

Allen Face

State-of-the-Art Concrete Floor Technology

F-Meter Operator Manual

Table of Contents

| | |
|---|---------|
| Section I: BATTERY CHARGING, RE-CALIBRATION, & MAINTENANCE | I - 1 |
| Charging the NiCad Power Pack | I - 1 |
| Re-Calibration Requirements | I - 1 |
| Routine Maintenance | I - 1 |
| Returning Your Unit for Service | I - 2 |
| Notice to Overseas Customers | I - 3 |
| | |
| Section II: SETTING-UP & OPERATING the DOWNLOAD SOFTWARE | II - 1 |
| Loading the F-Meter® Download Software onto Your PC's Hard Drive | II - 1 |
| What to Do If Loading/Operating Problems Are Encountered | II - 2 |
| Running the F-Meter® Download Software | II - 2 |
| Loading Requisite Reference Files | II - 3 |
| | |
| Section III: GENERAL OPERATION | III - 1 |
| Recommended Run Pattern | III - 1 |
| Unit Power-Up & Memory Clearance | III - 1 |
| “FF Only” and “FF & FL” Operation Modes | III - 1 |
| “Start New Session ?” Query | III - 2 |
| “<End Reversal Run” Message | III - 2 |
| | |
| Recording Runs in “FF Only” Mode | III - 2 |
| Starting a Run in “FF Only” Mode | III - 2 |
| Ending a Run in “FF Only” Mode | III - 3 |
| | |
| Recording Runs in “FF & FL” Mode | III - 4 |
| Starting a Run in “FF & FL” Mode | III - 4 |
| Pausing a Run in “FF & FL” Mode | III - 5 |
| Ending a Run in “FF & FL” Mode | III - 5 |
| Closing an “<End Reversal Run>” | III - 5 |
| Closing a Regular Run | III - 7 |
| | |
| Displaying Run Results | III - 7 |
| Check Codes | III - 7 |
| Automatic Retention of All Run Records | III - 7 |
| Automatic Downloading of All Run Records to Excel® | III - 8 |

Table of Contents (cont)

| | | |
|--|-----------|---------|
| Section IV: DETAILED KEY & LIGHT DESCRIPTIONS | | IV - 1 |
| Section V: DETAILED SCREEN DESCRIPTIONS | | V - 1 |
| Status / Information Screens | | V - 1 |
| Query Screens | | V - 3 |
| Instruction Screens | | V - 4 |
| Results Screens | | V - 4 |
| Battery Status Screens | | V - 6 |
| Error Message Screens | | V - 7 |
| Error Message Codes | | V - 8 |
| Section VI: F-METER PROJECT MANAGEMENT | | VI - 1 |
| Instructions for <i>Green</i> Form 394a “Daily Placement Report” | | VI - 2 |
| Instructions for <i>Blue</i> Form 394b “In-Place Area Report” | | VI - 5 |
| Instructions for <i>Blue</i> Form 394c “Remaining Area Report” | | VI - 8 |
| Instructions for <i>Yellow</i> “FF/FL Quality Control Charts” | | VI - 11 |
| Instructions for <i>Yellow</i> “FF/FL Quality Control Charts” | | VI - 11 |
| Project Management Utility Programs | | VI - 12 |
| Section VII: STANDARD FF/FL FLOOR TOLERANCE SPECIFICATION | | VII – 1 |
| ----- | | |
| Appendix I: ASTM E-1155 (Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers) | | A - 1 |
| Appendix II: ACI-117 Floor Tolerance Specifications & Commentary | | A - 2 |
| Appendix III: ACI-301 Section(s) re: Floor Tolerances | | A - 3 |
| Appendix IV: ACI-302 Section(s) re: Floor Tolerances | | A - 4 |

I. BATTERY CHARGING, RE-CALIBRATION, & MAINTENANCE

A. Charging the NiCad Power Pack (*Overseas Customers See Page I – 3*)

To charge / recharge the F-Meter's internal NiCad power pack, plug the charger body into a 115 volt grounded outlet and plug the charger lead into the socket (located behind the swivel door marked "Charger Socket") on the backside of the unit. Full recharging of an empty power pack (indicated by a flashing green POWER light and/or the "Code 2" or "Code 3" messages) should take no more than six (6) hours.

B. Prolonging NiCad Power Pack Performance (Monthly Battery Re-Conditioning)

Repeated re-charging of NiCad batteries that have not been fully discharged will cause the batteries to develop a "memory" that will significantly reduce the total capacity of the internal power pack. When this condition develops, the F-Meter – though re-charged and indicating "*Battery Full*" - will lose power much faster than normal. The following procedure should be performed monthly to avoid this "memory degradation" of the power pack:

- Leave the F-meter on overnight (or longer, if necessary) to allow the power pack to discharge completely.
- Re-charge the F-Meter for at least 10 hours.
- If the F-Meter still loses charge faster than normal, repeat the above discharge/re-charge procedure.
- If repeated re-conditioning fails to restore the power pack, please call (910) 763-4501.

C. Re-Calibration Requirements

The F-Meter's calibration is set at the factory and can not be changed by the operator. Unless the unit is dropped or otherwise obviously damaged, the factory calibration should remain constant well beyond the annual re-calibration period.

Every F-Meter must be returned annually to the factory for re-furbishing and re-calibration. (There is a nominal charge for this service.) The required return date is displayed on the F-Meter screen every time the unit is turned on. Normal turn-around time for re-furbishment and re-calibration is one-week (excluding transit time), and replacement units may be borrowed at no extra cost, if requested at least two-weeks in advance (freight both ways to be paid by borrower).

Undamaged F-Meters in current calibration are fully warranted indefinitely for both parts and labor.

D. Routine Maintenance

1. Use Windex and a soft cloth to clean all exterior surfaces.
NEVER use any organic solvent to clean the unit.
2. The wheel axles, bar and side plate fasteners, odometer wheel buttons, and towing eye are all ferrous. Oil these parts occasionally to prevent rust formation. All other exposed parts are either plastic, stainless steel, or aluminum, and thus require no maintenance other than routine cleaning.

3. For the F-Meter software to work properly, the round carbide contacts mounted at the bottom of the right front and floppy arm sensor "wheels" must remain fixed in their factory calibrated position. Lateral set screws prevent both these "wheels" from rotating. The position of the carbide contacts should be examined periodically. If it appears that either one has moved, the unit should be returned immediately to the factory for re-calibration.

Warning! The F-Meter is a sealed unit. NEVER attempt to remove either of the side plates !

!!! IRREPARABLE ELECTRONIC DAMAGE WILL OCCUR !!!

Warning! NEVER immerse the unit.
NEVER run the unit through standing water.
NEVER expose the unit to steady rain.

!!! IRREPARABLE ELECTRONIC DAMAGE WILL OCCUR !!!

.....

Warning ! All liabilities attendant to the use of any F-Meter shall reside entirely with the user. AF&C does not warrant the accuracy or adequacy of any of the information provided by the F-Meter and will not be liable for any damages suffered as a consequence of any use thereof or reliance thereupon by any party.

4. If the unit "hangs-up", and the display can not be returned to the "<OFF>" screen by pressing the <STOP/ESC> key, reset the entire system by pressing POWER <OFF> then POWER <ON>.
5. Questionable or troublesome units should be returned immediately to the factory for inspection and repair along with a note describing the problem(s) in detail.
6. After removing the manual and software disks from the F-Meter case, return units requiring service to:

ALLEN FACE & COMPANY, LLC
2725 Old Wrightsboro Road (12 - 5)
Wilmington, North Carolina 28405

Tel: **(910) 763-4501**
Fax: **763-4502**

Note : Please include your business card (or other identifying note) inside the case along with specific instructions regarding billing and return shipment. Unless arranged otherwise, return shipment will be made by FedEx Ground

II. SETTING-UP & OPERATING the DOWNLOAD SOFTWARE

A. Loading the F-Meter® Download Software onto Your PC's Hard Drive

The F-Meter Download software is supplied on one (1) standard CDROM. To load the software onto your PC's hard drive, proceed as follows:

From the Windows® Desktop, close all current applications.

Place the CD in your computer's CD Drive.

Open Windows Explorer and double left click on the CD Drive's letter to display the CD's contents.

Double left click on the file titled "GO" in the right panel. Follow all screen instructions, left clicking on the appropriate buttons as prompted.

If the Set-up routine is interrupted any time prior to its successful completion, before terminating, it will try to remove all the files that it has already created from your hard drive.

The default destination directory for the F-Meter software is *C:\Program Files\F-Meter Download*. If you want to change the destination directory, left click on the "Change Directory" button when prompted and key-in the requested alternative path information.

If, at any time during the Set-up process, any type of "File Conflict" message box appears, simply left click on the box's "Ignore" button.

Set-up will display a "Successfully Loaded" message when done. Left click on the "OK" button to return to Windows Explorer.

If the Windows Explorer screen fills the display, left click on the "Shrink Screen" button (at the upper right corner) to expose part of the Desktop.

