

## **Pavement Quality Indicator**



## **Operator's Handbook**

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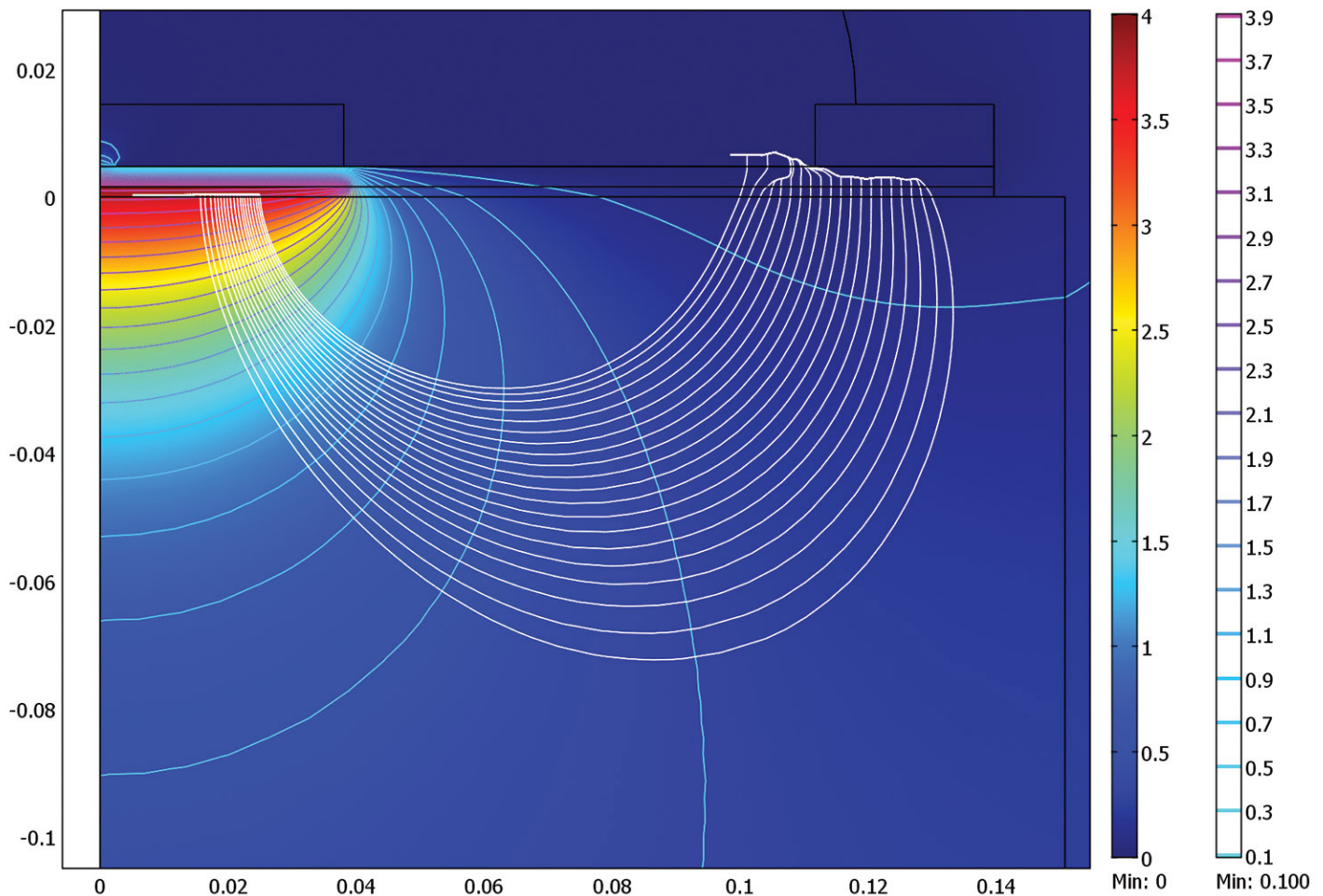
## Introduction

TransTech's Pavement Quality Indicator model PQI 380 utilizes state of the art technology to achieve accurate asphalt pavement density readings. It's primary features are:

- No special license or radioactive materials required
- Lightweight and easy to use
- 12 hours of portable operation
- Measures density in common units (lb/ft<sup>3</sup> or kg/m<sup>3</sup>)
- Relative moisture detection and correction when necessary
- Stores infinite records
- Data download via USB flash drive (semicolon delimited text file format)

## Measurement Technology

The PQI 380 uses impedance spectroscopy to measure the electrical response of asphalt from which the density is calculated. As shown in the Comsol simulation below, the electrical field transmits through the material from the sensor plate of the PQI 380. The impedance is then measured and used in the calculation of the density for that specific aggregate.



## **Application Summary**

The PQI 380 is intended primarily for use on newly-laid asphalt pavements with lift thickness ranging from 0.75 inches to 6 inches. **The calibration of the PQI 380 to a density standard (core) is very important for the reliability and consistency of the density measurements for each material.**

## **Safety**

Every effort has been made to make the PQI 380 convenient to use and inherently safe. The PQI 380 uses non-nuclear, low-voltage direct current to obtain measurements, therefore, there are no badges, licensing, storage or transport concerns. Like any instrument, however, the user should exercise care and common sense in its use to prevent mishaps.

### **Warning**

**Do not use the unit on or near electrical wiring.  
A potential shock hazard exists if contact is made with the exposed wiring.**

### **Warning**

**Use care in handling the unit. Personal injury can occur through improper handling.  
Take proper care to avoid accidentally dropping the unit.**

### **Warning**

**Unauthorized disassembly of the unit will void the warranty.**

### **Warning**

**Shipping the gauge with the batteries inside is not recommended.**

### **Caution**

**Charging the gauge overnight or unattended is not recommended**

### **Caution**

**Turn the unit off when not in use and during transport.**

### **Caution**

**Be sure not to switch standardization plates with other gauges. Check the Serial Numbers located on the gauge and on the plate to be sure they match.**

**Disclaimer:** TransTech reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on TransTech products previously or subsequently sold.

# **Controls & Components - Contents**

The PQI 380 is packaged and shipped with the following components. Contact TransTech Systems customer service if any of the parts are missing.

- PQI 380 unit
- Standardization Plate
- Storage/shipping case
- Operators Quickstart Guide
- CD Manual
- PQI 380 handle
- 120/220V AC to 12V DC battery charger
- 12V DC Car Charger
- Battery Pack



Fold open compartment contents

---

Charger  
AC Cord  
DC Cord  
CD Manual  
Handle

Slot for PQI 380 and Standardization Plate

**Case**



**CD Manual**



**PQI 380**



**Standardization Plate**  
(To remain in case)



**Charger**



**DC Cord**



**AC Cord**

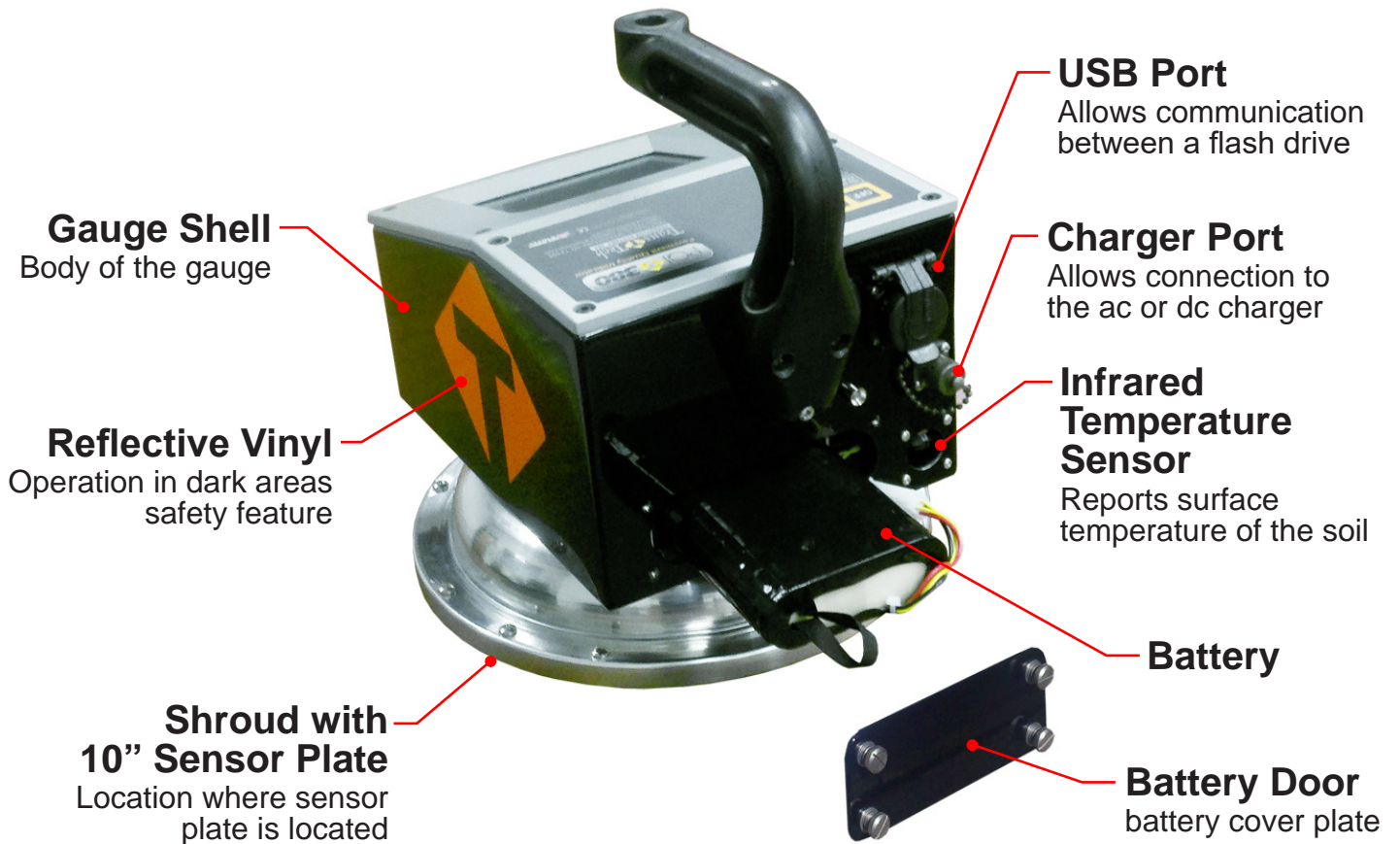
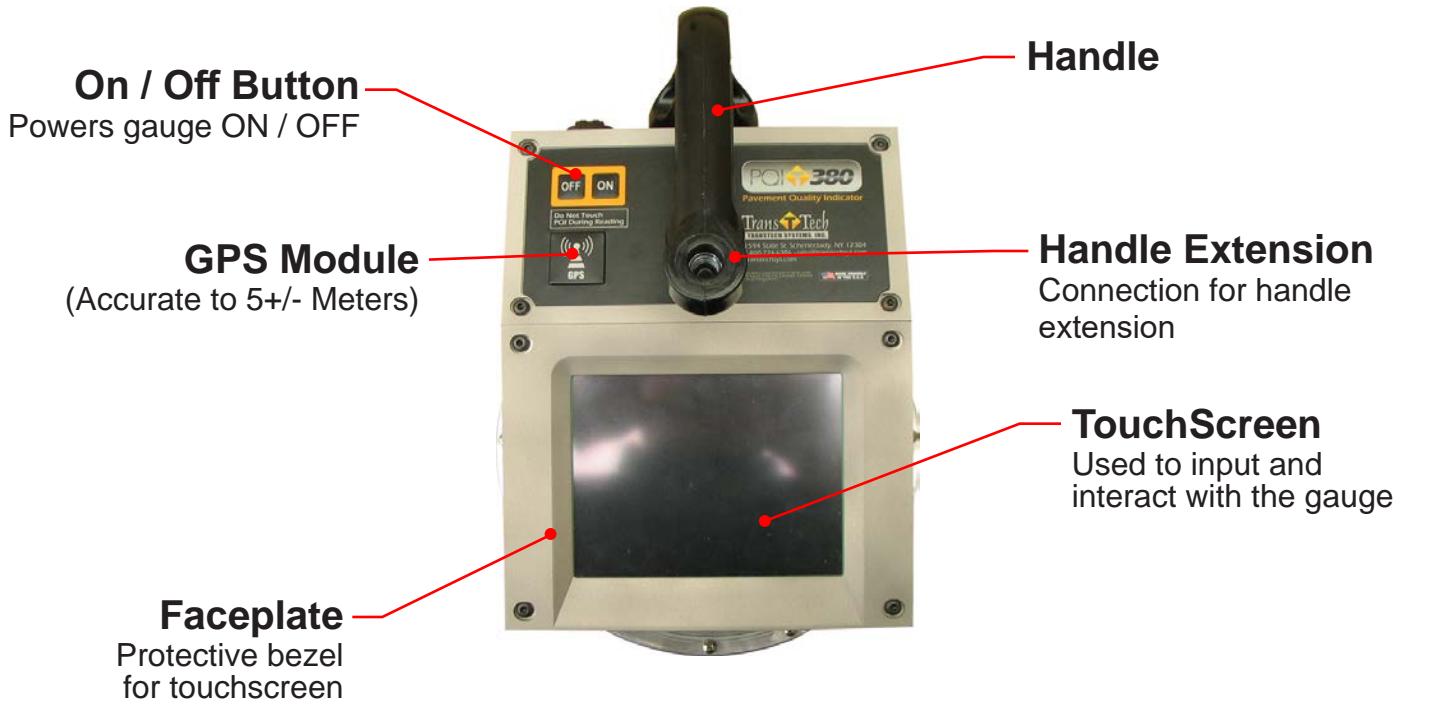


