are the same for all the Runs, then you can be sure that your Dipstick is working properly.

If there are minor variations in parts of the profiles, but the profiles eventually merge into one profile, this usually indicates that you didn't quite walk exactly the same line out and back.

If the profiles start at different elevations, you should use EDIT/RUN HEADER to set the start point elevations all the same, usually 0.

This is the best way for you to check your Dipstick®.

If you have problems when you check the calibration on your Test Track:

- Ensure that the floor is clean.
- Be sure the feet are in the proper holes.
- Check to see if the zeroing is still correct. (Be sure to warm up for 5 minutes before zeroing)

If you continue to have problems when you check the calibration on your Test Track:

- Send your Dipstick® to us for repair and/or recalibration.