Double left click on *Program Files* to display the newly created *F-Meter Download* folder.

Double left click on *F-Meter Download* to display the new folder's contents.

Right click (and hold) on the file titled "*download*" and drag the file over to any exposed part of the Desktop. A query box will display when the right mouse button is released. Left click on the box's "Create Shortcut(s)" button to create a new "Shortcut to download" icon on the Desktop.

Close Windows Explorer.

Right click on the new "Shortcut to download" icon, then left click on the "Rename" option in the displayed query box.

Key-in any desired name (e.g. "F-Meter Download ") for the shortcut. Press <Enter> to exit the renaming routine.

To run the F-Meter Download program, simply double left click on this new Desktop icon.

B. What to Do If Loading/Operating Problems are Encountered

The executable file that will run when the “F-Meter Download” (or alternatively named) Desktop icon created above is double left clicked is entitled *download.xl_*. This file is a Visual Basic for Applications® (VBA) program that operates entirely under Microsoft Excel®. For this program to run at all, therefore, you must have Microsoft Excel (and all the requisite *.dll *.ocx *.olb & *.tlb reference files) already installed on your PC. If any of these reference files can not be found by the program, an “Unable to find ___” run error will occur. In this event, refer to Section D “Loading Requisite Reference Files” below.

Operating entirely within the Excel environment greatly simplifies data transmission, data processing, and report generation. In addition, the chances are minimized that any fatal loading or operating conflicts will be encountered. Unfortunately, however, because the many Windows operating systems (e.g. 95, 98, NT, 2000, ME, XP) now in general use all differ significantly from one another, it is extremely difficult to develop proprietary “Windows” software that is universally loadable / runnable. Indeed, all large software manufacturers are now compelled to provide live technical support (via telephone) to work through the myriad problems that can occur just in trying to load – no less run – their products.

While the loading and operation of the F-Meter Download software have both been thoroughly tested, there is still a small chance that the software will not load or run properly on your particular machine. (Generally, if Set-up is able to load the program, then it should also be able to run.) If a loading or operation failure does occur, **please do not call us!** We just don’t have the manpower to provide the kind of lengthy real time support required to locate the problem and walk you through all the necessary re-configuration steps (assuming, of course, that a fix can even be identified). Your best option will be to try a different computer. Since neither Excel, nor the F-Meter software, is particularly demanding in terms of their memory or speed requirements, an older machine should be fine. For example, we have dedicated one of our old Pentium(r) 64MB 33MHz machines running Windows 95 exclusively to F-Meter downloading, and it runs perfectly well.

If you can not find a machine that will load and run the F-Meter Download software, then you have two options:

You can return the software to us for a full refund, or
We will sell you a low-cost computer on which the software has already been loaded.

In either event, we will do our best to make you happy.

C. Running the F-Meter® Download Software

To start the program, double left click on the Desktop icon created above. Simply follow the screen instructions, left clicking on the appropriate buttons as requested.

Every time the F-Meter is downloaded, all the runs in its memory are placed in a new Excel Workbook. The first sheet in the Workbook then lists the summary results – both collectively and individually - for all of the sessions so downloaded.

Each sheet in the Workbook corresponds to a different session, and the individual graphs for all of the runs collected during the session are displayed on its sheet. In addition, the various statistical results associated with each run are listed separately, as are the individual run profile point elevations (in inches x 1000).

The F-Meter Download routine terminates with the creation of the Workbook. No fixed reporting formats or data manipulation / listing procedures are imposed. Instead, the user is left to work within Excel to do with the raw data as he pleases. Excel (working in concert with Microsoft Word®) supports the fast and easy preparation of all manner of customized reports. Rather than limiting the user to a rigid, pre-determined format, this free-form approach uses the full power of both Excel and Word to couple ease of operation with maximum flexibility.

D. Loading Requisite Reference Files

The F-Meter Download set-up provided on the CDROM assumes that certain requisite reference files already exist on your hard drive. When your Windows operating system and your Microsoft Office Excel software were first loaded, these files should have been created as a matter of routine. Unfortunately, the folder (i.e. directory) structures used by the earliest versions of Windows and Excel were not maintained in later versions, so the files – if they exist at all – may be in a place where the F-Meter Download software can't find them. To remedy this problem (which will manifest itself as an "Unable to find ..." error message when you try to run the program), it will be necessary to create the requisite folder/file structure shown below:

```
C:\ Windows \ System \ stdole2.tlb
C:\ Windows \ System \ fm20.dll
C:\ Windows \ System \ mscomm32.ocx
C:\ Windows \ System \ ietimer.ocx
C:\ Program Files \ Common Files \ System \ Ado \ msado20.tlb
```

The F-Meter Download CDROM contains the above folder/file structure. To transfer this structure onto your C: drive, proceed as follows:

From the Windows® Desktop, close all current applications.

Place the CDROM in your computer's CD drive.

Double left click on the "My Computer" icon on the Desktop.
(This will open the "My Computer" window.)

Double left click on CD drive letter in the "My Computer" window.
(This will open the "CD Drive ID# (_:)" window.)

Left click on Edit in the "CD Drive ID# (_:)" window, then left click on "Select All" in the drop-down box.
(This will highlight both the "Windows" and "Program Files" folders.)

Using the right mouse button, drag the highlighted folders on top of the "(C:)" hard drive icon in the "My Computer" window.

Answer "No" to all inquiries regarding the replacement of identically named files that already exist on your C: drive.

After all missing files have been transferred, close the "My Computer" and "CD Drive ID# (_:)" windows.

There are 3 other Microsoft Office reference files that are also required by the F-Meter Download program:

```
C:\ Microsoft Office \ Office \ excel8.olb
C:\ Microsoft Office \ Office \ mso97.dll
C:\ Program Files \ Common Files \ Microsoft Shared \ Vba
```

These large files are all standard components of the Microsoft Office installation and should already be present on your C: drive in the indicated folders.

III. GENERAL OPERATION

A. Recommended Run Pattern

Select the run pattern to be measured. ASTM E-1155 (see Appendix) requires that the measurement lines conform to one of the following two schemes:

1. Runs parallel and perpendicular to the longest slab boundary, where the aggregate run length in each direction is approximately equal, or
2. Runs of any length all oriented at 45° to the longest slab boundary.

Owing to the great data collection speed of the F-Meter, it is strongly recommended that all tests always be performed using an “X the Bays” approach – even if the N/S and E/W column spacings are not exactly equal. Standardizing the run pattern on the bay diagonals offers a number of practical advantages:

1. The minimum q and z sampling requirement will always be well satisfied.
2. Uniform coverage is automatically obtained.
3. No run location decisions are required of the operator.
4. No measurement line diagrams ever have to be produced or archived.
5. Straight line steering of the unit without the aid of a taut string reference is facilitated.
6. Tests can always be easily duplicated in future.
7. Results from different projects can always be reasonably compared.

B. Unit Power-Up & Memory Clearance

Press the **<ON>** button to turn the unit **ON**. Observe the various system status screens during power up. Attach the leash to the hook on the front of the unit.

Respond to all memory status inquiries as prompted:

At the “VOID Clears Memory” prompt, pressing the **<VOID PREV RUN>** button initiates the MEMORY CLEARANCE routine. At the “Are You Sure ?” query, pressing the **<GO/OK>** button will then permanently delete all resident run records from memory. Be careful when clearing the memory ! Erased (and voided) runs are **unrecoverable**.

Pressing **<STOP/ESC>** exits the MEMORY CLEARANCE routine at any prompt.

C. “<FF Only>” and “<FF & FL>” Operation Modes

Pressing the **<GO/OK>** button at the “Measure FF Only ?” query puts the unit into “FF Only” mode. In this mode, point elevations and FL numbers are not recorded. Only a run’s FF numbers are measured and summarized. In “FF Only” mode, both the “pausing” and “unit reversal” procedures (see below) are suppressed, and the unit operates like the original F-Meter. “FF Only” mode is convenient for testing elevated slabs where FL is not required, and run graphs are not wanted. (Once selected, the operation mode is set for the entire session; the only way to change the operation mode is to restart the unit.)

Pressing the <STOP/ESC> button at the “Measure FF Only ?” query puts the unit into “FF & FL” mode. In this mode, all ASTM E-1155 profile features (FF, FL, and the individual run point elevations) are recorded, and the “pausing” and “unit reversal” protocols described below must be followed.

D. “Start New Session ?” Query

If the operational mode (i.e. “<FF-Only>” or “<FF and FL>”) is kept the same as that used for the previous power up, the “Start New Session ?” query will next appear. Answering “NO” (by pressing the <STOP/ESC> key) to this query will cause the runs collected during this power up to be added to those of the previous session. Answering “YES” (by pressing the <GO/OK> key) will cause the runs collected during this power up to be assembled under their own new session number.

E. “<End Reversal Run>” Message

When the unit is operating in “<FF and FL>” mode and the message “<End Reversal Run>” appears after the <GO/OK> button is pressed to start a new run, the unit reversal procedure described in Section III.H.4 below must be performed at the end of that run. The F-Meter automatically determines when an end reversal reading is required, and, depending upon the operational environment, may or may not require the procedure after every run.