**Handle**



**QuickStart Guide**

## Gauge Features

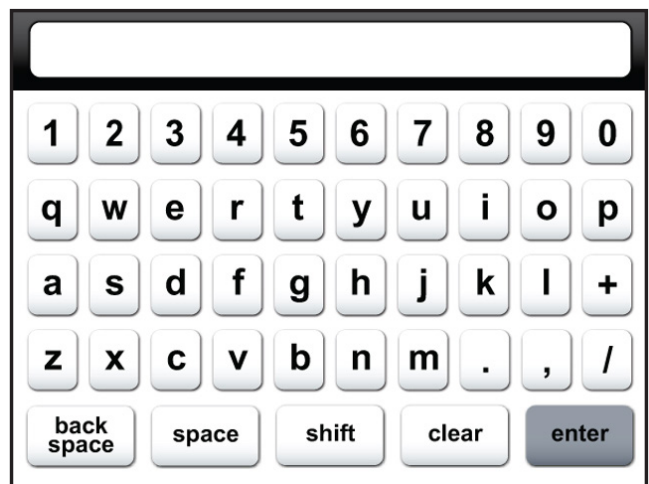
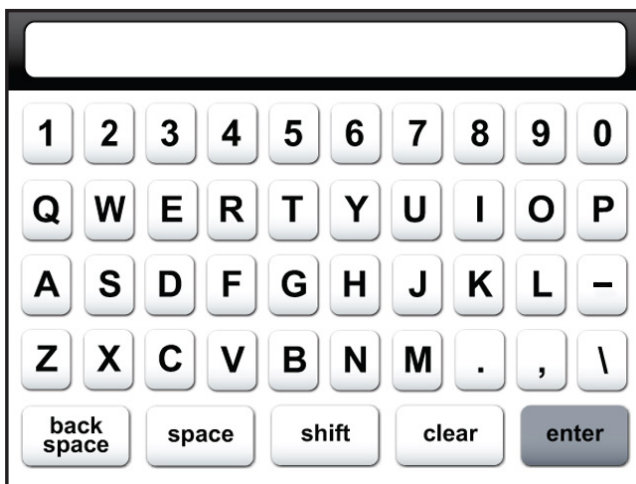




## External / Internal Controls




External controls on the PQI 380 consist of an ON / OFF switch and a 480x640 VGA touch screen display for navigating through the user interface and entering alpha/ numeric data.

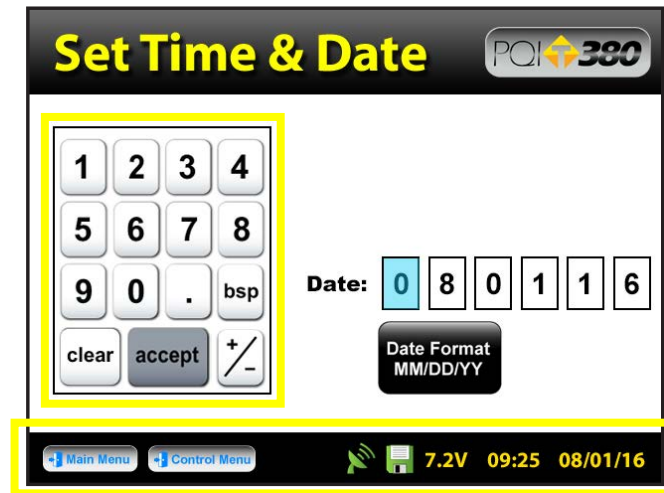
Be sure not to drag your finger from one button to the next. A firm yet light touch is all that is needed to navigate from screen to screen.



Unique yet consistent icons are located on most screens for easy one touch navigation. When data input is required of the operator the screen will display the above keyboard. Toggle from upper to lower case letters using the **Shift** button.  The upper case keyboard provides the option of a minus key while the lower case keyboard provides the plus key. Once editing is completed simply press **Enter**  to save and return to the previous screen.

## External / Internal Controls

The numeric keypad as shown in this example allows for only numbers and a decimal point. Press **Accept**  to save your entry and in most cases return to the previous screen.



The **Status Bar** is located at the bottom of the screen (excluding the keyboard screens) and will continuously update the remaining voltage of the batteries while displaying the date, time and status of the GPS and data logging features.

## Power Save / Auto Shut Down

The PQI 380 has a built in power saving mode. If there are no buttons pressed after approximately 20 minutes the unit will go into a power saving mode. Pressing any key will wake the PQI 380 for continued use. If the PQI 380 is left on for an hour without any buttons being pressed, it will shut itself down, to conserve battery run time

## Setting up the PQI 380

Prior to using the PQI 380 for the first time the gauge will need to be configured to make measurements and record data correctly.

**The following steps must be completed before operating the PQI 380:**

1. Installing and charging the batteries
2. Starting the software
3. Set the local time / set date
4. Set up the GPS
5. Select units of measurement
6. Select data logging
7. Define the asphalt being tested (Mix Details)
8. Define project details (for the data logging feature)
9. Select measurement mode

## Installing Batteries



You will find a plate on the back of the PQI 380 with 4 spring loaded bolts.

1. Turn each bolt approximately 2 full turns until the spring releases
2. Remove the plate from the gauge
3. Next you will find a wire with a connector, disconnect the battery from the gauge
4. Then pull the nylon strap to slide the battery out of the compartment.

**(Do not pull the battery by the connector wire, doing so could damage the battery)**

## Charging Batteries

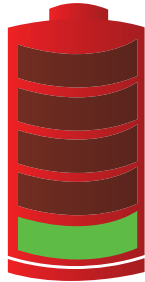
1. Turn the PQI 380 unit OFF
2. Connect the charger to the charger connector located on the back of the PQI 380
3. Plug the charger into a standard AC outlet
4. The red indicator lamp will turn green to indicate that the batteries are charged (approx. 4hrs)
5. Unplug charger from the power source before disconnecting the charger from the PQI 380

## Battery Care Tips

- Whenever uncertain about the battery charge level or condition, recharge it
- The battery will self-discharge and should **NOT** be left uncharged for more than 30 days
- An occasional complete discharge followed by a full recharge is recommended
- **NEVER** drop the battery as this can damage the internals
- **DO NOT** store in freezer or expose to extreme heat
- Battery should be fully charged before use

## Battery Voltage

Battery voltage can be viewed on the status bar located at the bottom of all screens. A fully charged battery will display **over 8 volts**. The battery voltage will decrease as the PQI 380 is used. A low battery voltage icon will be displayed at approximately **6.5 volts**.








Low Battery Indicator



The gauge will continue to operate until the battery can not supply enough voltage to complete a measurement. Once this happens, the gauge will automatically shut down and will not restart until charged. Depending on the condition of the batteries, once the voltage drops below 6 volts, the gauge may be able to take about 12 to 15 additional readings. **It is important to re-charge the battery after each use.**

## Starting the Software OFF ON



Pressing the **ON** button will power on the PQI 380. After a few seconds the TransTech splash screen will appear followed by the Main Menu screen. The Main Menu screen will display five options, **Start PQI380**,  **Calculator**,  **Contact TransTech**,  **GPS Control**  and **Update Software**. 

# Main Menu



Start button opens the Control Menu screen



Contact button displays TransTech and distributor contact information



Calculator button opens the built in calculator





Update Software button opens the software update screen



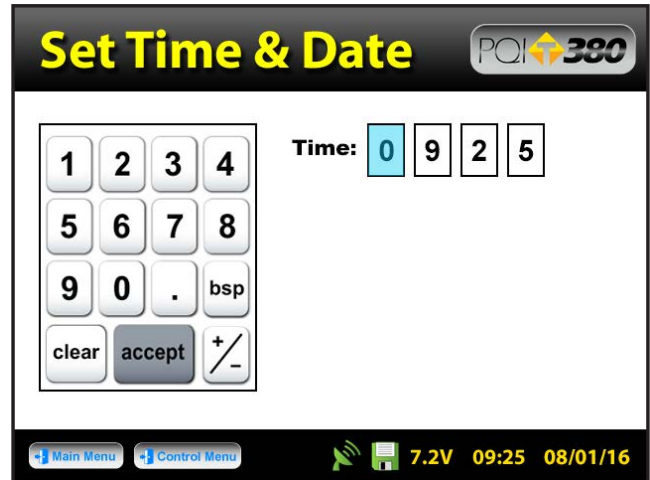
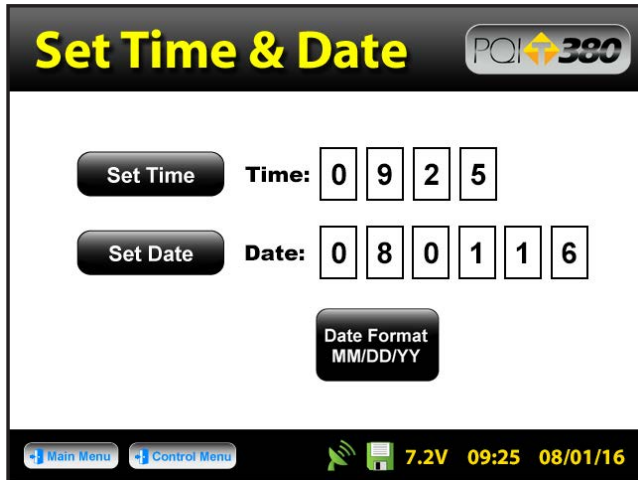
GPS Control button opens the GPS Settings screen

# Local Time and Change Date Format

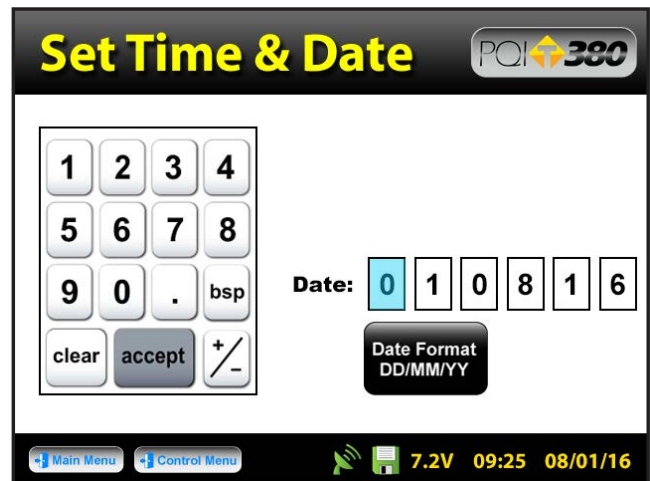
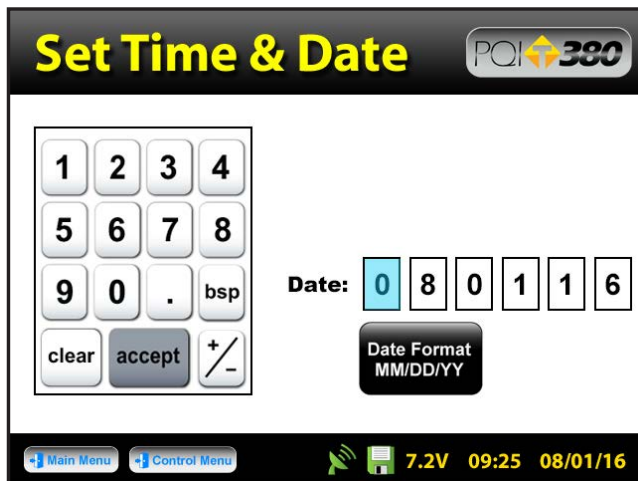


You may set the date and time in two locations. From the Main Menu, press **Set Time & Date** located on the status bar  or from the Control Menu press **Date & Time**. 

