

TransTech Systems' Pavement Quality Indicator™ (PQI) Application Brief

Density of hot mix asphalt is the most important construction variable in the durability of asphalt pavement surfaces. All current methods of measuring asphalt pavement density have major limitations. Destructive core samples and laboratory measurement are time consuming and costly. Useful information does not reach the paving crew in time to make any corrections to the paving process. The alternative, nuclear densitometers, currently the "gold standard" in the industry, are cumbersome to use, require strict licensing and usage procedures, take several minutes to get data, and have limitations in their accuracy. Further, the time required by nuclear devices to obtain useful density data limits their in-process, Quality Control (QC) effectiveness during pavement construction.



TransTech Systems' important innovation is the development of an alternative, electrical-impedance based Pavement Quality Indicator™ (PQI) for use as a QC tool during the paving process. For their efforts, TransTech has recently been issued a second patent on the device. The reason this device is innovative is that, through the use of its constant voltage, low frequency, electrical impedance approach, which is based on a novel toroidal electrical sensing field that is established in the material to be measured via a flat sensing plate, the PQI is able to make instantaneous, in-situ measurements of pavement density. This density, or compaction level, is measured by the response of the PQI's electrical sensing field to changes in electrical impedance of the material matrix, which in turn is a function of the composite dielectric constant of the paving material and the air trapped in the voids of the material. Since the dielectric constant of air is much lower than that of the paving material, as compaction increases, the combined dielectric constant increases because the percentage of air in the mix

decreases. The embedded computer allows the PQI to perform sophisticated calibration and correction functions and enables the device to store a number of readings for later retrieval and analysis. The importance of this innovation is that relative density measurements can now be taken instantly, allowing for necessary changes to the rolling pattern to be made immediately, as well as making it possible to take many more readings per hour on the job site, both of which help ensure the best possible pavement quality. The device is light weight, easy to use and requires no special licensing. Thus, almost any member of the paving crew can operate it successfully. Improvements in the latest PQI Model 301, including its ability to compensate for surface water, together with the recent completion of a highly successful FHWA Five State Pooled Fund Study, which concluded that the use of the PQI for providing QC during paving is a perfectly acceptable method and provides results at least as good as the nuclear devices in widespread use today, have positioned the PQI as the ideal rapid measurement, non-destructive device for determining asphalt pavement density on the market today.

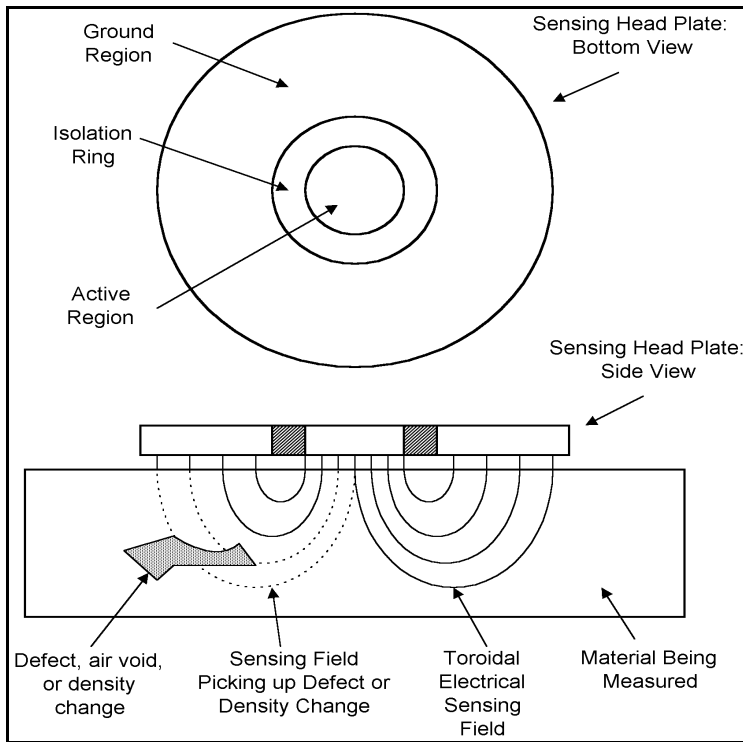
TransTech Systems, Inc. began the initial phase of work on the PQI in 1995 at its original Latham, NY facility, under the New York State Energy Research and Development Authority Agreement 4354-ERTER-TR96. Throughout the five phases of the program, encompassing approximately six years, TransTech achieved outstanding results and has benefited from, in addition to its own internal funding, support from the FHWA and AASHTO, delivered through the NCHRP under the IDEA Program administered by the TRB, under the auspices of the National Academy of Sciences. In addition, the USACE, through WES, was a key supporter and has provided funding as well as critical technical guidance. Substantial technical support has also been provided by Rensselaer Polytechnic Institute faculty in areas including statistics, software development, materials studies and mathematical algorithms.



Currently, the PQI is a commercial product with approximately 400 units sold. It has been accepted internationally as well as domestically, and is now being used in more than 10 countries worldwide. It is fully expected that with its second patent in hand, the improved compensation for surface water, the success of the FHWA



Pooled Fund Study and the anticipated AASHTO provisional spec, due out in 2003, the PQI will steadily increase its market share by allowing paving contractors, state and local DOT/DPWs and the research community to take advantage of its rapid, accurate and repeatable pavement density measurements for QC as well as for vital research on road construction "hot topics" such as segregation, texture, permeability, sensor fusion, characterization of Superpave mats, density profiling, and density-on-the-run.



Pavement Quality Indicator™

Operational Theory Schematic

TransTech Systems' PQI Model 301—lightweight and easy to use! Readings can be taken within seconds of turning on the unit, and a simple compact keypad lets you input instructions quickly. One keystroke switches all data between English and metric units.

PQI 301 SPECIFICATIONS:

Unit Weight (with battery): under 16 lbs.
Unit Dimensions (with handle): 10 3/4" x 10 3/4" x 11"
Shipping Case Dimensions: 13" x 13 3/4" x 16 1/2"
Operating Temperature & Humidity: ambient 20 to 110°F; RH 95%
Storage Temperature & Humidity: 0 to 150°F; RH 95% noncondensing
Maximum Surface Temperature: 350°F
Power Supply: 12 VDC, 4.0 Amp-hr NiMH
Current Drain: 225 ma
Battery Chargers: fast-charge 120 VAC, 12 VDC, 1 Amp
Recharge Time: 4 hours
Linearity: Typical $\pm 2\%$ of full scale or better; $\pm .5\%$ with limited range calibration ($\pm .2\%$ optional)
Display: 4-line alphanumeric, backlit
Scale: English lb/cu-ft or metric kg/cuM
Measuring Depth: 1 to 4 inches (25 to 100 mm)
Continuous Operational Time (fully charged battery): >13 hours
Accessories: Battery Charger, Shipping Case
Data Storage: 99 records by station, location, date and time
Infrared Temperature Sensor Range: 0 to 350°F
Moisture Indicator: Relative H₂O levels and correction
Option: Extended Warranty



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