F. The “<OFF>” Screen

After the operation mode and session number selection, the unit displays the “<OFF>” (i.e. “not recording”) screen. The yellow INDEX light illuminates every inch of travel, and the distance counter increments every inch. Pressing <STOP/ESC> at any time resets the distance counter.

G. Recording Runs in “FF Only” Mode

1. Starting an “FF Only” Mode Run:

Place the unit on the floor at the desired run start point. Align the sensor side (i.e. the side with the floppy arm) “wheels” with the desired run line. Manually rotate the odometer wheel (i.e. the rear wheel with the six side studs) as required until the yellow INDEX light stays **ON**.

*NOTE: Throughout the run recording procedure, the yellow INDEX light must be **ON** whenever the <GO/OK> or <STOP/ESC> buttons are pushed.*

Warning! Prior to each run, make sure that the follower arm swings freely. Any binding of the follower arm (usually caused by grit caught between the arm and the adjacent wheel mounting bars, or by binding of the 1/4" brass hex connecting rod on the 1/8" diameter black pin) will compromise measurement accuracy. **If the brass connecting rod is bound on the black pin, manually slide the connecting rod back and forth along the pin until it feels "loose".**
.....

Press the <GO/OK> button to initiate “FF Only” run recording. The screen will immediately display “<Go>”. As soon as the unit is moved, the “<ON>” screen will appear, and the distance counter will start to increment every inch as the unit advances.

A recording speed of 2 to 3 feet per second (i.e. a slow to medium walk) is recommended. Note that the yellow INDEX light now only flashes every foot.

Note: Sampling accuracy is generally insensitive to speed variations or stops and starts, provided that the “wheels” never lose contact with the measured surface. Nonetheless, a steady deliberate pace is recommended. Measurement accuracy will obviously be compromised if unit is pulled too fast on a rough surface so that it bounces and/or chatters.

Considerable experience has shown that measurement accuracy is not adversely affected by running across unfilled sawcuts, construction joints, or other wide cracks. It is suggested that these routine breaks in the surface be ignored.

Warning! Measurement accuracy will be compromised, if the unit is not pulled approximately in a straight line.

Measurement accuracy will be compromised by any reading taken in reverse.

Measurement accuracy can be compromised by dirt on the measured surface.

Always sweep the measurement line clear of any grit or debris prior to data collection.

Occasionally, a grit particle will become embedded in one of the wheels (even on a "clean" floor) and cause the unit to "clunk" every 3 - 6 inches of travel. If this happens, continue the run (as measurement accuracy will not be seriously affected) and simply wipe the wheels clean as they rotate.

2. Ending an “FF Only” Mode Run:

The minimum run length is **11'- 0"**. Attempting to terminate a run that is shorter than this distance will automatically cancel the run and return the unit to “<OFF>” (i.e. “not recording”) mode.

The maximum run length is **120'- 0"**. Pulling the unit in “<ON>” mode beyond this distance will auto-matically cancel the entire run and return the unit to “<OFF>” mode. (The unit may be pulled any distance in “<OFF>” mode without consequence.)

A run may be terminated any time the unit is stopped with the yellow INDEX light **ON** (i.e. at any exact foot down the run). If the unit is inadvertently pulled beyond the desired end point (so that the yellow INDEX goes **OFF**), simply continue on to the next exact foot. With the unit stationary and the yellow INDEX light **ON**, press the **<STOP/ESC>** button to end the run. The screen will immediately display “*Computing Run ##*”. After the run calculation is completed and results are recorded, the red RECORD light will go **OFF**, and the unit will return to the “<OFF>” screen.

H. Recording Runs in “FF & FL” Mode

1. Starting an “FF & FL” Mode Run

Make sure that you have the slotted brass bar and a pencil with you.

Place the unit on the floor at the desired run start point. Align the sensor side (i.e. the side with the floppy arm) “wheels” with the desired run line. Manually rotate the odometer wheel (i.e. the rear wheel with the six side studs) as required until the yellow INDEX light stays **ON**.

***NOTE:** Throughout the run recording procedure, the yellow INDEX light must be **ON** whenever the unit is **PAUSED** (see below), or the **<GO/OK>** or **<STOP/ESC>** buttons are pushed.*

Warning! Prior to each run, make sure that the follower arm swings freely. Any binding of the follower arm (usually caused by grit caught between the arm and the adjacent wheel mounting bars, or by binding of the 1/4" brass hex connecting rod on the 1/8" diameter black pin) will compromise measurement accuracy. **If the brass connecting rod is bound on the black pin, manually slide the connecting rod back and forth along the pin until it feels "loose".**

Press the **<GO/OK>** button to initiate run recording. The screen will now display “<Don’t Move>”. **Do not move** the unit until the red RECORD light comes **ON** and the screen says “<Go>”. As soon as the unit is moved, the “<ON>” screen will appear, and the distance counter will start to increment every inch as the unit advances.

A recording speed of 2 to 3 feet per second (i.e. a slow to medium walk) is recommended. Note that the yellow INDEX light now only flashes every foot. Continue to observe the distance counter on the screen as the run is recorded.

Note: Sampling accuracy is generally insensitive to speed variations or stops and starts, provided that the “wheels” never lose contact with the measured surface. Nonetheless, a steady deliberate pace is recommended. Measurement accuracy will obviously be compromised if unit is pulled too fast on a rough surface so that it bounces and/or chatters.

Measurement accuracy is not appreciably affected by running across unfilled sawcuts, construction joints, or other wide cracks. These width breaks in the surface may be ignored.

Warning! Measurement accuracy will be compromised, if the unit is not pulled approximately in a straight line.

Measurement accuracy will be compromised by any reading taken in reverse.

Measurement accuracy can be compromised by dirt on the measured surface.

Always sweep the measurement line clear of any grit or debris prior to data
Occasionally, a grit particle will become embedded in one of the wheels (even on a "clean" floor) and cause the unit to "clunk" every 3 - 6 inches of travel. If this happens, continue the run (as measurement accuracy will not be seriously affected) and simply wipe the wheels clean as they rotate.

2. Pausing an "FF & FL" Mode Run:

Starting at **8'-1"**, and then every 10'-0" thereafter, the red RECORD light will start blinking, and the "<PSE>" screen will appear. When this happens, the unit must be stopped **within the next 3 feet** so that the yellow INDEX light stays **ON**. When the unit remains stationary for 2 seconds in this PAUSE mode (with the yellow INDEX light **ON**), the red RECORD light will go **OFF**, and the screen will display "<Don't Move>".

Recommence the run only after the red RECORD light comes back **ON**, and the screen says "< Go >". After pausing, before the unit is moved again, there is no prohibition against ending the run by pressing the **<STOP/ESC>** button, thereby initiating the UNIT REVERSAL routine (see below).

Repeat this RUN PAUSE routine every time the red RECORD light starts blinking and the "<PSE>" screen appears.

3. Ending an "FF and FL" Mode Run:

The minimum run length is **11'- 0"**. Attempting to terminate a run that is shorter than this distance will automatically cancel the run and return the unit to "<OFF>" (i.e. "not recording") mode.

The maximum run length is **120'- 0"**. Pulling the unit in "<ON>" mode beyond this distance will auto-matically cancel the entire run and return the unit to "<OFF>" mode. (The unit may be pulled any distance in "<OFF>" mode without consequence.)

A run may be terminated any time the unit is stopped with the yellow INDEX light **ON** (i.e. at any exact foot down the run). If the unit is inadvertently pulled beyond the desired end point (so that the yellow INDEX goes **OFF**), simply continue on to the next exact foot. With the unit stationary and the yellow INDEX light **ON**, press the **<STOP/ESC>** button to stop the run. The red RECORD light will go **OFF**, and the screen will display "<Don't Move>".

4a. Closing an "<End Reversal Run>" (Reversing the Right Side Sensor "Wheels"):

If the "<End Reversal Run>" message has appeared at the start of an "FF & FL" mode, the run must be closed by taking a reversed reading taken at the run end point. *The entire run does not have to be reversed!* Only a single reversed reading at the final measurement point is required.

After the **<STOP/ESC>** button has been pressed (with the yellow INDEX light **ON**), **do not move** the unit until the red RECORD light comes back **ON**, and "< Reverse Unit >" appears on the screen.

Place the slotted brass bar (slot side up) on the floor behind the odometer wheel (i.e. the right rear wheel with the six side studs). Fit the slotted brass bar up against the back of the odometer wheel so that the slot engages the wheel tread and the top edge of the bar rests against the wheel rim. Put a pencil mark on the floor in front of (and in line with) the fixed right front sensor "wheel".

Grasp the F-Meter's handle with your right hand and lift the unit off the floor so as **not to move** the slotted brass bar. Holding the slotted brass bar in place with your left hand, set the F-Meter back down on the floor so that the fixed right front sensor "wheel" snugly engages the slot and the right rear odometer wheel aligns precisely with the pencil mark. The net effect of this unit reversal, therefore, is simply to interchange the positions of the right front and right rear sensor "wheels" at the final reading point. (A diagram illustrating the proper reversing procedure is given on the following page.)