# Local Time and Change Date Format




To set the time, press the **Set Time** button. **Set Time** Press the appropriate numbers for the time in 24 hour format. Once you are satisfied with your entry, press **Accept** **accept** to save and return to the previous screen.




To set the date, press the **Set Date** button. **Set Date** The date will display in either the MM/DD/YY or DD/MM/YY format which may be toggled from the button located on both screens. As you did with the time, press the appropriate numbers for the date in the format chosen. Press **Accept** **accept** to save and return to the previous screen. **(Note: Date will be preset by the factory)**

## Setup the GPS

Setting up the GPS is nothing more than turning it on and waiting to connect to satellites. The GPS feature can take up to 15 minutes to connect to satellites depending on your location. From the **Main Menu**, press **GPS Control**.  GPS status can be toggled ON or OFF.




When the GPS is **enabled** the satellite icon on the status bar turns from red to green. 



GPS formatting can also be toggled from the **Universal Transverse Mercator (UTM)** grid to **Latitude/Longitude (LAT-LON)**. Initially the display will read Sats 0 for both formats until connections have been made. The above examples show a connection to five satellites (Sats 5) in both formats. GPS locations will appear on the bottom left corner of all reading mode screens and will store with each reading when data logging is **enabled**.

# Control Menu

From the **Main Menu** press **Start PQI 380**  to enter the **Control Menu**. From this menu, you will find the icons listed below.



Opens the project details screen



Opens the modes screen where you can choose a measurement mode



Starts the standardization process



Opens the units screen, where you can toggle lbs/ft<sup>3</sup> to kg/m<sup>3</sup>, F° to C°, in. to mm. or %compaction to %voids



Opens the mix details screen



Opens the time and date screen



Opens the diagnostics screen



Opens the data management screen, where you can delete, download and print job files

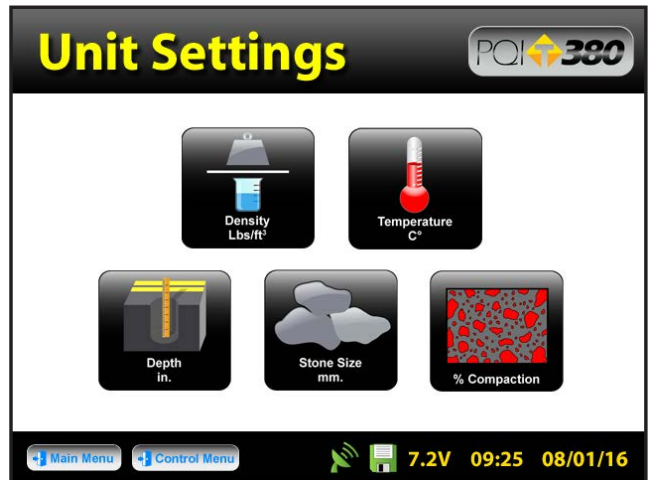


Opens the datalogging screen where you can toggle datalogging on / off



Starts the measurement process

## Select Measurement Units



From the **Control Menu**, press **Units**. Density, Temperature, Depth, Stone Size and % Compaction can be toggled independently between system international (SI “metric”) and U.S. customary units. For example, you can set the density to **lb/ft<sup>3</sup>** while temperature is set to **celsius**, depth is set to **inches** while stone size is set for **millimeters**.

## Data Logging



From the **Control Menu**, press **Data Logging**. If you wish to save your data, you must enable the data logging feature by toggling the button to ON. The floppy disk on the status bar will turn from red to green when data logging is enabled.

**Data will not save for continuous or segregation reading modes.**

Data stored includes all project and mix details, as well as the compaction, density, temperature and the date and time of each reading. If the GPS is on and it is connected to satellites, the location in the format chosen as well as GPS date and GPS time for each reading will also be recorded.

## Mix Details

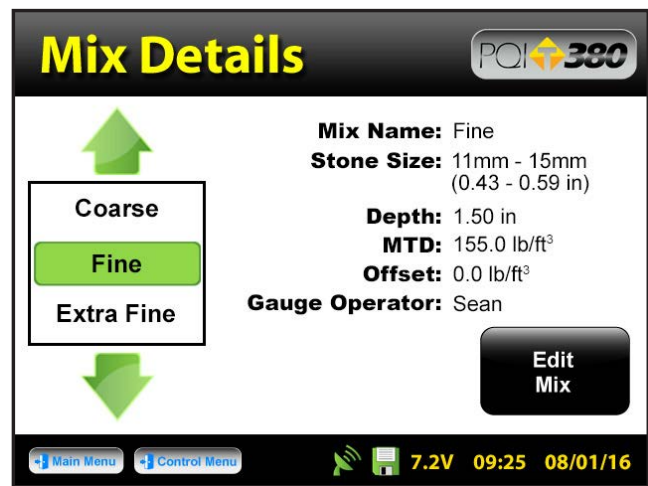
The density determined by the PQI 380 is highly material dependent so it is extremely important that the mix information for each mix design are input accurately into the gauge.



**Note:** Readings taken prior to accurately setting up the mix details section of the gauge will result in incorrect density and compaction results.

The PQI 380 is configured to store 20 unique mixes that are identified by user entered descriptions. If 20 mixes have been defined in the PQI 380 and a 21<sup>st</sup> mix is required, one of the original 20 will need to be modified to reflect the mix details of the new mix design. The details of the new mix will need to be input by editing the details of a previously defined mix. Once the old mix details are overwritten with new information, the old information is gone and the new information is saved in the gauge. Previously stored data files with the old mix information will not be overwritten.

The default mixes stored in a new PQI 380 will have generic mix names (i.e. Mix1, Mix2, etc), the stone sizes will all be set to 9.5mm (0.375in.) at a depth of 5 inches with a Maximum Theoretical Density (MTD) of 125lb/ft<sup>3</sup>. **Readings taken prior to editing the default information on a mix that does not resemble the default information will result in incorrect density and compaction.**

## Editing Mix Details



From the **Control Menu**, press **Mix**  to enter the mix details screen. The mix highlighted in green on the left is displayed in detail on the right. **Fine** To edit the details of this mix, press **Edit Mix**. 

## Editing Mix Details - Mix Name

Edit Mix

**Edit Mix** POI 380

← Exit

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

Fine

1 2 3 4 5 6 7 8 9 0

q w e r t y u i o p

a s d f g h j k l +

z x c v b n m . , /

back space space shift clear enter

There are six black buttons labeled Mix, **Mix:** Stone Size, **Stone Size:** Depth, **Depth:** MTD, **MTD:** Offset **Offset:** and Operator. **Operator:** By pressing one of these labeled buttons, you will enter the keyboard screen which will allow you to edit and save information for that mix value.

For example press **Mix**, **Mix:** the keyboard will open allowing you to change the mix name. Press **clear** **clear** if you would like to start over with a new name. Press **shift** **shift** to toggle from lowercase to uppercase letters. Once editing has been completed, press **Enter**. **enter**

## Editing Mix Details - Stone Size

Edit Mix

**Edit Mix** POI 380

← Exit

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

**Edit Mix** POI 380

Select Stone Size then press **Accept**

32mm - 38mm (1.3 - 1.5 in)

24mm - 31mm (0.94 - 1.2 in)

16mm - 23mm (0.63 - 0.91 in)

**11mm - 15mm (0.43 - 0.59 in)**

3mm - 10mm (0.12 - 0.39 in)

**Accept**

Main Menu Control Menu 7.2V 09:25 08/01/16

Press **Stone Size**. **Stone Size:** There are five options of aggregate sizes listed in millimeters (inches). If, however, you do not see your specific stone size listed choose the closest stone size available. For example, if your mix has an aggregate size of 20mm (0.79in), select **16mm - 23mm (0.63 - 0.91)**. Press **Accept** **Accept** after you made your selection.

## Editing Mix Details - Depth

Edit Mix

**Edit Mix** POI 380

**Exit**

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

**Edit Mix** POI 380

Depth 1.50 in

New Depth

**Reject**

1 2 3 4

5 6 7 8

9 0 . bsp

clear accept

Main Menu Control Menu 7.2V 09:25 08/01/16

Press **Depth**. **Depth:** enter the depth of the asphalt mat on the numeric keypad in the units you previously selected for the depth. Once the correct value has been entered, press **Accept**. **accept**

**An out of range Warning will display for depths entered outside of the following range:**  
0.75in - 6.0in (19.05mm - 152.4mm)

## Editing Mix Details - Maximum Theoretical Density (MTD)

Edit Mix

**Edit Mix** POI 380

**Exit**

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

**MTD Setting** POI 380

Current MTD 155.0 lb/ft<sup>3</sup>

New MTD

**Reject**

1 2 3 4

5 6 7 8

9 0 . bsp

clear accept

Main Menu Control Menu 7.2V 09:25 08/01/16

Press **MTD**. **MTD:** enter the **Maximum Theoretical Density (MTD)** of the mix on the numeric keypad in the units you previously selected. The MTD is provided from the asphalt mix designer and is a key value in determining the percent compaction. Once the correct value has been entered, press **Accept**. **accept**

**An out of range Warning will display for an MTD entered outside of the following range:**  
100lb/ft<sup>3</sup> - 200lb/ft<sup>3</sup> (1601.8kg/m<sup>3</sup> - 3203.7kg/m<sup>3</sup>)

## Editing Mix Details - Offset

Edit Mix

**Edit Mix** PQI 380

**Exit**

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

**Offset** PQI 380

Mix Name: Fine

PQI is reading too HIGH

PQI is reading too LOW

Main Menu Control Menu 7.2V 09:25 08/01/16

The offset for this material can be adjusted at a later time. **Measurements taken prior to adjusting the offset will not include the offset.** You will need to take a measurement to determine the offset. The offset feature will be revisited later in the calibration section of this document.

## Editing Mix Details - Operator

Edit Mix

**Edit Mix** PQI 380

**Exit**

Mix: Fine

Stone Size: 11mm-15mm (0.43 - 0.59 in)

Depth: 1.50 in

MTD: 155.0 lb/ft<sup>3</sup>

Offset: 0.0 lb/ft<sup>3</sup>

Operator: Sean

Main Menu Control Menu 7.2V 09:25 08/01/16

Sean

1 2 3 4 5 6 7 8 9 0

q w e r t y u i o p

a s d f g h j k l +




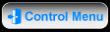
z x c v b n m . , /

back space space shift clear enter

Press **Operator**. **Operator:** Enter your name as the operator of the gauge, press **Enter**. **enter** The gauge will return to the edit mix screen. Verify all mix information on this screen. Once you have verified the results of the mix, press **Exit** **Exit** to save the mix.

