5 Requirements for Intelligent Compaction

by Chris Mata, Tom King, & Al Hodson

Introduction

Did you know a process called Intelligent Compaction (IC) has been revolutionizing the paving industry? But what is IC, and how can a paving contractor use it to make his businesses more efficient, accurate and profitable?

"Intelligent Compaction" refers to the compaction of road materials using rollers equipped with measurement systems and onboard computer reporting systems using GPS mapping. Nationwide, state highway agencies are starting to require Intelligent Compaction on select jobs. According to the Federal Highway Administration over 37 states are committed to using Intelligent Compaction with Minnesota, California and Texas recognized as national leaders. Federally-funded highway projects now require stringent documentation, Quality Accuracy and Quality Control (QA/QC) data, and warranty provisions. The technology discussed in this white paper is derived from Intelligent Compaction essentials.

In order to achieve Intelligent Compaction and remain competitive in today's paving environment, contractors need five things: Precision Mapping, Pass Count Tracking, Compaction Control, Temperature Mapping, and Documentation of Quality Assurance and Quality Control. Compaction technology enables contractors to build a better surface, reduce material use, and significantly improve productivity. The more you use these tools, the more productive and profitable your paving operations will be.

Precision Mapping

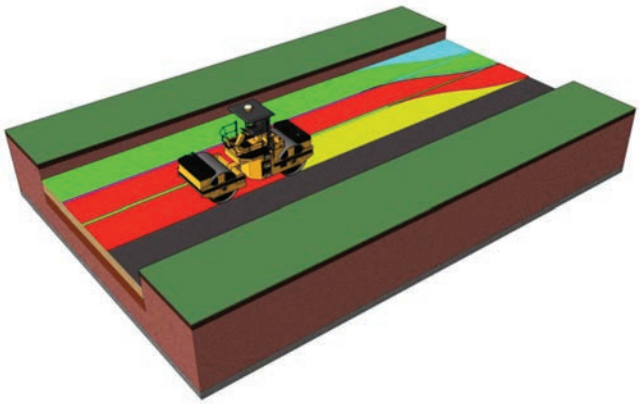
Every job has different needs and Precision Mapping—also referred to as location referencing—takes the guesswork out of asphalt compaction. Accurate mapping leads to more consistent compaction.

Precision Mapping uses satellite date to make rollers more efficient. The position of the roller is established through Global Positioning Satellites (GPS). A GPS antenna is most often mounted on top of the roller's cab. That GPS enables Precision Mapping, which allows operators to raise productivity by utilizing the most efficient rolling pattern. The operator's pattern can be viewed by using either 2D or 3D paving control systems. The control box for these systems offers graphical displays with adjustable light settings for both day or night paving.

Traditional paving methods often result in wasted materials and potential fines. Projects such as airports, large commercial surfaces, and highways require accuracy. Precision paving with less material is achievable with the right equipment. GPS mapping technology eliminates time-consuming and costly human errors. An accurate 3D control increases road smoothness while using less asphalt than traditional paving methods.

Pass Count Tracking

Intelligent Compaction requires Pass Count Mapping and daily inspections. To reach desired compaction, the compactor operator needs to achieve a certain pass target. With some jobs requiring up to eight passes, any operator can easily lose track of exact pass count. When this happens, a contractor cannot monitor compaction performance or verify accurate completion of the compaction job. Pass Count Mapping monitors the number of passes over an area and adjusts the effort to avoid over- or under-compaction. More importantly, contractors are able to guarantee accurate compaction.

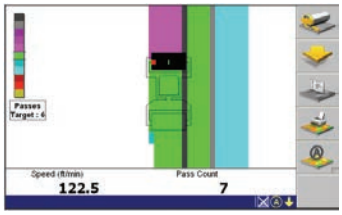


Common issues seen today in the field are:

- The operator loses track of his passes and the job becomes guesswork
- The supervisor cannot monitor pass count performance and cannot verify accurate completion of the compaction job
- Inconsistent density
- Under-compaction or over-compaction
- Penalties, missed bonuses, premature road failure and legal issues

Pass Count Mapping takes the guesswork out of asphalt compaction. It results in more consistent achievement of target pass count and increases productivity by taking the most efficient rolling pattern. Compaction density is tracked and recorded to insure proper compaction, eliminating the risk of penalties.

Pass Count Mapping requires a roof-mounted GPS receiver, a control box, and a Connected Site Link. The system calculates the exact position of the machine and displays a color map and scale indicating the current number of passes and where an operator has overlaps or gaps. Productivity reporting includes system usage, compaction terrain logging, and machine productivity statistics.



For office reporting, data can manually be logged using a modem, or automatically logged on the cloud. The cloud allows project managers to view real-time data using Wireless Data Synchronization via a Wi-Fi or cellular connection.

Compaction Control

The asphalt compactor is the last machine to pass over a paving project, and mistakes during this phase can be very costly to fix. Traditional compaction measurements use a nuclear density gauge to test a sample of a site. Today, Compaction Control systems use an accelerometer to measure Compaction Meter Value (CMV)1, Resonance Meter Value (RMV)2, Frequency3 and Amplitude4. These systems eliminate

1 Measures of soil stiffness affected by machine direction, speed, and weight
2 Measure of decoupling or drum bounce
3 Vibration Frequency (impacts/min)
4 Impact force

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much of the guesswork from asphalt compaction and help contractors achieve more consistent compaction to target design density. Real-time view detects where compaction does not meet design specs and immediately notifies the operator while recording the data to the cloud*. This alleviates the use of traditional methods for validation of problem areas: contractors can significantly reduce the need for re-work by installing a Compaction Control system on their asphalt compactors.