If necessary, without displacing the unit, lift and manually rotate the odometer wheel until the yellow INDEX light stays **ON**. With the sensing side (i.e. the "floppy arm" side) of the unit now reversed at its final measurement position, press the **<STOP/ESC>** button. The red RECORD light will go **OFF**, and the screen will again display "*Don't Move*".

Do not move the unit until the red RECORD light comes back **ON**, and "*Computing Run ##*" appears on the screen. After completing the calculation, the unit will automatically return to "*OFF*" mode.

4b. Closing a Regular “FF & FL” Mode Run

If the “<End Reversal Run>” message has not appeared at the start of an “FF & FL” mode, the run will be closed automatically. After the <STOP/ESC> button has been pressed (with the yellow INDEX light **ON**), **do not move** the unit until the red RECORD light comes back **ON**, and “Computing Run ##” appears on the screen. After completing the calculation, the unit will return automatically to the “<OFF>” screen.

B) I. Displaying Run Results

Individual and combined F-Number results and run profile elevations are displayed (or deleted) using the <PREV RUN>, <ALL RUNS>, <VOID PREV RUN>, <GO/OK>, and <STOP/ESC> buttons. See Section III for a detailed explanation of the key press sequences used to manage and display the individual and aggregate session run records..

Note: F-Meter FF, FL, and Profile Elevation run results conform fully to all ASTM E-1155 requirements.

J. Check Codes

Immediately following each display of <PREV RUV> or <ALL RUNS> results, a nine (9) character “Check Code” will now appear. This check code encrypts the pertinent FF/FL and run date information to permit independent confirmation of all reported values.

A contractor self-testing his FF/FL numbers, for example, can submit his results (along with the associated check codes) to an owner, who can then independently confirm the veracity of the contractor’s report simply by accessing the Check Code screen on the AF&Co website: www.allenface.com. A match between these deciphered results and those presented in the contractor’s original report is absolute confirmation of the report’s veracity.

K. Automatic Retention of All Run Records

The unit may be turned off at any time by pressing the <OFF> button. If the unit is running “ n #.## “ version software, all resident run data will be saved automatically, even if the battery pack loses charge. Pressing the <GO/OK> button after power up at the “Are You Sure ?” prompt is the only way that run records can be cleared from non-volatile memory. When the memory has been cleared in this manner, the total run capacity is reset to **99** runs, and the session number (see below) is reset to **1**.

The run records in all non-volatile memory units are organized under “session numbers”, and the run numbers shown on the <OFF> and <ON> screens now consist of two parts: the associated session number and the sequential run number. Run number “3, 14”, for example, was recorded during the third session and is the fourteenth run in memory.

Every time the unit is turned **ON**, a new session begins. Turning the unit **OFF** terminates the current session. This protocol allows runs taken on different projects (or slabs) to be collected under different session numbers and thus be kept separate from one another. The <**ALL RUNS**> routine reports the aggregate FF/FL results for all the runs collected during each individual session as well as the aggregate FF/FL for all the sessions combined (i.e. all the runs in memory).

Units running “ v #.## ” version software lose all resident data whenever the unit is turned off (or the battery pack loses charge) and do not support the “Session Number” organization protocol.

K. Automatic Downloading of All Run Records to Excel®

All units running “ n #.## ” version software have been fitted with serial communication ports and are fully capable (with the requisite cabling and PC software) of downloading all retained data directly into MicroSoft Excel. After attaching the unit to the COM port of any PC or laptop (fitted with Excel and running the associated F-Meter VBA Download Program), all resident run data can be downloaded to the host computer in a matter of seconds.

The F-Meter Download Program puts the run data directly into Excel, and immediately displays the individual run statistics, graphs, and data lists as soon as all the files have transferred. Each download becomes a new Excel Workbook; each downloaded session becomes a separate Worksheet in that Workbook; and each run becomes a separate Chart on its session’s Worksheet. With just a rudimentary knowledge of Excel, these downloaded data may be manipulated quickly to produce any type of formal report desired.

IV. DETAILED KEY & LIGHT DESCRIPTIONS

A. KEY FUNCTIONS

1. POWER Section

- a. <ON> : turns power "On"
- b. <OFF> : turns power "Off"

Warning! The POWER <OFF> key is functional at all times ! On all volatile memory models (i.e. all units running [v #.##] version software), pressing POWER <OFF> will immediately turn the unit off and erase all saved data !

2. RECORD Section

- a. <GO/OK> : Deletes all runs in memory and resets unit (from the "Are You Sure ?" screen)
 - : Selects "< FF Only Mode >" (from the "Measure FF Only ?" screen)
 - : If yellow INDEX lamp is lit, starts run recording (puts unit in "<ON>" mode)
 - : Displays selected run results (from the "OK Shows Run ss,rr" screen)
 - : Displays individual point elevations (from the "Run rr: Show H's ?" screen)
 - : Deletes selected run from memory (from the "OK Voids Run ss,rr" screen)

- b. <STOP/ESC> : Exits memory clearance routine (from the "<VOID> Clears Runs" screen)
 - : Exits memory clearance routine (from the "Are You Sure ?" screen)
 - : Selects "< FF & FL Mode >" (from the "Measure FF Only ?" screen)
 - : If yellow INDEX light is ON in "< FF Only Mode >", stops run recording and starts run calculation (from the "<ON>" screen)
 - : If yellow INDEX light is ON in "< FF & FL Mode >", stops run recording and starts "<Reverse Unit>" routine (from either the "<ON>" or "< Go >" screens)
 - : If yellow INDEX light is ON in "< FF & FL Mode >", after the unit has been reversed, starts the run calculation (from the "<Reverse Unit>" screen)
 - : Resets the odometer (from the "<OFF>" screen)
 - : Displays the battery status and number of runs left (from the "Reset Odometer" screen)
 - : Displays the current GMT date and time (from the "rr Runs Left" screen)

 - : Displays the continuous front-to-back right side sensor "wheel" elevation difference in inches (from the "Run Time: hh:mm GMT" screen)
 - : Returns to the "<OFF>" screen (from the "+ i.iii" screen)
 - : Returns to the "<OFF>" screen (from the "Run rr: Show H's ?" screen)
 - : Exits the sequential run point elevation display (from the "ff: H = iii + " screens)

 - : Returns to the "<OFF>" screen after any error message

3. RESULTS Section

a. <PREV RUN> : Selects the particular run results to be displayed beginning with last run recorded
Sequentially pushing the <PREV RUN> key scrolls the selected run number

When the desired run number appears in the "<OK> Shows Run ss,ss" screen, pressing the RECORD <GO/OK> key displays the results for that run

b. <ALL RUNS> : Displays composite results for all recorded (unvoided) runs
In all non-volatile memory units (i.e. all units running [n #.##] version software),
aggregate results are displayed for all runs in memory and for all the runs
contained in each session

c. <VOID PREV RUN> : Selects particular run to be deleted beginning with last run recorded
Sequentially pushing <VOID PREV RUN> scrolls the selected run number

When desired run number appears in "<OK> Voids Run ss,rr" screen,
press the RECORD <GO/OK> key to void that run

Warning! Once voided, run records can not be recovered.

B. LAMP DESCRIPTIONS

1. POWER lamp (green) : When steady, indicates unit power is ON
: When flashing, indicates low battery condition (i.e. unit needs charging)

2. INDEX lamp (yellow) : When ON in "<OFF>" mode, indicates unit has advanced 1 inch
: When ON in "<ON>" or "<PSE>" modes, indicates the unit is at an acceptable static reading point
: When ON in "<Reverse Unit>" mode, after the right side sensor "wheels" have been properly reversed at the run termination point, indicates that the <STOP/ESC> key should be pushed

Note! The yellow INDEX lamp must be ON whenever: 1) the <GO/OKAY> key is pushed to start a run, 2) the <STOP/ESC> key pushed to stop a run, or 3) the <STOP/ESC> key is pushed after the unit reversal procedure to start the run calculation.

3. RECORD lamp (red) : When steady, indicates unit is in "<ON>" mode
When flashing, indicates run should be paused, or that recording has been stopped automatically by a "soft-fail" or "run length error" event

V. DETAILED SCREEN DESCRIPTIONS

A. STATUS / INFORMATION SCREENS

1. " *F-Meter [x #.##] "* : Software version identification. x = "n" for non-volatile memory versions; x = "v" for volatile memory versions
2. " ©2003: Allen Face" : Software copyright notice
3. "FF/FL per ASTM E1155" : ASTM conformity verification
4. " S/N: ##### " : The unit's serial number
5. "Re-calibrate by:" : The date by which unit must be returned to factory for re-calibration
"mmm dd, yyyy "

Note! F-Meter warranty terms require that each unit be returned annually (every three years for international units) to the factory for re-calibration. Please consult our website (www.allenface.com) for the current fee charged for this service. In-shop time for routine re-calibrations averages less than 3 days. Free loaner units (customer pays all freight charges) are usually available upon request.