## Editing Mix Details






After pressing Exit from the Edit Mix screen the gauge will return to the **Mix Details** screen. Here you may use the green up or down arrows   to select a new mix for editing or change an existing mix. **The green highlighted mix is the CURRENT MIX**  that the gauge will use when taking readings. Prior to exiting this screen, be sure this is the mix you want and the information to the right has been verified. Press **Control Menu**  on the status bar to return to the Control Menu. If the gauge is shutdown, the current mix prior to shutdown will remain the current mix when started back up.

## Project Details



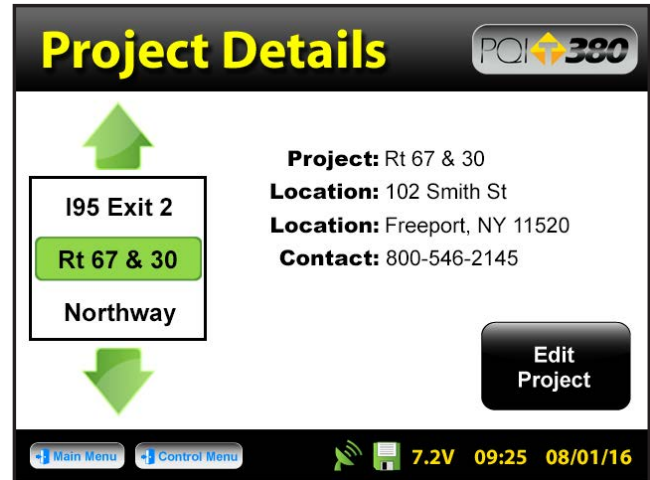
The Pqi 380 is configured to store 10 unique projects that are identified by user entered descriptions. If 10 projects have been defined in the Pqi 380 and an 11<sup>th</sup> project is required, one of the original 10 will need to be modified to reflect the new project. The details of the new project will need to be input by editing the details of a previously stored project. Once the old projects are overwritten with new information, the old information is gone and the new information is saved in the gauge. Previously stored data files with the old mix information will not be overwritten.



You may revisit each project at any given time to continue taking readings. Data from readings taken within each project will store in the order of which they were taken. If mix details change within a project (i.e. offset, stone size, etc) or project details are added, data for readings taken after the changes will continue to store on the same dat file in the order of which they were taken. Only by changing the project name itself will the data be stored on a separate dat file.

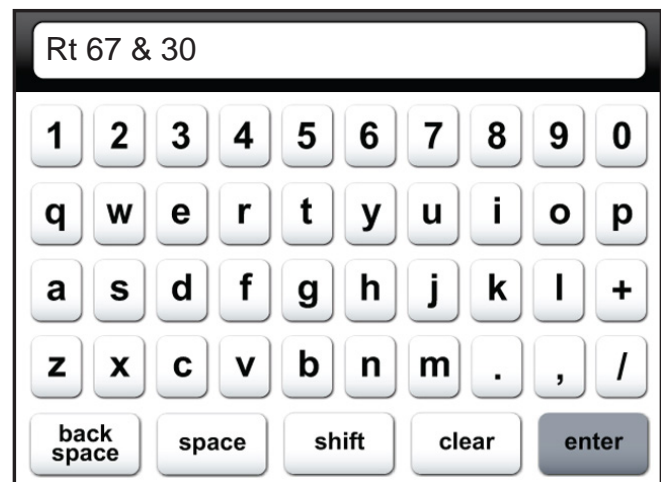
The default projects stored in a new Pqi 380 will have generic project names (i.e. Project1, Project2, etc) along with generic project details (i.e. My Street, My Road, Contact). The Project Details screen will resemble the Mix Details screen such that you are able to select your project using the up and down arrows.   The green highlighted project  is the **CURRENT PROJECT**. Readings taken will store on a dat file using the **CURRENT PROJECT NAME**. If the gauge is shutdown, the current project prior to shutdown will remain the current project when started back up.


## Editing Project Details





Edit Project




From the **Control Menu**, press **Project**  to enter the **Project Details** screen. The project highlighted in green **Rt 67 & 30** is displayed in detail on the right. To edit the details of this project, press **Edit Project**. 



There are four black buttons labeled Project,  Location,  Location,  and Contact.  By pressing one of these labeled buttons, you will enter the keyboard screen which will allow you to edit and save information for that project.

For example, press **Project**,  the keyboard will open allowing you to change the default name. Press **clear**  if you would like to start over with a new name. Press **shift**  to toggle from lowercase to uppercase letters. Once editing has been completed, press **Enter**. 

Press **Exit**  to save the project information and return to the project details screen.

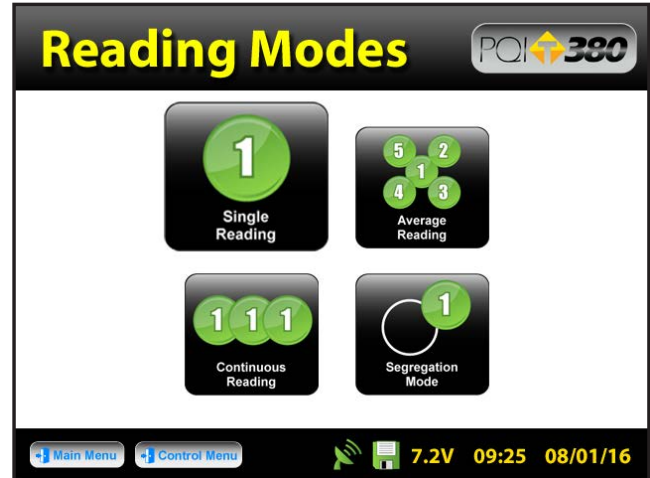
**If you took readings with data logging enabled but did not set up a project, data will store on the default project name (ex. Project1). Always take note of the project and mix names displayed on your reading mode screens.**


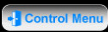
## Reading Modes - Selection and Definition



The PQI 380 has four reading modes - Single, Average, Continuous and Segregation. Continuous and Segregation mode will not save data. Single and Average mode will only save data when data logging is enabled.

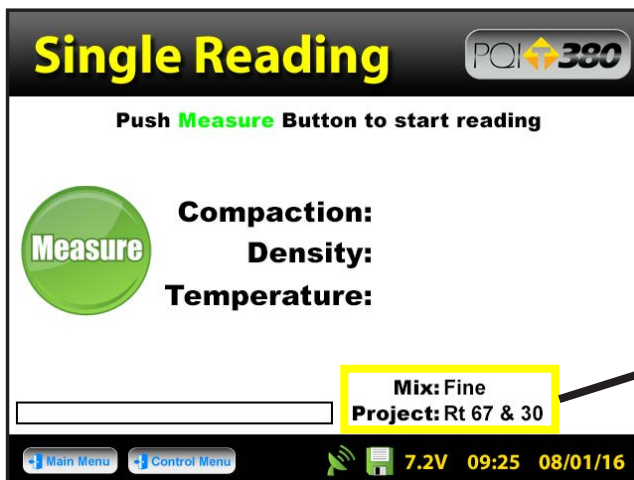
## Reading Mode Selection



To select or change a reading mode from the **Control Menu**, press **Modes**.  Press the button of the mode you would like to use. The active mode button will appear larger than the rest. For example, **single mode** has been selected above. Once your selection has been made, press **Control Menu** on the status bar to return to the Control Menu. 

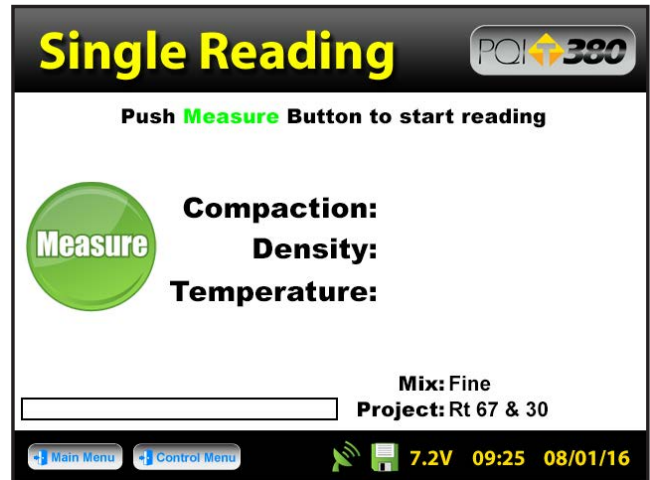
## Reading Mode Definition


**Take note and verify the mix and project names displayed in the bottom right corner of all reading modes. Do not touch or hover over the gauge when it is taking a reading. Place the gauge on a flat and dry surface whenever possible.**



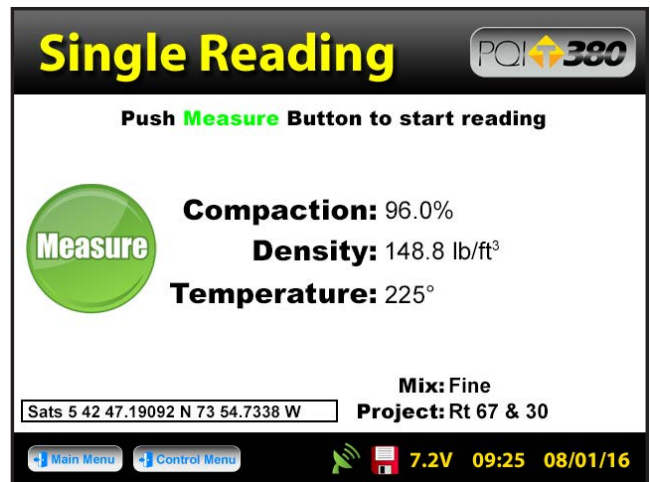
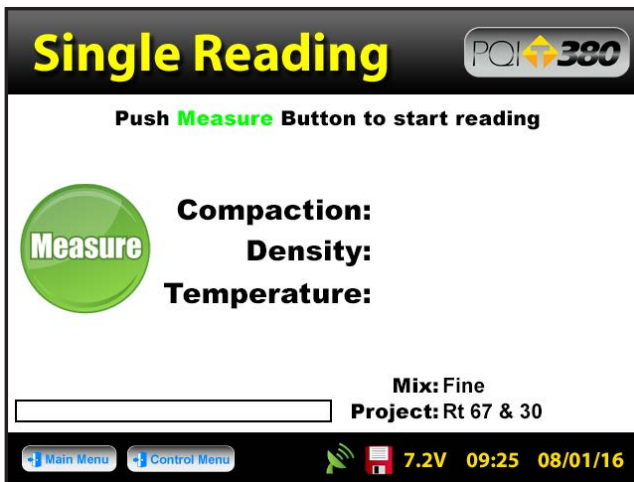
**Mix: Fine  
Project: Rt 67 & 30**



## Reading Mode Definition



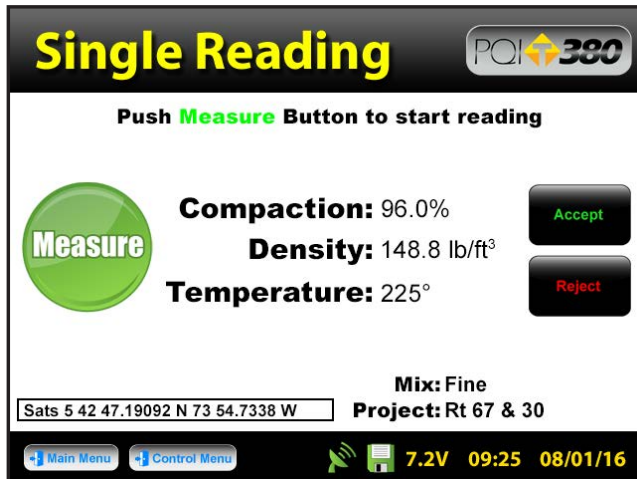
From the **Control Menu**, press **Measure**  to begin taking readings. The heading of the screen will display the active mode (**Single, Average, Continuous, Segregation**).





## Single Reading Mode




To begin taking readings, press **Measure** . If data logging is disabled,  the PQI 380 will display the results of the first reading and await another.