Compaction Control identifies compaction problems early, allowing contractors to fix them in the construction process. It significantly reduces the threat of re-work. Compaction Control eliminates the need for a test roller which reduces transportation costs and leads to less maintenance on machines.

Jobs requiring the use of Intelligent Compaction will ask for an Intelligent Compaction Measurement Value (ICMV). It is essential to have an accelerometer, which should only be placed on the front drum of a machine. An accelerometer-based ICMV is a composite of the current lift and the layers below it.

Intelligent Compaction positions operators to roll a more efficient pattern, increase productivity, and save fuel.

Compaction Control systems are compatible with all asphalt compactors. The wiring harness and brackets are permanently installed for optimal fit and integration with the machine body. These components can be used on a wide range of paving and earthmoving machines to increase utilization and more. Intelligent Compaction positions operators to roll a more efficient pattern, increase productivity, and save fuel.

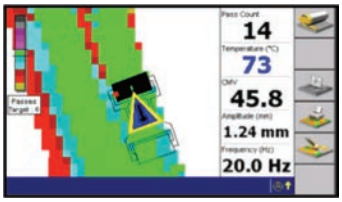
The Compaction Control system displays and records the following:

- Machine Position (GNSS)
- Machine Pass Count/Coverage
- Compaction Width
- Asphalt Temperature
- Compaction Measurements (soils)
- Vibratory Status (on/0ff/rear/both)
- Vibratory Frequency
- Machine Speed
- Direction of travel (forward, reverse)

*For office reporting compaction modules have the ability to automatically log data to the cloud.

Infrared Temperature Mapping

Today, it is an art for the operator to correctly judge the optimal temperature window for compaction. According to the DOT asphalt should be compacted between 175 to 320 degrees Fahrenheit, although this can vary depending on the asphalt mix. In general asphalt becomes too stiff to compact at 175 degrees Fahrenheit.



Traditionally, the operator would have a second person using a heat gun to gauge the asphalt's temperature. With the use of Infrared Temperature Mapping, contractors can save time and money on paving projects. Asphalt contractors need to better understand the temperature of the material they are compacting in order to prevent displacing material that is too hot or damaging an asphalt surface that is too cold to compact.

When rolling on asphalt below 175°, material is too hard to compact and at anything above 320°, the material becomes too soft and can be displaced. The asphalt temperature is critical to the amount of compaction and the time available for compaction. Infrared Temperature Mapping takes away the guesswork by measuring real-time surface temperatures, thus enabling the operator to find the optimal window for compaction. Not all asphalt mixtures are the same, and with temperature mapping users can define custom minimum and maximum values. The defined high and low temperature warnings are displayed over the machine icon in all of the plan view maps, enabling operators to watch the pass count map and still get warnings if the temperature is too high or too low.

Sensors are installed on the front and rear drum to measure surface temperature of the mat in the direction of operation. The system automatically switches between using the front and rear sensors so that the leading sensor is always indicated on the in-cab control box. The operator sees accurate temperature information on the asphalt surface about to be compacted, prior to the temperature drop caused by the wet steel drum passing over the hot mat.

With Infrared Temperature Mapping, an operator is informed and equipped to have a better understanding of material conditions on the job. This improves consistency of density and smoothness. The

temperature data can be accessed and displayed on a color map, and may be recorded for further analysis with the use of office software packages once the job is complete.

Documentation of Quality Assurance and Quality Control

Compaction is one of the most critical processes when paving a highway. Conventional rolling equipment has worked reasonably well over the years; however, there have been several innovations in paving technology that has greatly improved pavement construction. Compaction Reporting is beneficial for site engineers, project managers and contractors.

Documentation of Quality Assurance (QA) and Quality Control (QC) is becoming a standard in Federal project bids. Advanced Compaction Control and documentation provides a real-time summary of compaction data. In-field reporting and an in-cab printer allow on-site supervisors and quality managers to monitor compaction operations and correct possible issues immediately.

Compaction Reporting is beneficial for site engineers, project managers and contractors.

Intelligent Compaction technology greatly reduces the number of manual compaction tests needed, which lowers testing costs and necessitates fewer samples to tag and store. Compaction data logs can be wirelessly transferred from the machine to the office for analysis using web-based fleet, asset, and productivity management solutions. This technology generates electronic data of results, allowing post-process quality control and analysis that can be viewed on any desktop or laptop computer.

Keeping track of historical records of jobsite data is a lot easier with this equipment, and it correlates with long-term results that can be referred to on demand. It is essential to have verification that target criteria have been met on all Intelligent Compaction jobs.

Conclusion

As implementation of Compaction Control technology becomes standard for paving jobsites, the use of these techniques and equipment are becoming more than a smart choice: it's becoming a paving requirement for Federally funded contracts nationwide.

Precision Mapping, Pass Count Tracking, Compaction Control, Infrared Temperature Mapping, and Documentation of Quality Assurance and Quality Control are all necessary to qualify for jobs listing Intelligent Compaction as a bid requirement. The benefits are: faster material inspections, reduction of human errors, improved in-place density, more efficient compaction operations, better pavement performance, longer-life pavements, and clear data for archival and warranty work documentation.

Entry into Intelligent Compaction can be overwhelming. But this technology can be integrated into existing paving fleets. Data management and integration of software packages can be taught by vendors at the point of sale and during implementation of Intelligent Compaction technology. It is always important to learn best practices when using any tool. Partnering with a knowledgeable provider is crucial to learning and implementing Intelligent Compaction technology into your fleet. There are dealers with Intelligent Compaction experts that have answers to your questions. Every business has different needs. A good provider can help configure the proper system for specific projects on top of selling you the equipment. These experts can help train your employees on the latest technologies and understand how to get the most profit utilizing Compaction technology on your jobsite.

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