6. " < FF Only Mode > " : Indicates the unit is operating in "<FF Only Mode>". Pausing and unit reversal procedures are suspended, and only FF results are recorded (i.e. no FL or point elevation results are produced)
7. " < FF & FL Mode > " : Indicates the unit is operating in full measurement mode. Pausing and unit reversal procedures are in full effect, and all FF, FL, and point elevation results are recorded.
8. " <End Reversal Run > " : The unit reversal run closing procedure must be performed at the end of the "FF & FL" mode run now being recorded.
9. " No Runs Stored " : The run memory is empty
10. " rr Runs Stored " : There are currently "rr" run records stored in memory
11. "Deleting All Records" : The desire to clear memory has been confirmed
" Re-starting Unit "

12. " Session # ss " : The current session number is "ss"
13. " rr Runs Left " : "rr" runs can still be recorded before the memory is full
14. "Max Run Lngth = 120' ": Reminder that the maximum length allowable for any run is 120 feet
15. "ss,rr:<OFF> ff' ii'" : The "<OFF>" screen. The unit is not recording. "ss" is the current session number. "rr" is the next recordable run number. "ff" + "ii" are the feet and inches traveled since the last odometer reset.
16. "ss,rr:<ON> ff' ii' " : The "<ON>" screen. The unit is recording a run. "ss" is the current session number. "rr" is the run number being recorded. "ff" + "ii" is the current run length (in feet and inches) recorded.
17. "ss,rr:<PSE> ff' ii'" : The "<PAUSE>" screen. The unit is recording a run. "ss" is the current session number. "rr" is the run number being recorded. "ff" + "ii" is the current run length (in feet and inches) recorded. The "<ON>" screen changes to this screen (and the red RECORD light starts flashing) every time the run length reaches an exact multiple of 10 feet. Within the next 3 feet, the unit must now be paused with the yellow INDEX light ON.
18. "Computing Run ss,rr" : In <FF Only Mode>, run recording has been properly exited by pressing the <STOP/ESC> key with the yellow INDEX light ON.
 In <FF & FL Mode>, after reversing the right side sensor "wheels" at the run termination point, the unit reversal routine has been properly exited by pressing the <STOP/ESC> key with the yellow INDEX light ON.
 The run just recorded (session number "ss", sequential run number "rr") is now being calculated.
19. "ss,rr: qqqqqq Rdgs" : This screen appears after the run calculation has been completed. "ss" is the current session number. "rr" is the next run number to be recorded. "qqqqqq" is the aggregate number of *q* readings (see ASTM E1155) recorded in the current session. Pressing the <STOP/ESC> key or spinning the odometer wheel will cause the "<OFF>" screen to reappear.
20. " Reset Odometer " : The <STOP/ESC> key has been pressed with the "<OFF>" screen displaying a distance greater than 1'-0". After this screen appears momentarily, the "<OFF>" screen will reappear with the distance counter reset to 1'-0".
21. " Serial I/O Active " : This message scrolls across the screen whenever the F-Meter is communicating with another computer through the serial cable.

B. QUERY SCREENS

1. " <VOID> Clears Runs " : Pressing the <VOID PREV RUN> key at this start-up prompt will initiate memory clearance and unit reset. Pressing the <STOP/ESC> key at this prompt will skip the memory clearance routine and retain all current run records
2. " Are You Sure ? " : The memory clearance routine has been entered by pressing the <VOID PREV RUN> key at the "<VOID> Clears Runs" query. Pressing the <GO/OK> key at this query will permanently delete all run records and cause the unit to perform a full reset. Pressing the <STOP/ESC> key at this query will exit the memory clearance routine and retain all current run records.
3. " Measure FF Only ? " : Pressing the <GO/OK> key at this query puts the unit into "<FF Only Mode>". Pausing and unit reversal procedures are suspended, and only FF results are recorded (i.e. no FL or point elevation results are produced) Pressing the <STOP/ESC> key at this query puts the unit into "<FF & FL Mode>". Pausing and unit reversal procedures are in effect, and all FF, FL, and point elevation results are recorded.
4. "<OK> Shows Run ss,rr" : Pressing the <GO/OK> key at this prompt causes the results for run "rr" in session "ss" to be displayed. Pressing the <PREV RUN> key at this prompt scrolls "rr" to the next recorded run number. Pressing the <STOP/ESC> key at this prompt exits the run results selection routine and returns to the "<OFF>" screen.
5. " Run rr: Show H's ? " : Pressing the <GO/OK> key at this query causes the point elevations (on 1 foot centers) down run number "rr" to be displayed sequentially. The display rate (40 elevation readings per minute) allows the readings to be keyed into a spreadsheet manually.
6. "<OK> Voids Run ss,rr" : Pressing the <GO/OK> key at this prompt causes the results for run "rr" in session "ss" to be deleted permanently from memory. Pressing the <VOID PREV RUN> key at this prompt scrolls "rr" to the next recorded run number. Pressing the <STOP/ESC> key at this prompt exits the void run results selection routine and returns to the "<OFF>" screen.

Warning! Once voided, run records can not be recovered.

C. INSTRUCTION SCREENS

1. " < *Reposition Unit* > " : An erroneous attempt has been made to start a run (by pushing the <GO/OK> key with the INDEX light OFF. Reposition the unit until the yellow INDEX light is ON and push the <GO/OK> key again.
2. " < *Don't Move* > " : The unit is automatically recording a static reading. Do not move the unit until prompted to do so.
3. " < *Go* > " : The unit is ready to proceed with dynamic run recording. Pull the unit down the measurement line at a slow, steady walk until the "<PSE>" screen appears, or the desired end point is reached.
4. " < *Continue Run* > " : An erroneous attempt has been made to stop the run with the yellow INDEX light OFF. Pull the unit down the measurement line to the next exact foot and stop the unit with the yellow INDEX light ON. Press the <STOP/ESC> key again to stop the run.
5. " < *Reverse Unit* > " : Run recording has been stopped by pressing the <STOP/ESC> key with the yellow INDEX light ON. A final reversed reading must now be taken at the run stop point. See **Section II.F** for detailed instructions on how to perform this critical reversed end-of-run reading procedure properly.
6. "<*Adjust Odometer Wheel*>" : After the unit has been lifted and reversed at the run stop point, an erroneous attempt has been made to record the reversed end-of-run reading by pressing the <STOP/ESC> key with the yellow INDEX light OFF. Without displacing the unit from its reversed end-of-run position on the measurement line, carefully lift the back right odometer wheel, rotate it manually as required, and set it back down on the floor so that the yellow INDEX light stays ON. Press the <STOP/ESC> key again to record the reversed end-of-run reading.

D. RESULTS SCREENS

1. " *Run Date: mm/dd/yy* " : Depending upon context, in month / day / year format, either:
The GMT date the run being reported was recorded,
The GMT run date of the last run recorded in the particular session being reported, or
The current date (GMT) displayed by pressing the <STOP/ESC> key at the "*Reset Odometer*" screen.

2. " *Run Time: hh:mm GMT* " : Depending upon context, in military Greenwich Mean Time, either:
The time the run being reported was recorded,
The run time of the last run recorded in the particular session being reported, or
The current time displayed by pressing the <STOP/ESC> key at the "*Reset Odometer*" screen.
3. " + *i.iii* " : In inches, the instantaneous unzeroed elevation difference between the front and rear right side sensor "wheels". This display is initiated by pressing the <STOP/ESC> key at the "*Reset Odometer*" screen, once again at the "*Battery*" status screen, and once again at the "*Run Date*" screen. The display may be exited at any time by pressing the <STOP/ESC> key to return to the "<OFF>" screen.

Note! These displayed front-to-rear elevation differences may or may not be perfectly zeroed. Thus, a value of " 0.00" " will not necessarily indicate perfect level. Their relative magnitudes will be correct to within +- 0.002", however.

4. " *No Runs Saved* " : The memory is empty. There are no run records to display.
5. " *Run rr Voided* " : Run number "*rr*" has previously been deleted from memory and can no longer be displayed.
6. "*ss,rr: L = ###.0 ft*" : The length of run number "*rr*" in session number "*ss*" is "*###.0*" feet.
7. " *ss,rr: FF = ###.#*" : The FF number calculated for run number "*rr*" in session number "*ss*" is "*###.#*"
8. " *FL not recorded!* " : The current run or session being reported was measured in "<*FF Only Mode*>", so there were no FL results recorded.
9. " *ss,rr: FL = ###.#*" : The FL number calculated for run number "*rr*" in session number "*ss*" is "*###.#*"
10. "*90%CI= < aaa.a- zzz.z>*" : The 90% confidence interval (see ASTM E1155) for the FF or FL value being reported ranges between the lower limit "*aaa.a*" and the upper limit "*zzz.z*".
11. "*Chk Code: \$\$\$\$\$\$\$\$*" : The check code for the current run or session being reported is "*\$\$\$\$\$\$\$\$*".