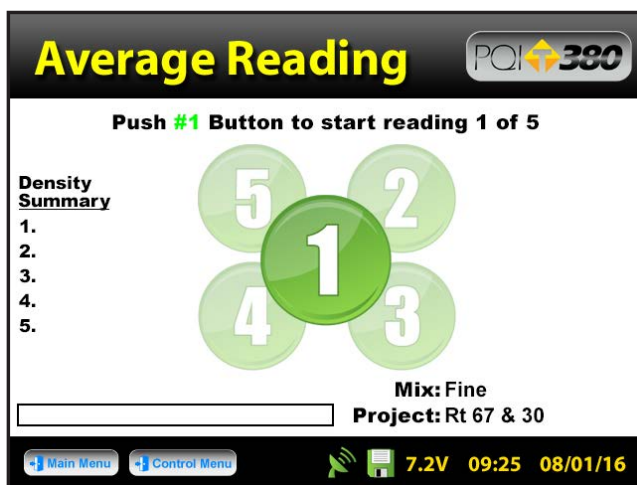
## Single Reading Mode




If data logging is enabled,  the PQI 380 will display **Accept**  and **Reject**  buttons for that reading. Once accepted, the **Enter Location** screen will load which will allow specific information to be stored for that reading. Press **Accept**  to immediately bypass this screen or when you have finished entering information for that reading.

## Average Reading Mode

The cloverleaf measurement pattern is displayed for your convenience with the highlighted position being the current position to measure. 



Position the gauge on the asphalt in position 1 as it appears on the screen. **Do not touch the gauge while it is busy taking a measurement.** When reading 1 is complete, the density summary list will begin to populate and the gauge will prompt you to move to location 2. Move the gauge to position 2 and press 2  to continue. Repeat these steps for the remaining three measurements.

# Average Reading Mode



Data Logging ENABLED

Data Logging DISABLED

**Average Reading** PQI 380

**Density Summary**

- 1. 148.5 lb/ft<sup>3</sup>
- 2. 148.1 lb/ft<sup>3</sup>
- 3. 147.9 lb/ft<sup>3</sup>
- 4. 148.6 lb/ft<sup>3</sup>
- 5. 148.4 lb/ft<sup>3</sup>

**Compaction:** 95.6% **Accept**

**Density:** 148.3 lb/ft<sup>3</sup>

**Temperature:** 225° **Reject**

Mix: Fine  
Project: Rt 67 & 30

Sats 5 42 47.19092 N 73 54.7338 W

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**Average Reading** PQI 380

**Density Summary**

- 1. 148.5 lb/ft<sup>3</sup>
- 2. 148.1 lb/ft<sup>3</sup>
- 3. 147.9 lb/ft<sup>3</sup>
- 4. 148.6 lb/ft<sup>3</sup>
- 5. 148.4 lb/ft<sup>3</sup>

**Compaction:** 95.6%

**Density:** 148.3 lb/ft<sup>3</sup>

**Temperature:** 225°

Mix: Fine  
Project: Rt 67 & 30

Sats 5 42 47.19092 N 73 54.7338 W

Main Menu Control Menu 7.2V 09:25 08/01/16 **Next Reading**

After the fifth reading the PQI 380 will display the five individual readings under density summary along with the average of the compaction, density and temperature. **The gauge does not store individual readings, only the average readings will be stored. If individual readings are needed, this will be the last time the screen will display them.** If data logging is enabled the gauge will prompt you to **Accept** or **Reject** the current average reading. If rejected, the average reading will not store on the dat file and the gauge awaits another set of readings. If data logging is disabled the gauge displays the average and awaits the next reading set.

**Average Reading** PQI 380

**Density Summary**

- 1. 148.5 lb/ft<sup>3</sup>
- 2. 148.1 lb/ft<sup>3</sup>
- 3. 147.9 lb/ft<sup>3</sup>
- 4. 148.6 lb/ft<sup>3</sup>
- 5. 148.4 lb/ft<sup>3</sup>

**Compaction:** 95.6% **Accept**

**Density:** 148.3 lb/ft<sup>3</sup>

**Temperature:** 225° **Reject**

Mix: Fine  
Project: Rt 67 & 30

Sats 5 42 47.19092 N 73 54.7338 W

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**Enter Location** PQI 380

**Exit**

**Accept**

**Station:** Fine Mix

**Description 1:** First Reading

**Description 2:** Rt 67 & 30 Job Site

**Operator:** Sean

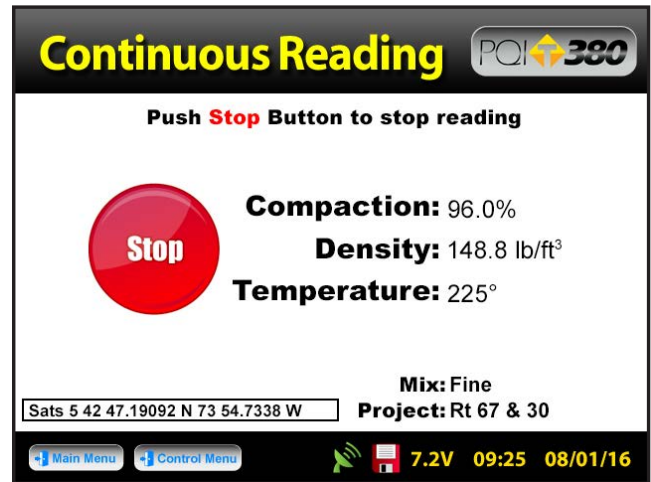
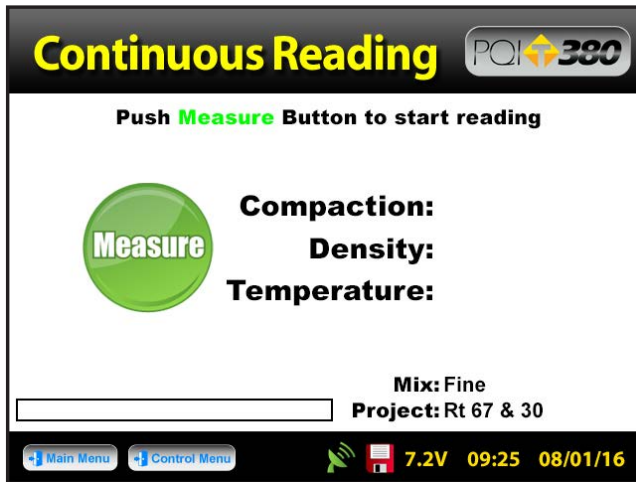
Main Menu Control Menu 7.2V 09:25 08/01/16


If data logging is enabled and you wish to save the displayed average reading, press **Accept**. As with the single mode, the **Enter Location** screen will load which will allow specific information to be stored for that reading. Press **Accept** to immediately bypass this screen or when you have finished entering information for that reading.

## Continuous Reading Mode



Data will NOT store for this mode. To begin taking readings, press **Measure**.

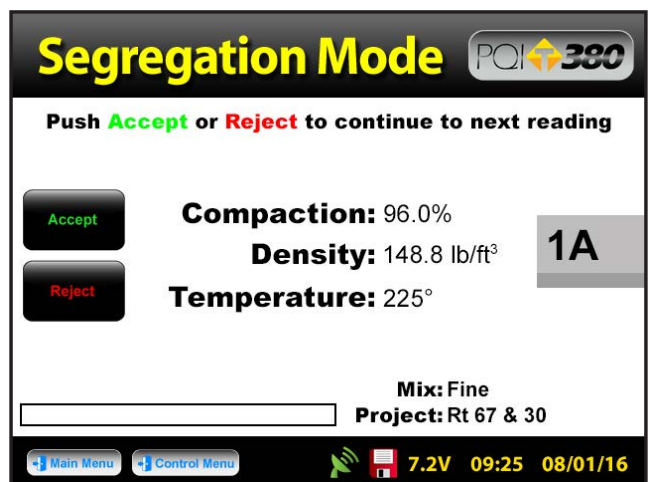
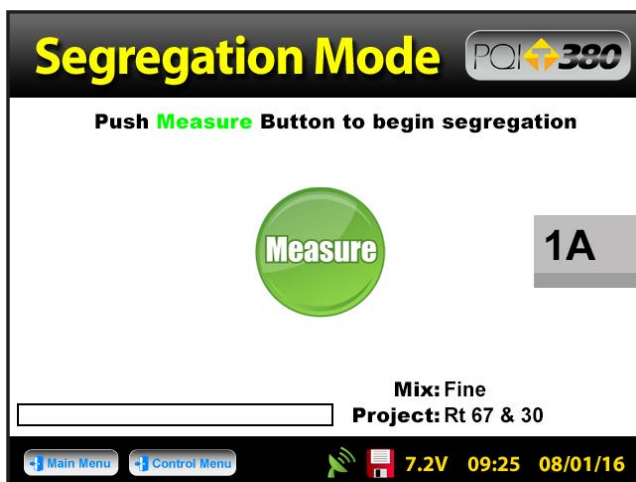


Once the measure button has been pressed, the continuous mode will continuously display and update the compaction, density and temperature until the **STOP** button  is pressed.





## Segregation Reading Mode

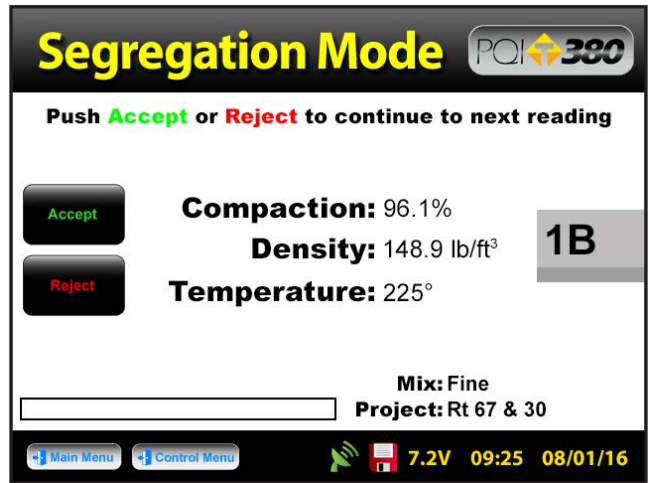
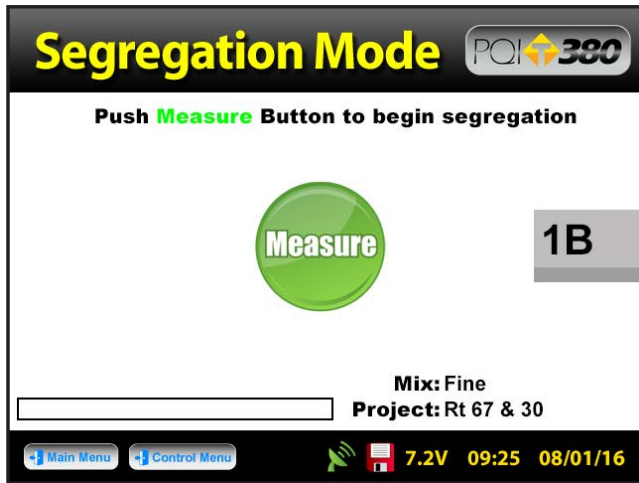





Data will NOT store for this mode. Be sure to write down the individual readings if you must make note of them. This mode mimics the PQI 300 where two readings ('A' and 'B') are taken for each location. **Segregation** is the separation of the coarse and fine aggregate particles in the asphalt mix. A segregated mix will usually result in density fluctuations in the finished mat. The PQI 380's segregation mode can be used to conveniently measure the density variations that result from mix segregation. The operation of segregation mode is patterned after test procedures used by a number of testing organizations. The PQI 380 is used to take a number of readings at pre-determined locations on the mat and the variations in the readings are calculated after all readings have been taken.