12. " *ff*: $H = iii +$ " : The profile elevation "*ff*" feet from the start point of the run currently being reported is "*iii*" / 1000 inches. The sign (+ or -) indicates whether the reported elevation is above (+) or below (-) the mean profile elevation.

Note! For consistency of reporting and graphing, every run profile is arbitrarily referenced to its mean elevation. Thus, elevation "0000" (i.e. the x-axis) simply corresponds to the average profile elevation (i.e. the area under the run profile above the x-axis will always equal the area above the run profile under the x-axis.)

13. " *All ss Sessions* : " : The results which follow are the aggregation of all the runs contained in all "*ss*" sessions in memory.
14. " *Session ss*: " : The results which follow are the aggregation of all the runs contained in session number "*ss*".
15. "*rr Runs: ffff.0 ft*" : The aggregate length of all "*rr*" runs in the current session being reported is "*fff.0*" feet.
16. "*rr Runs: FF = ###.#*" : The aggregate FF number for all "*rr*" runs in the current session being reported is "*###.#*".
17. "*rr Runs: FL = ###.#*" : The aggregate FL number for all "*rr*" runs in the current session being reported is "*###.#*".

E. BATTERY STATUS SCREENS

1. " *Battery: bb%* " : The NiCad battery pack voltage is currently at "*bb*" percent of its nominal maximum value.
2. " *Battery: Full* " : The NiCad battery pack voltage is currently at more than 99% of its nominal maximum value.
3. " *<Recharge Battery>* " : The NiCad battery pack voltage is approaching its nominal minimum operating value. There is less than 15 minutes of operating power remaining.
4. "*<Recharge Unit ASAP>*": The NiCad battery pack voltage is at its nominal minimum operating
"*<Turn Unit Off ASAP>*" value. Immediately turn unit OFF off and re-charge for at least 3 hours.

F. ERROR MESSAGE SCREENS

1. “ *Run Structure Error* ” : The subject run record has been corrupted. Clearing the memory of all runs at unit start-up will usually correct this problem. If this problem occurs repeatedly, however, the unit will have to be returned to the factory for service.
2. “ *Memory Error* ” : The current run pointer has been corrupted. Clearing the memory of all runs at unit start-up will usually correct this problem. If this problem occurs repeatedly, however, the unit will have to be returned to the factory for service.
3. “ *Operator Error* ” : The operator has violated the required operational protocol.
- 4a. “ *Index Light Not On* ” : Either the <GO/OK> key has been pressed in “<OFF>” mode, or the
“ *When <__> Pushed* ” <STOP/ESC> key has been pressed in “<ON> or “<PSE>” mode when the yellow INDEX light is OFF.
- 4b. “ *Unit Has Moved* ” : The unit has moved with the “ < *Don't Move* > ” screen displayed. Press the <STOP/ESC> key to cancel the run and return to the “<OFF>” screen.
- 4c. “ *Run Not Paused* ” : Recording in “ < *FF & FL Mode* > ”, the unit has not been properly paused after the “<PSE>” screen has appeared.
5. “ *Run rr Too Short* ” : Run “rr” has been terminated before 12'-0” have been measured.
6. “ *Softfail @ fff' ii* ” : A reading outside the permitted range has been taken in “<ON>”, “<PSE>”, or “<Reverse Unit>” modes. Press the <STOP/ESC> key to cancel the run and return to the “<OFF>” screen.
7. “ *Run Lngth > 120' Max* ” : The length of the run being recorded has exceeded the maximum 120'-0” allowable.
8. “ *Run ss,rr Cancelled* ” : The run being recorded has suffered a fatal recording error and has been cancelled. Press the <STOP/ESC> key to return to the “<OFF>” screen.
9. “ <OK>= Yes <ESC>= No ” : A key other than the <GO/OK> and <STOP/ESC> keys has been pressed in response to a query screen requiring a “Yes” or “No” answer. Press the <GO/OK> key for “Yes”, or the <STOP/ESC> key for “No”.

G. ERROR CODES

- 0 : Fatal RAM test failure during unit start-up.
- 1 : NVRAM Memory Corrupted (invalid next run number)
- 2 : Very Low Battery (recharge immediately)
- 3 : Low Battery (recharge as soon as possible)
- 4 : NVRAM Memory Corrupted (invalid control character)
- 5 : Calculated FF not a number
- 6 : Calculated FF = positive infinity
- 7 : Calculated FF = negative infinity
- 8 : Calculated 90% Confidence Interval for FF not a number
- 9 : Calculated 90% Confidence Interval for FF = positive infinity
- 10 : Calculated 90% Confidence Interval for FF = negative infinity
- 11 : Calculated FL not a number
- 12 : Calculated FL = positive infinity
- 13 : Calculated FL = negative infinity
- 14 : Calculated 90% Confidence Interval for FL not a number
- 15 : Calculated 90% Confidence Interval for FL = positive infinity
- 16 : Calculated 90% Confidence Interval for FL = negative infinity
- 17 : Slope sensor reading outside allowable range
- 18 : Invalid key press (recording)
- 19 : Invalid key press (pausing)

VI. F-METER PROJECT MANAGEMENT

Because the <ALL RUNS> key estimates both FF and FL using the Normal Probability Distribution, daily F-Meter results can be used to impose complete statistical control over the on-going floor installation. As each new floor slab is installed and measured, the exact numbers of square feet on the slab that are **equal** to both specified overall F-Numbers, and the remainders of square feet on the slab that are either **inferior** to, or **superior** to, OAFF and OAFL can be calculated. The running project totals for these **equal** and **unequal** areas will then precisely describe the present status of the entire floor installation relative to its specified final flatness and levelness. This information can be used in turn to determine the F-Numbers that must be exhibited by the remaining placements in order to make the completed floor conform exactly to OAFF and OAFL. The F-Meter Project Management Program thus provides all of the feedback necessary to drive the floor construction constantly towards total compliance with specified overall tolerances.

Once the entire floor has been installed, if either of the specified overall F-Numbers is not achieved, then the total **unequal** area associated with the floor's measured F-Number will have a **negative** value. This negative (i.e. "defective") area will then be used to compute the monetary remedy required by Paragraph F of the Standard FF/FL Specification (see Section VII in this manual).

Each day's Project Management calculations can be executed in just a few minutes using a hand-held calculator, and the following color- coordinated forms and tables:

Form 394 a: "Daily Placement Report"

This *green* report is used exclusively with **Table 1**:

"Convert F-Number Ratio to Unequal Area Ratio" ,

which comprises the *green* pages in this manual.

Forms 394 b & c : "In-Place Area Report" & "Remaining Area Report"

These two *blue* reports are used exclusively with **Table 2**, which comprises the *blue* pages in this manual. Table 2 is separated into "a" and "b" sections:

Table **2a** : "Convert Negative Unequal Area Ratio to F-Number Ratio"

Table **2b** : "Convert Positive Unequal Area Ratio to F-Number Ratio"

"FF/FL Quality Control Charts"

This *yellow* report contains two charts (one for FF and one for FL) which present both the daily placement and in-place area results in easy-to-read graphical form.

**Instructions for Completing *Green* Form 394a
"Daily Placement Report"**

A *green* Daily Placement Report (Form 394a) should be maintained on every project throughout the course of the floor's installation. Each new placement should be measured immediately after final troweling, when the floor is still uncoated, uncut, and unsoiled. (As noted above, instant measurement and reporting offers the greatest protection available against the development of a floor tolerance dispute.) Since the results for succeeding placements are simply added to the next available line on Form 394a, each newly updated Daily Placement Report will not only detail the condition of the slab most recently installed, but also the entire placement-by-placement history of the project.

The *green* Daily Placement Report is executed as follows:

- Step 1:** Record the project name in the title block space provided.
- Step 2:** Record the floor's Specified Overall FF-Number in Block A .
- Step 3:** Record the floor's Specified Overall FL-Number in Block B .
- Step 4:** Record the slab installation date under "DATE PLCD".
- Step 5:** Record the name given the placement under "SLAB ID".
- Step 6:** Record the size (square footage) of the placement under "SLAB AREA" [Column C].
- Step 7:** Record the FF-Number measured on the slab (the F-Meter <ALL RUNS> result) under "MEAS FF" [Column D]
- Step 8:** Using a calculator, divide the slab's measured FF-Number (the value just recorded in Column D) by the floor's specified overall FF-Number (the value recorded in Block A) and record the result (rounded to 3 decimal places) under "FF RATIO D / A".
- Step 9:** Enter Table 1 (the *green* pages in this manual) with the FF Ratio just calculated, and record the corresponding conversion factor under "TABLE 1 VALUE" [Column E].

NOTE: Make sure that the conversion factor recorded in Column E is given its correct sign !

- Step 10:** Multiply the total placement area (the value recorded in Column C) by the Table 1 conversion factor (the value just recorded in Column E) and record the result under " = FF AREA C x E ".

NOTE: Careful attention must be given to the sign of the Table 1 conversion factor when calculating the unequal FF area !