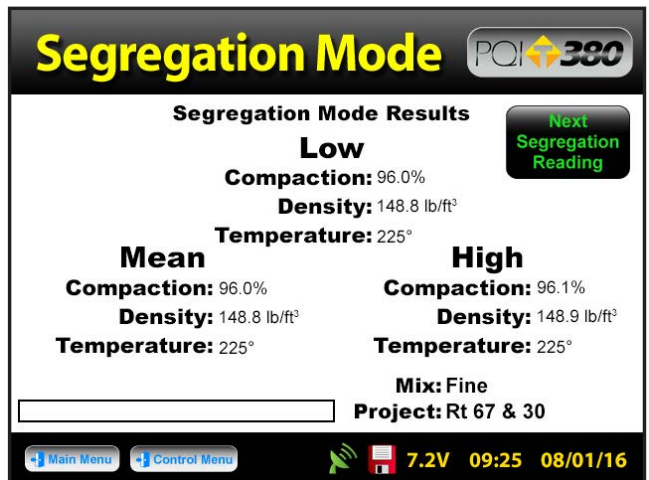
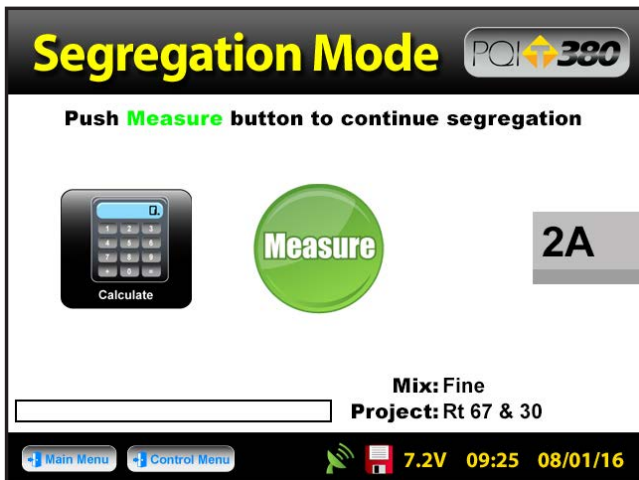




# Segregation Reading Mode

Position the PQI 380 on the first pre-determined location on the mat and press **Measure**  to obtain reading 1A **1A** for location 1. **If needed, write down the results of the reading at this time.** For every reading taken you will be given the option to **Accept**  or **Reject**  the reading. Two readings ('A' and 'B') are taken at each location and the average value is used. Taking the average of two readings is required for nuclear gauges, which exhibit poor repeatability. The PQI 380 has excellent repeatability so two readings should not be required, however two readings are taken for compatibility with existing nuclear test procedures. If satisfied with the first reading, press **Accept**. 



The PQI 380 will then prompt you to take the next reading in the same location, 1B. **1B**. Press **Measure**.  Results of reading 1B for location 1 will display and wait to be accepted  or rejected.  **If needed, write down the results of the reading at this time.**





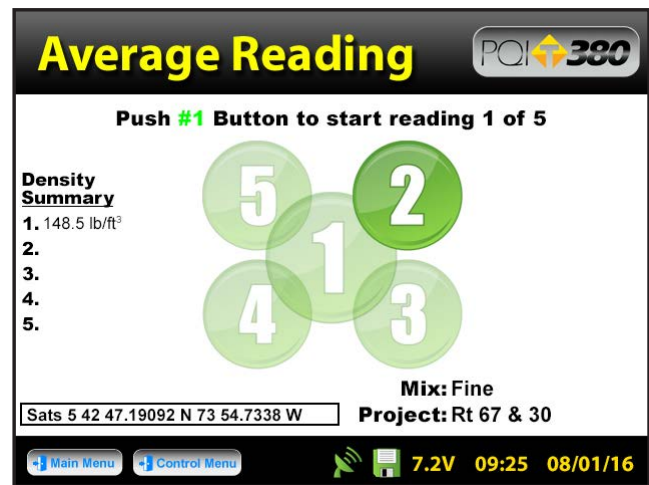
The PQI 380 will then show a **Calculate**  button and prompt for reading 1 at location two (2A). After the last pair of readings has been accepted, press **Calculate**.  The gauge will display compaction, density and temperature for the lowest, highest and mean readings.






## Calibration - Core Calibration Method

The calibration of the PQI 380 to each new mix is necessary for accurate and consistent readings. This is due to the various HMA mixtures being used in the field today. Changes in the aggregate type and size as well as changes in the binders produce a wide variety of electrical properties. Once calibrated to a standard (core) the PQI 380 will maintain optimal precision and accuracy.

For optimal results, the **core calibration method** is the most accurate method when calibrating the PQI 380. The level of quality control from the plant to the mat will determine the number of test locations an operator should identify (one to five). The standard method for establishing a control strip as specified in **AASHTO TP 68-04** would be a total of five core locations. Remember the calibration will only be as good as the cores they are calibrated to. Therefore, the more test locations you have the more accurate the results.

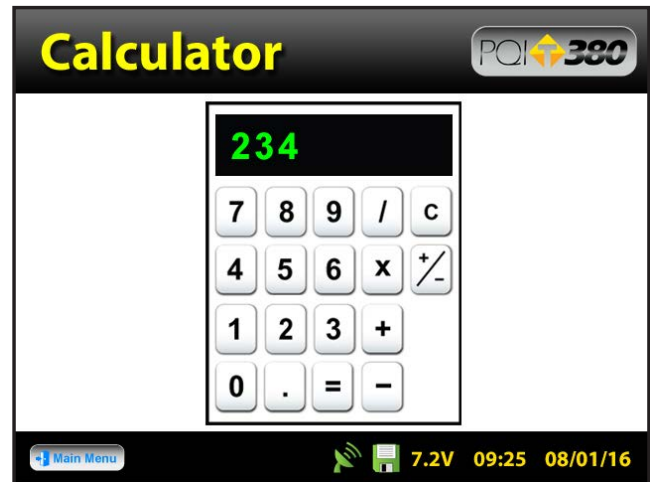
Place the PQI 380 in the first location on the asphalt mat. Using the sensor plate as a guide, draw a circle around the PQI with a crayon marker. Using the **Average Mode** on the PQI, Press 1  for the first reading. **(DO NOT TOUCH OR HOVER OVER THE PQI WHILE IT IS TAKING A READING)** The PQI 380 does **NOT** store individual readings, only the average reading will be stored when data logging is enabled. 



Move the PQI approximately 2 inches up and to the right. The average reading mode screen will also guide you to the proper location and reading number. Press 2  to begin the second reading. Continue through the clover leaf pattern until you have completed five individual readings. After the fifth reading, the PQI 380 will display all five individual readings for verification under the density summary portion of the screen. **If individual readings are needed write them down, this will be the last time the screen will display them.** The average of these five individual readings will display in the center of the display prompting for **Accept**  or **Reject** . Write down the average PQI 380 reading on the **Core Comparison Calibration Work Sheet** located at the back of this manual. Press **Accept**  to store the average reading on the data file. If the option to accept or reject does not display then data logging is disabled  and the average reading will not store.

## Calculating the Offset

Direct percent compaction of the test mat is achieved by pulling physical samples (cores) from the locations previously tested. Once the core density lab reports are received enter the value for each core on the **Core Comparison Work Sheet**. Calculate the difference between the average PQI 380 readings and the core density values. The five calculated differences (Core Density - PQI 380 Average Density) will then be averaged to obtain one difference. This difference will be the **Offset** for that specific mix that will be stored in the gauge for that mix. Therefore, you will be adjusting the value of the PQI 380 readings by that amount in order for the gauge to read the same as the core(s).



If you do not have a calculator handy, from the **Main Menu**, press Calculator. 

Once the numeric difference is calculated, determine whether the PQI 380 is reading **too high** or **too low**. For example, if the PQI reads **155lb/ft<sup>3</sup>**, and you would like it to read **150lb/ft<sup>3</sup>**, the PQI is reading too high and the **adjusted value for the offset is 5**.

## Editing Mix Details - PQI 380 Offset Setup

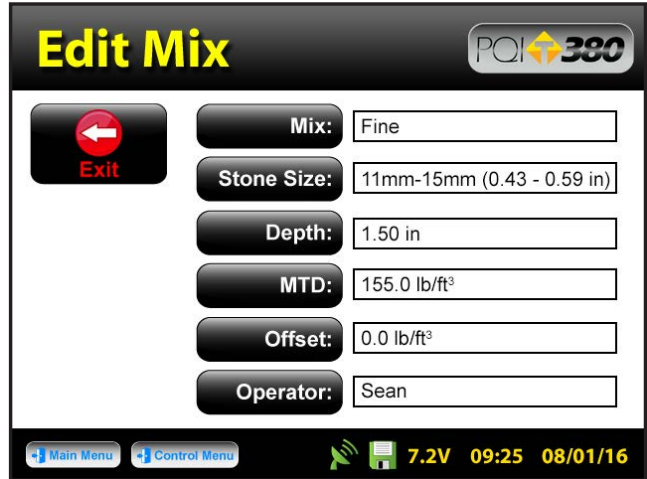
Offset:



From the **Main Menu** press **Start PQI 380**,  then from the **Control Menu** press **Mix**. 

# Editing Mix Details - PQI 380 Offset Setup

Offset:



Be sure that the green highlighted mix is the mix you wish to add the offset to. **Fine** Press **Edit Mix**, **Edit Mix** then press **Offset**. **Offset:** Using the density you previously measured and comparing the value to the density desired, determine whether the PQI 380 reading is **too low** or **too high**. In the previous step we determined that the PQI is reading too high and the **adjusted value for the offset is 5**.



Press **PQI is reading too High** **PQI is reading too HIGH** or **Low** **PQI is reading too LOW** depending on your situation. For our example, we are going to press **PQI is reading too HIGH**. The next screen will contain a numeric keypad as well as the values for the mix name and the current offset for that mix. Type in the adjusted value for the offset which we previously determined would be 5. Press **5**, **5** then press **Enter**. **Enter**

## Editing Mix Details - PQI 380 Offset Setup

Offset:

**Offset** PQI 380

Mix Name: Fine  
Current Offset: 0.0  
Adjust Value:   
New Offset: -5.0

1 2 3 4  
5 6 7 8  
9 0 . bsp  
clear

Accept Reject

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**Edit Mix** PQI 380

Exit

Mix: Fine  
Stone Size: 11mm-15mm (0.43 - 0.59 in)  
Depth: 1.50 in  
MTD: 155.0 lb/ft<sup>3</sup>  
Offset: -5.0 lb/ft<sup>3</sup>  
Operator: Sean

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The adjusted value and new offset will be the same if the current offset was originally zero. If the current offset had been -1 and the adjusted value 5, then the new offset would be -6 for a PQI that was reading too high. Press **Accept**. You will be brought to the **Edit Mix** screen where you can verify the updated offset information for that mix. Once verified, press **Exit** to save your results, then press **Control Menu** on the status bar to return to the Control Menu.

**The offset for each mix can be adjusted at any time. Readings taken prior to a specific adjustment will not reflect that adjustment. Data files will record each offset used to calculate density for each reading.**

## Data Management

From the **Control Menu**, press **Data Management**. This is where project files will be saved, viewed, printed and downloaded.

**Data Management** PQI 380

Data Files

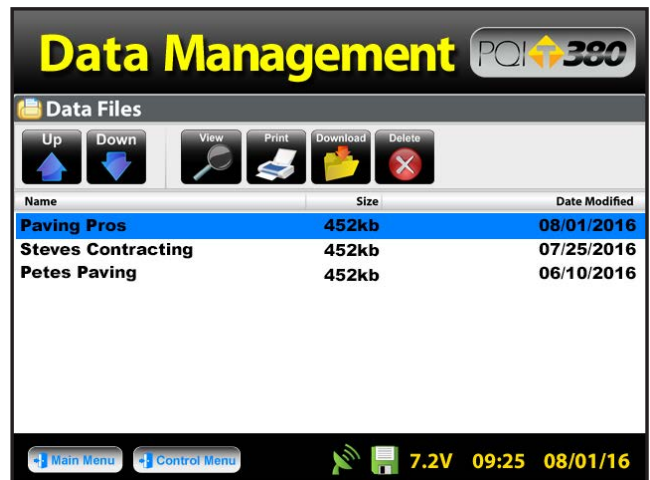
Up Down View Print Download Delete








Name	Size	Date Modified
Paving Pros	452kb	08/01/2016
Steves Contracting	452kb	07/25/2016
Petes Paving	452kb	06/10/2016

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- Scroll Up
- Scroll Down
- View details of the data file
- Print data file
- Download data file
- Delete data file

## Downloading Data



From the **Control Menu**, press **Data Management**.  Scroll down to the project you would like to download using the arrows.   Insert the USB flash drive into the USB port located on the back of the gauge. Press **Download**.  You will be prompted to insert the USB flash drive if you haven't already and then to press **Download**.  The gauge will return to the data management screen which now displays **BUSY**  in the top right hand corner. When downloading is complete the gauge will display **READY**. 