If the conversion factor recorded in Column E is **negative**, then the resulting unequal FF area must be recorded as a **negative** value, thereby indicating **less than specified** (i.e. "inferior") flatness.

Conversely, if the conversion factor recorded in Column E is **positive**, then the resulting unequal FF area must be recorded as a **positive** value, thereby indicating **better than specified** (i.e. "superior") flatness.

Step 11: Record the FL-Number measured on the slab (the F-Meter <ALL RUNS> result) under "MEAS FL" [Column F].

Step 12: Divide the slab's measured FL-Number (the value just recorded in Column F) by the floor's specified overall FL-Number (the value recorded in Block B) and record the result (rounded to 3 decimal places) under "FL RATIO F / B ".

Step 13: Enter Table 1 (the *green* pages in this manual) with the FL Ratio just calculated, and record the corresponding conversion factor under "TABLE 1 VALUE" [Column G].

NOTE: Make sure that the conversion factor recorded in Column G is given its correct sign !

Step 14: Multiply the total placement area (the value recorded in Column C) by the Table 1 conversion factor (the value just recorded in Column E) and record the result under " = FL AREA C x G ".

NOTE: Again, careful attention must be given to the sign of the Table 1 conversion factor when calculating the unequal FL area !

If the conversion factor recorded in Column G is **negative**, then the resulting unequal FL area must be recorded as a **negative** value, thereby indicating **less than specified** (i.e. "inferior") levelness.

Conversely, if the conversion factor recorded in Column G is **positive**, then the resulting unequal FL area must be recorded as a **positive** value, thereby indicating **better than specified** (i.e. "superior") levelness.

Step 15: Repeat Steps 4 through 14 above for each successive floor placement installed and measured. Add each new set of results to the next available line on Form 394a. In this manner, each new Daily Placement Report will present a complete running history of the daily F-Numbers achieved throughout the course of the project.

The following example shows a Daily Placement Report taken from a 100,000 sqft OAFF-35/OAFL-25 warehouse project after the fifth day of slab work. This example illustrates all of the various inputs, calculations, and Table 1 look-ups required to complete Form 394a:

Instructions for Completing *Blue* Form 394b "In-Place Area Report"

Like the Daily Placement Report, an In-Place Area Report (*blue* Form 394b) should be issued every day that floor slabs are installed. The In-Place Area Report uses cumulative area data from the Daily Placement Report to compute the composite FF and FL numbers for all of the floor slabs installed to date. The In-Place Area Report thus tells the contractor exactly where he stands at any instant relative to the overall F-Numbers that must ultimately be produced. After the entire floor has been installed and measured, the FF and FL numbers calculated on this *blue* form constitute the final overall values for the finished floor.

The In-Place Area Report is executed as follows:

Step 1: Record the project name in the title block space provided.

Step 2: Record the floor's Specified Overall FF-Number in Block A .

Step 3: Record the floor's Specified Overall FL-Number in Block B .

Step 4: Record today's date under "REPORT DATE".

Step 5: Sum all of the placement areas recorded to date under "SLAB AREA" [Column C] on the Daily Placement Report and record this total under "TOTAL AREA IN-PLACE" [Column C] on the In-Place Area Report.

Step 6: Sum all of the unequal FF areas recorded to date under " = FF AREA C x E " on the Daily Placement Report and record this total under "TOTAL = FF AREA" [Column D] on the In-Place Area Report.

NOTE: When summing all of the unequal FF areas recorded on the Daily Placement Report, be sure to pay careful attention to sign ! Positive values add to the total; negative values subtract from the total. If the composite FF-number to date is less than the value recorded in Block A , then the cumulative unequal FF area obtained in Step 6 will be a **negative** number and must be recorded as such.

Step 7: Divide the total unequal FF area (the value just recorded in Column D) by the total area in-place (the value recorded in Column C) and record the result (rounded to 3 decimal places) under " = AREA RATIO D / C " .

NOTE: Again, be sure to give this result the correct sign. If the total unequal FF area is **negative**, then the unequal area ratio computed in this step must be **negative**.

Step 8: Enter either Table 2a or Table 2b (the *blue* pages in this manual) with the unequal area ratio just calculated. If the calculated ratio is **negative**, use Table 2a. If the calculated ratio is **positive**, use Table 2b. Record the corresponding Table 2 conversion factor under "TABLE 2 VALUE" [Column E].

Step 9: Multiply the specified overall FF-number (the value recorded in Block A) by the Table 2 conversion factor (the value just recorded in Column E) and record the result under "OA FF A x E ".

NOTE: This value is the estimated overall FF-number for all of the floor slabs installed to date.

Step 10: Sum all of the unequal FL areas recorded to date under " = FL AREA C x G " on the Daily Placement Report and record this total under "TOTAL = FL AREA" [Column F] on the In-Place Area Report.

NOTE: When summing all of the unequal FL areas recorded on the Daily Placement Report, again be sure to pay careful attention to sign ! Positive values add to the total; negative values subtract from the total. If the composite FL-number to date is less than the value recorded in Block B , then the cumulative unequal FF area obtained in Step 10 will be a **negative** number and must be recorded as such.

Step 11: Divide the total unequal FL area (the value just recorded in Column F) by the total area in-place (the value recorded in Column C) and record the result (rounded to 3 decimal places) under " = AREA RATIO F / C ".

NOTE: Once more, be careful to give this result the correct sign. If the total unequal FL area is **negative**, then the unequal area ratio computed in this step must be **negative**.

Step 12: Enter either Table 2a or Table 2b (the *blue* pages in this manual) with the unequal area ratio just calculated. If the calculated ratio is **negative**, use Table 2a. If the calculated ratio is **positive**, use Table 2b. Record the corresponding Table 2 conversion factor under "TABLE 2 VALUE" [Column G].

Step 13: Multiply the specified overall FL-number (the value recorded in Block B) by the Table 2 conversion factor (the value just recorded in Column G) and record the result under "OA FL A x G ".

NOTE: This value is the estimated overall FL-number for all of the floor slabs installed to date.

Step 14: As each successive Daily Placement Report is issued, repeat Steps 4 through 13 above to generate the associated In-Place Area Report. Add each new set of results to the next available line on Form 394b. In this manner, each successive In-Place Area Report will present a complete running history of the overall F-Numbers produced throughout the course of the project.

The following In-Place Area Report is the companion to the sample Daily Placement Report shown on Page VI-4 . This example illustrates all of the various inputs, calculations, and Table 2a & Table 2b look-ups required to complete Form 394b:

Instructions for Completing *Blue* Form 394c "Remaining Area Report"

The Remaining Area Report (*blue* Form 394c) is the companion to the In-Place Area Report and, likewise, should be issued every day that floor slabs are installed. The Remaining Area Report uses the cumulative area data recorded on the In-Place Area Report to compute the FF and FL numbers that must be achieved on the slabs remaining to be installed in order to make the completed project floor exactly equate to the specified overall FF and FL numbers.

The Remaining Area Report is executed as follows:

Step 1: Record the project name in the title block space provided.

Step 2: Record the total project floor area (in sqft) in Block A .

Step 3: Record the floor's Specified Overall FF-Number in Block B .

Step 4: Record the floor's Specified Overall FL-Number in Block C .

Step 5: Record today's date under "REPORT DATE".

Step 6: Record the last value shown in Column C of the In-Place Area Report under "TOTAL AREA IN-PLACE [Column D] on the Remaining Area Report.

Step 7: Subtract the total project floor area shown in Block A from the total in-place floor area just recorded in Column D and record the result in Column E .

NOTE: This balance of square feet remaining to be installed on the project will always be a **negative (-)** number.

Step 8: Record the last value shown in Column D of the In-Place Area Report under "TOTAL = FF AREA" [Column F] on the Remaining Area Report.

NOTE: Be sure that the value recorded in Column F is given the correct sign.

Step 9: Divide the total unequal FF area (the value just recorded in Column F) by the negative area balance (the value recorded in Column E) and record the result (rounded to 3 decimal places) under " = FF RATIO F / E ".

NOTE: The sign given to this ratio will always be **opposite** to the sign of the total unequal FF area recorded in Column F .

Step 10: Enter either Table 2a or Table 2b (the blue pages in this manual) with the unequal FF area ratio just calculated. If the calculated ratio is **negative**, use Table 2a. If the calculated ratio is **positive**, use Table 2b. Record the corresponding Table 2 conversion factor under "TABLE 2 VALUE" [Column G].

Step 11: Multiply the specified overall FF-number (the value recorded in Block B) by the Table 2 conversion factor (the value just recorded in Column G) and record the result under "REQD FF B x G ".

NOTE: This last calculated value is the FF-number that must be exhibited by the total floor area remaining to be placed in order that the entire project floor - when completed - will exactly equal the specified overall FF-number.

Step 12: Record the last value shown in Column F of the In-Place Area Report under "TOTAL = FL AREA" [Column H] on the Remaining Area Report.

NOTE: Once more, be sure that the value recorded in Column H is given the correct sign.

Step 13: Divide the total unequal FL area (the value just recorded in Column H) by the negative area balance (the value recorded in Column E) and record the result (rounded to 3 decimal places) under "= FL RATIO H / E ".

NOTE: Again, the sign given to this ratio will always be **opposite** to the sign of the total unequal FL area recorded in Column H .

Step 14: Enter either Table 2a or Table 2b (the blue pages in this manual) with the unequal FL area ratio just calculated. If the calculated ratio is **negative**, use Table 2a. If the calculated ratio is **positive**, use Table 2b. Record the corresponding Table 2 conversion factor under "TABLE 2 VALUE" [Column I].

Step 15: Multiply the specified overall FL-number (the value recorded in Block C) by the Table 2 conversion factor (the value just recorded in Column I) and record the result under "REQD FL C x I ".

NOTE: This last calculated value is the FL-number that must be exhibited by the total floor area remaining to be placed in order that the entire project floor - when completed - will exactly equal the specified overall FL-number.

Step 16: As each successive In-Place Area Report is issued, repeat Steps 5 through 15 above to generate the associated Remaining Area Report. Add each new set of results to the next available line on Form 394c. In this manner, each successive Remaining Area Report will present a complete running history of the overall F-Numbers that must be exhibited by the remaining work in order for the completed floor to satisfy the specified flatness and levelness tolerances exactly.

The following Remaining Area Report is the companion to the sample In-Place Area Report shown on Page VI-7. This example illustrates all of the various inputs, calculations, and Table 2a & Table 2b look-ups required to complete Form 394c:

Instructions for Preparing *Yellow* "FF/FL Quality Control Charts"

The *yellow* FF/FL Quality Control Charts present the results from the Daily Placement Report and the In-Place Area Report in easy-to-read graphical form. On most projects, these two process control charts constitute the simplest and most effective means for communicating the flatness and levelness status of the on-going floor installation.

The FF/FL Quality Control Charts are prepared as follows:

- Step 1:** Record the project name in the space provided.
- Step 2:** Record the floor's Specified Overall FF-Number in the block provided.
- Step 3:** On the FF chart, mark and label a bold horizontal line corresponding to OAFF-number just recorded.
- Step 4:** Record the floor's Specified Overall FL-Number in the block provided.
- Step 5:** On the FL chart, mark and label a bold horizontal line corresponding to OAFL-number just recorded.
- Step 6:** Record the total project floor area (in sqft) in the block provided.
- Step 7:** Divide the last value in Column C ("TOTAL AREA IN-PLACE") on the In-Place Area Report by the total project floor area and multiply the result by 100. Fill in the "% COMPLETE" bar chart to indicate the percentage of floor installed to date.
- Step 8:** On the FF chart, label the next available vertical line from the left with the last date shown in the left-most column on the Daily Placement Report.
- Step 9:** Place an open dot on this newly labeled vertical line corresponding to the last value shown in Column D ("MEAS FF") on the Daily Placement Report.
- Step 10:** On this same vertical line, place a solid dot corresponding to the last value shown in the column marked "OA FF A x E" on the In-Place Area Report.
- Step 11:** Connect the open dots on all adjacent vertical lines on the FF chart with dashed lines.
- Step 12:** Connect the solid dots on all adjacent vertical lines on the FF chart with solid lines.
- Step 13:** On the FL chart, label the next available vertical line from the left with the last date shown in the left-most column on the Daily Placement Report.
- Step 14:** Place an open dot on this newly labeled vertical line corresponding to the last value shown in Column D ("MEAS FL") on the Daily Placement Report.
- Step 15:** On this same vertical line, place a solid dot corresponding to the last value shown in the column marked "OA FL B x G" on the In-Place Area Report.
- Step 16:** Connect the open dots on all adjacent vertical lines on the FL chart with dashed lines.
- Step 17:** Connect the solid dots on all adjacent vertical lines on the FL chart with solid lines.

Step 18: As each new Daily Placement Report and In-Place Area Report is issued, revise the previous FF/FL Quality Control Chart by repeating Steps 7 through 17

The sample FF/FL Quality Control Charts shown on the following page were prepared using the information contained on the sample Daily Placement Report shown on Page VI-4 and the sample In-Place Area Report shown on Page VI-7.

Each of the four F-Meter Project Management reports illustrates the enormous power of the F-Number System to steer every floor installation towards a successful conclusion. By F-Metering each new placement as soon as the trowels are taken off the floor, and then immediately executing Forms 394 a, b, and c , along with the FF/FL Quality Control Charts, the project management will always have at hand all of the information necessary to insure that the specified floor flatness and levelness tolerances are completely satisfied.

E. Project Management Utility Programs

The following Microsoft QuickBasic programs may be found in the "ProjMgmt" folder on the CD-ROM supplied with the F-Meter:

"F_REPORT": supports preparation of the Daily Placement, In-Place Area, and Remaining Area Reports by automatically generating all of the tabular values to be entered thereon.

"F_COMBIN": combines the individual F-number results from any number of different runs, slabs, or F-Meter sessions into the composite F-numbers for all the runs/slabs/sessions taken together.

"F_VIDEOS": demonstrates the practical affect of achieving different FF and FL numbers on a floor by showing the motions exhibited by two lift truck axles rolling side-by-side over different FF/FL profiles.

All three of these utility programs are self-explanatory and may be run under Windows simply by double left clicking on their titles from Windows Explorer.

VII. STANDARD FF/FL FLOOR TOLERANCE SPECIFICATION

A. **Designation:** The floor area bounded by column lines (___), (___) , (___) , and (___) is designated the Random Traffic Floor . Any floor slab which comprises a portion of the Random Traffic Floor is designated a Random Traffic Slab.

B. **Local Flatness/Levelness:** Except as set forth in Paragraph D below, the Random Traffic Floor shall conform to the following minimum F-number requirements:

Specified overall values : OAFF- (___) / OAFL- (___)
Minimum local values : MLFF- (___) / MLFL- (___)

C. **General Conformity to Design Grade:** Except as set forth in Paragraph D below, the entire Random Traffic Floor shall fall within $\pm 3/4"$ of its specified elevation.

D. **Exceptions:** Both the overall and minimum local FL levelness tolerances set forth in Paragraph B above shall not apply to any Random Traffic Slab that is to be inclined or cambered. Likewise, no FL levelness tolerances will be applied to any unshored elevated construction. The general conformity to design grade tolerance set forth in Paragraph C above will apply to unshored elevated slab constructions, but in all such cases, the tolerance will be increased to $\pm 1-1/4"$.

E. **Testing:** All floor flatness, levelness, and grade conformity tests shall be made (at the Owner's expense) on each newly installed Random Traffic Slab within 8 hours after completion of the final troweling operation. FF and FL tests shall be made by a factory certified technician in accordance with ASTM E1155 (latest revision) using an "F-Meter" as manufactured by Allen Face & Company of Wilmington, NC. Grade conformity tests shall be made using an optical or laser level. Results of all floor tolerance tests - including a formal notice of acceptance or rejection of the work - shall be provided to the contractor within 12 hours after testing. Failure to adhere to the testing and reporting requirements set forth in this paragraph shall constitute *de facto* acceptance of the work.

NOTE: Weekends and holidays shall be ignored when computing specified testing and reporting deadlines.

F. Remedy for Out-of-Tolerance Work: The entire Random Traffic Floor shall be subdivided into Minimum Local Floor Sections bounded either by the column and half-column lines, or the construction and control joints, whichever subdivision yields the smaller areas.

All Minimum Local Floor Sections measuring at or above both the specified MLFF and MLFL numbers shall be accepted for F-number compliance as constructed. All Minimum Local Floor Sections which fail to meet or exceed both the specified MLFF and the specified MLFL shall be corrected in their entirety. Such corrective work on elevated slabs may take the form of grinding or depression-and-retopping. Such corrective work on slabs-on-grade may take the form of grinding, depression-and-retopping, or removal-and-replacement. In all cases, the particular method of correction to be employed shall be determined solely by the Owner.

If the entire Random Traffic Floor, when completed, fails to meet or exceed both the specified OAFF-number and the specified OAFL-number, then liquidated damages shall be paid by the Contractor to the Owner in an amount equal to:

$$\$(\text{---}) \times \left[\frac{\text{Total balance of ft}^2 \text{ measuring below Specified OAFF}}{\text{Specified OAFF} / \text{Actual OAFF}} \right] \times$$

or

$$\$(\text{---}) \times \left[\frac{\text{Total balance of ft}^2 \text{ measuring below Specified OAFL}}{\text{Specified OAFL} / \text{Actual OAFL}} \right] \times$$

whichever is the greater amount. The defective square footages to be used in the above formulae shall be calculated using the "F-Meter Project Management" procedure published by:

**Allen Face and Company L.L.C.
2725 Old Wrightsboro Road
(Building 12 – Unit 5)
Wilmington, NC 28405
Tel: (910) 763 4501
Fax: (910) 763 4502**

G. Additional Information: A complete description of the F-Number System may be found in either the Apr '87 issue of CSI's Construction Specifier or the Jan '89 issue of ACI's Concrete International.