## Downloading Data onto your Computer




Open an Excel spreadsheet and import the data by clicking **Import External Data** from the data menu then click **Import Data**. Change the look in folder to the location you stored your data as well as changing the files of types to **all files**. Highlight and open your data file (ex. **Project1.pqidat**). Check delimited, click **Next**, check **Tab**, check **Semicolon**, click **Finish**. Highlight the beginning cell and click **OK**.

**Column headings and data for each individual reading include the following:**





**Project Details:** Project Name, Location 1, Location 2, Contact;

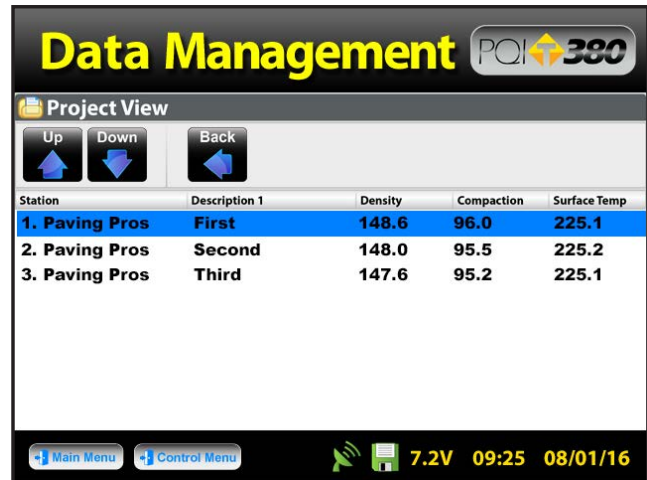
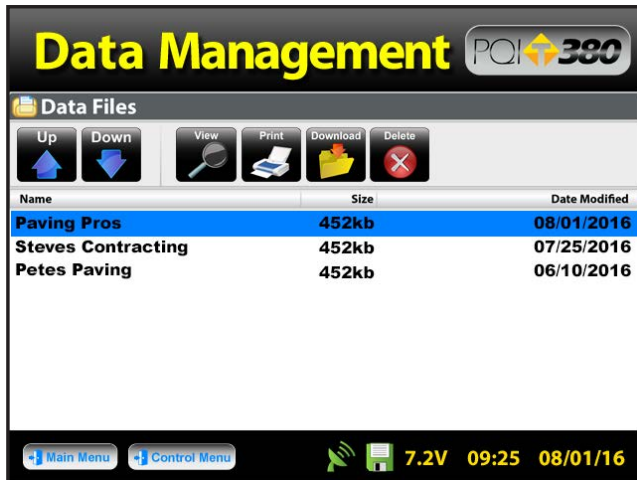
**Mix Details:** Mix Name, Stone Size, Depth, MTD, Offset, Gauge Op; Station Information: Station Name, Station Offset, Description, Operator; Density, Compaction, Surface Temperature, GPS location, GPS time, GPS date, PQI380 Date/Time.

## Printing a Project File


If you have purchased the TransTech portable printer for your PQI 380 you will be able to print test results on-site directly from your gauge. Plug in your printer and from the **Data Management** screen, use the arrows   to scroll to your selected project and select the **Print** button. 

## Viewing a Project File

Once you are in the **Data Management** screen you can view completed tests in your project files. Use the arrows   to scroll and highlight the desired project and select **View**.  All of your tests saved to this project will be listed in the order they were taken. Only the most pertinent information will be shown in this view including: Test Number, Station, Description1, Density, Compaction and Surface Temperature. Press the **Back** button  to exit the **Project View** screen.



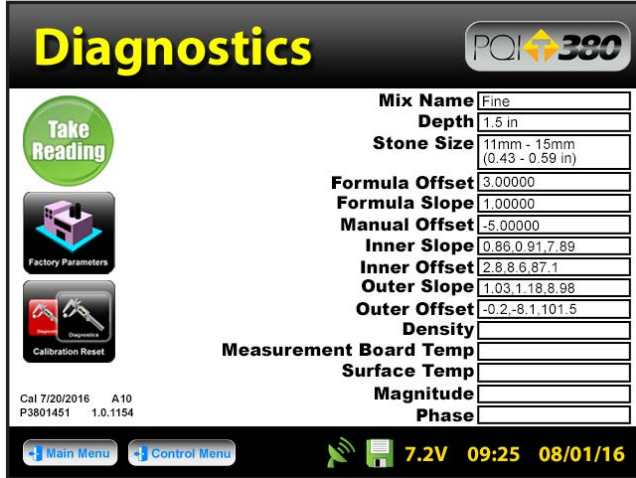
## Deleting a Project File

When you wish to delete a project, select and highlight the correct project using the arrows and press **Delete**.  You will be prompted with a warning asking if you are sure you wish to delete the file. Once confirmed and deleted, you will no longer be able to retrieve the measurement data.





## Maintenance and Troubleshooting

In the event that the PQI 380 were to malfunction an internal diagnostics mode can be activated to provide necessary technical information to the factory. In the event that a repair is required, **we strongly recommended that authorized factory service be obtained.** Unauthorized repair or maintenance by the user during the warranty period will void the unit's warranty.





**Diagnostics** PQI 380

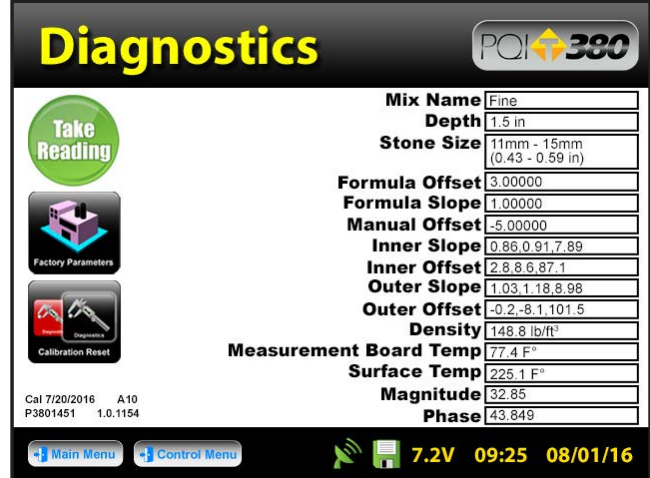
**Take Reading**

 Factory Parameters  
 Calibration Reset

Mix Name	Fine
Depth	1.5 in
Stone Size	11mm - 15mm (0.43 - 0.59 in)
Formula Offset	3.00000
Formula Slope	1.00000
Manual Offset	-5.00000
Inner Slope	0.86, 0.91, 7.89
Inner Offset	2.8, 8.6, 87.1
Outer Slope	1.03, 1.18, 8.98
Outer Offset	-0.2, -8.1, 101.5
Density	
Measurement Board Temp	
Surface Temp	
Magnitude	
Phase	



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P3801451 1.0.1154

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
**Diagnostics** PQI 380



**Take Reading**

 Factory Parameters  
 Calibration Reset

Mix Name	Fine
Depth	1.5 in
Stone Size	11mm - 15mm (0.43 - 0.59 in)
Formula Offset	3.00000
Formula Slope	1.00000
Manual Offset	-5.00000
Inner Slope	0.86, 0.91, 7.89
Inner Offset	2.8, 8.6, 87.1
Outer Slope	1.03, 1.18, 8.98
Outer Offset	-0.2, -8.1, 101.5
Density	148.8 lb/ft <sup>3</sup>
Measurement Board Temp	77.4 F°
Surface Temp	225.1 F°
Magnitude	32.85
Phase	43.849

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From the **Control Menu**, press **Diagnostics**.  Place the gauge on the asphalt mat and press **Take Reading**.  Parameters from this display should be written down and relayed back to TransTech or your distributor as a diagnostics tool.

## Factory Calibration


Yearly recalibration of the gauge is recommended to maintain consistency and accuracy for the electronic components.



**Control Menu** PQI 380

 Project  
 Modes  
 Standardize  
 Units  
 Mix  
 Date & Time  
 Diagnostics  
 Data Management  
 Data Logging  
 Measure

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The diagnostic button  on the **Control Menu** will turn red as a reminder to calibrate the gauge. Only TransTech Systems or authorized distributors are able to perform this type of calibration.

## Calibration Reset



**Diagnosics** POI 380

Take Reading

Factory Parameters

Calibration Reset

Mix Name	Fine
Depth	1.5 in
Stone Size	11mm - 15mm (0.43 - 0.59 in)
Formula Offset	3.00000
Formula Slope	1.00000
Manual Offset	-5.00000
Inner Slope	0.86, 0.91, 7.89
Inner Offset	2.8, 8.6, 87.1
Outer Slope	1.03, 1.18, 8.98
Outer Offset	-0.2, -8.1, 101.5
Density	
Measurement Board Temp	
Surface Temp	
Magnitude	
Phase	

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**Attention!**

The calibration date has been extended 30 days

It is crucial that the gauge be re-calibrated. Contact TransTech at 1-800-724-6306

OK

The **Calibration Reset** button  is located in the diagnostics screen. Pressing the calibration reset button will cancel the calibration warning for 30 days. **It is recommended that the gauge be calibrated when this warning is displayed.**

## Factory Parameters



**Diagnosics** POI 380

Take Reading

Factory Parameters

Calibration Reset


Mix Name	Fine
Depth	1.5 in
Stone Size	11mm - 15mm (0.43 - 0.59 in)
Formula Offset	3.00000
Formula Slope	1.00000
Manual Offset	-5.00000
Inner Slope	0.86, 0.91, 7.89
Inner Offset	2.8, 8.6, 87.1
Outer Slope	1.03, 1.18, 8.98
Outer Offset	-0.2, -8.1, 101.5
Density	
Measurement Board Temp	
Surface Temp	
Magnitude	
Phase	

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Password \_

1	2	3	4	5	6	7	8	9	0
q	w	e	r	t	y	u	i	o	p
a	s	d	f	g	h	j	k	l	+
z	x	c	v	b	n	m	.	,	/
back space	space	shift	clear	enter					

The **Factory Parameters** button  is located in the diagnostics screen. This feature is used for TransTech inhouse diagnostics. If this button is pressed the keyboard will load and you will be prompted for a password. In certain circumstances TransTech may provide you with the password to aid them in diagnosing your gauge.

## **Maintenance**

The PQI 380 has been designed to require a minimum of maintenance or service. Normal care in use should insure long and trouble free operation.

### **Keep the PQI 380 bottom surface clean and dry:**

For accurate readings, the PQI 380 should have a clean, dry, smooth interface with the mat. Therefore, you should wipe the PQI 380 sensor plate surface dry and clean after each reading. Also, before placing the PQI 380 on the mat, you should check the surface of the mat to make sure there is no loose material on the surface, which would prevent the PQI 380 from seating properly. If a buildup of asphalt begins to form on the sensor plate surface, clean the surface with WD-40 or a citrus cleaner.

### **Touchscreen:**

Do not clean the touchscreen with abrasive products. Apply window cleaner to a soft rag and wipe the surface clean.

### **Factory Calibration:**


Yearly recalibration of the gauge is recommended to maintain consistency and accuracy for the electronic components.

### **Battery Care Tips:**

- Whenever uncertain about the battery charge level or condition, recharge it.
- The battery will self-discharge and therefore should NOT be left uncharged for more than 30 days.
- An occasional complete discharge followed by a full recharge is recommended .
- NEVER drop the battery as this can damage the internals.
- DO NOT store in freezer or expose to extreme heat
- Battery should be fully charged before use

## Troubleshooting


The chart below provides guidance to a few suspect conditions.

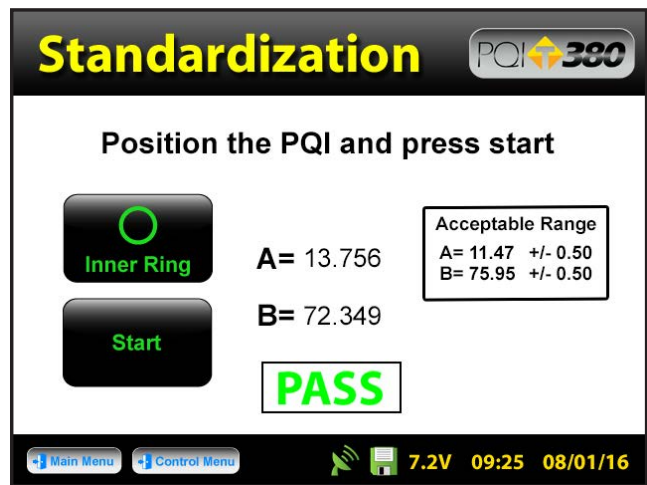
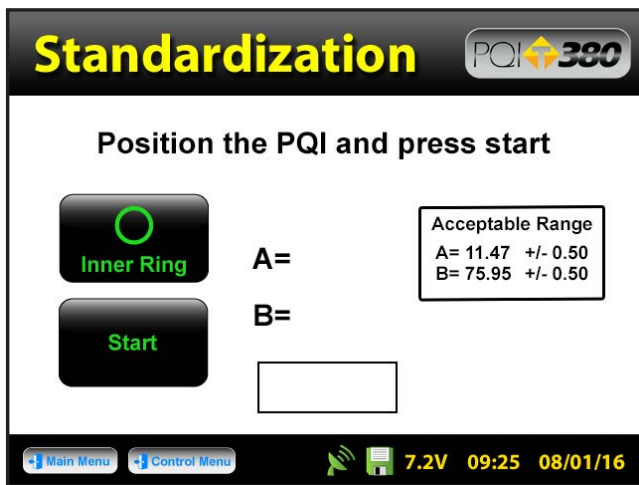
Problem	Remedy
Buttons Sticking / Frozen Software	Repress the frozen button firmly for three seconds. Be sure not to drag your finger from one button to the next. If this does not work, reset the gauge by turning it off and then back on.
Incorrect Density Reading	<p><b>Clean off sensor plate</b></p> <p><b>Check Current Mix Details-</b> be sure you have selected the proper aggregate size and entered all details correctly</p> <p><b>Check Calibration-</b> check your calculations for the adjusted value of the offset and that it was entered correctly</p> <p><b>Call Factory</b></p>
Battery Problems / Gauge Keeps Shutting Down / Gauge Will Not Come On	<p><b>Ensure battery pack is plugged in</b></p> <p><b>Check battery voltage-</b> plug gauge into charger and wait for the green LED to illuminate to indicate a full charge</p> <p><b>Call Factory</b></p>
Data is not recording	<p><b>Check Data Logging-</b> the floppy disk icon on the status bar should be green, data logging should be enabled.</p> <p><b>Check Current Project Name-</b> data readings will store on the Current Project only, be sure you have the correct Project name set on the gauge (Verify the name of the Project and Mix on each reading screen)</p>
GPS Communication Errors	<b>Call Factory</b>
Touch screen is frozen	<p>A piece of sand or grit may be caught under the edge of the bezel creating a false touch. Using a business card or other flexible card, slide the card under the edge of the metal bezel to dislodge anything that may be caught.</p> 



# Standardization

To assure that the PQI 380's ability to make consistent measurements has not been compromised, a daily measurement should be taken on a reference material and tracked day to day for any unacceptable variations. A metallic plate has been installed in the bottom of the PQI 380 carrying case that is suitable for this purpose.



Although this verification is referred to as a standardization of the gauge, the results of the standardization in no way influence the measurement of the gauge, they only serve to alert the user to a change in the way that the gauge is operating. Unexpected changes in the standardization values should be noted and discussed with product service at TransTech.

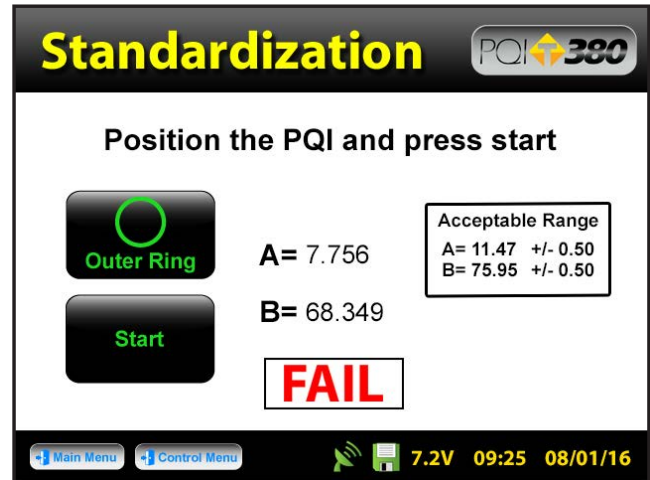
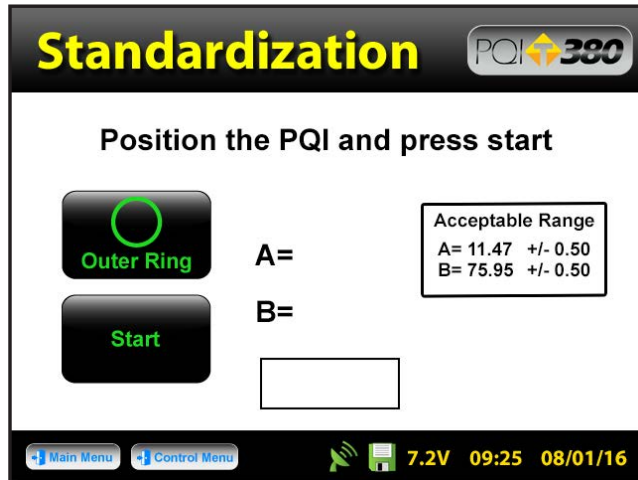
Standardizations are performed **inside the carry case**. Located at the bottom of the case is a steel plate. **Position the gauge on top of the plate inside the case. Be sure the gauge screen is facing you, if it is placed in the case backwards the handle will prevent proper seating you will get a false reading.** The case should not be on top of or around any large metal objects. From the **Control Menu**, press the **Standardize** button.  Press **Start**,  to begin the standardization. **Do not touch the gauge while it is busy.**



The acceptable range for the A and B values are displayed on the screen, however, the PQI 380 will respond with a **PASS**  or **FAIL**  based on these ranges automatically.

## Standardization

The result of the standardization should read PASS. **PASS** Press **Inner Ring**,  the status will change from **Inner Ring** to **Outer Ring**. Press **Start**  to run the standardization on the outer ring setting, the result should read PASS. **PASS** If the result indicates a FAIL **FAIL** for either or both tests, call TransTech or your distributor.



If you receive a FAIL, prior to calling TransTech Systems try the following:

1. Reposition the gauge / case to another location (outside preferably)
2. Be sure that you are testing the gauge inside the carry case that was provided with the PQI. The gauge and case are paired during production to determine the standardization.
3. Do not place the case on the back or near an automobile as well as any other large metal objects and / or wires
4. Be sure that no foreign objects have adhered to the bottom of the gauge or on the steel plate
5. Shut off all cell phones within 10ft of the gauge

**WARNING:** THE STANDARDIZATION OF THE PQI 380 WILL ONLY WORK WITH THE PLATE IT HAS BEEN ISSUED TO. IF YOU RECEIVE A FAIL RESULT, CHECK TO BE SURE THE SERIAL NUMBERS LOCATED ON THE GAUGE AND THE STANDARDIZATION PLATE ARE THE SAME.

**WARNING:** THE STANDARDIZATION OF THE PQI 380 MAY GIVE A FALSE "FAIL" IF TEST IS TAKEN TOO CLOSE TO METAL OBJECTS, POWER LINES OR OTHER ELECTRICAL DEVICES THAT MAY BE TOO CLOSE TO THE GAUGE. TURN THE GAUGE OFF AND MOVE THE GAUGE AT LEAST 10 FEET FROM THESE OBJECTS. IF AFTER THESE PRECAUTIONS ARE TAKEN THE GAUGE STILL DISPLAYS A "FAIL" CONTACT YOUR DISTRIBUTOR.

## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

## Core Comparison Calibration Work Sheet

1. Enter the core density readings and the average PQI 380 readings for each location.
2. Subtract the PQI readings from the core density for each location.
3. Add the differences for each location = total difference.
4. Calculate the average difference (total difference  $\div$  5). This is the adjusted value for the offset.

Location	1	2	3	4	5
Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

---

## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

## Core Comparison Calibration Work Sheet

1. Enter the core density readings and the average PQI 380 readings for each location.
2. Subtract the PQI readings from the core density for each location.
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Location	1	2	3	4	5
Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

## Core Comparison Calibration Work Sheet

1. Enter the core density readings and the average PQI 380 readings for each location.
2. Subtract the PQI readings from the core density for each location.
3. Add the differences for each location = total difference.
4. Calculate the average difference (total difference ÷ 5). This is the adjusted value for the offset.

Location	1	2	3	4	5
Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

---

## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

## Core Comparison Calibration Work Sheet

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Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

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Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

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## Measurement Table

Company Name \_\_\_\_\_ Date \_\_\_\_\_

Job Site \_\_\_\_\_

Asphalt Mix \_\_\_\_\_ MTD \_\_\_\_\_

## Core Comparison Calibration Work Sheet

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2. Subtract the PQI readings from the core density for each location.
3. Add the differences for each location = total difference.
4. Calculate the average difference (total difference  $\div$  5). This is the adjusted value for the offset.

Location	1	2	3	4	5
Core Density					
PQI Readings					
Difference					

Total Difference	
Average Difference (Adjusted Value Offset)	

### **TransTech Systems Product Warranty**

The Company warrants to the Purchaser that the product delivered hereunder will be free from defects in material or workmanship and be the kind and quality designated or specified in the contract or purchase order. This warranty shall apply only to defects appearing within one (1) year from the date of shipment by the Company.

If the product delivered hereunder does not meet the above warranty and if the Purchaser promptly notifies the Company, the Company shall thereupon correct any defect, including nonconformance with the specifications, either (at the Company's option) by repairing any defective or damaged parts of the product, replacing the product, or by making available the necessary repaired or replacement parts.

The liability of the Company under this warranty, for any loss, whether the claim is based on contract or negligence, shall not in any case exceed the cost of correcting defects in the product as herein provided, and upon the expiration of the warranty period, all such liability shall terminate. The foregoing shall constitute the exclusive remedy of the Purchaser and the exclusive liability of the Company. The foregoing warranty is exclusive and in lieu of all other warranties, whether written, oral, implied or statutory.

No warranty of merchantability or of fitness for purpose shall apply. Unauthorized service shall void this warranty.

### **TransTech Systems Product Non-Warranty Return Policy**

Non-warranty returns for TransTech Systems Inc. products must be made within twenty (20) days from the original date of shipment, unless otherwise indicated. Returned products must be in the original packaging, unused and in undamaged condition. Proof of purchase is required. Upon receipt of the product TransTech will inspect the product to the above mentioned criteria.

Unused products will be issued a credit to the Purchaser's account that was used to purchase the product. TransTech will not credit prepaid shipping cost. The original packing slip or invoice is required to be sent back with the product to be returned.

The Purchaser is responsible for shipping the product back to TransTech, carefully package the item(s) and include the packing slip and return manufacturing authorization number on the package. Prepay shipping is required – TransTech will not accept C.O.D.s.

Returns will be credited within 10 working days.

### **Proper Process of Warranty or Non-Warranty Shipments to TransTech Systems**

For product returns (warranty or non-warranty), please follow the instructions below to assure prompt handling:

Call us for authorization (518-370-5558 or 800-724-6306), obtain a return manufacturing authorization number (RMA), and the return shipping address.

Indicate to our representative the reason for returning the product.

For Warranty Returns, Purchaser is responsible for shipping to TransTech's office. TransTech will pay ground shipping return to the Purchaser.






1976 – 2026  
Fifty Years of Precision



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