Intelligent Compaction
Intelligent Compaction (IC) is an equipment-based technology for better quality control that results in longer pavement lives. IC machines are vibratory rollers that include accelerometers, a global positioning system, infra-red temperature sensors, and on-board computers that can display color-coded maps in real-time to track roller passes, asphalt surface temperatures, and stiffness of compacted Asphalt.
Compaction is one of the most important processes in roadway construction.
Cost of Compaction

- Least expensive part of the paving process
- Aggregates and oil are expensive in comparison
- Compaction adds little to the cost of a ton of asphalt
Effects of Compaction

- Compaction is equally important in extending pavement life
- Saves money in maintenance costs
- Understanding compaction is very important

Relative comparison between each component's contribution to extend pavement life:

- High
- Low

Component: Aggregate, Asphalt, Compaction
Asphalt needs high consistent densities to ensure adequate support, stability, and strength.
Why do we need IC?
Why Intelligent Compaction?

Shortcomings in the Compaction Process...

Limited “On The Fly” Feedback

Over or Under-Compaction Can Occur
Conventional spot-testing

non-destructive
spot-testings

Troxler

PQI/PDM

destructive
spot-testings

Drill-core
Sampling Coverage

1 / 1,000

100 % Coverage
Practical example: Counting of passes

Consistency

1-3 passes
Up to 13 passes
Up to 15 passes
1 pass

Passes

1 2 3 4 5 6 7 8 >8
Components: acceleration sensor
HCQ System

Acceleration sensor: measurement principle
HCQ System
Components: display unit
Components: PC Panel
Panel PC – mounting position
New position GPS-antenna
GPS accuracy

24 satellites on 6 orbits
Intervisibility of min. 4, ideal 8 satellites required
Correction calculation of the GPS-signals via geostationary reference stations.

Correction signal is transmitted via communication satellites to D-GPS-receiver (rover).

Accuracy: 2 – 4 in.
RTK – Real Time Kinematik

– Base station
  Accuracy approx. .1 to 3 cm.

**Advantages RTK:**

- High accuracy!
- Minor problems by shading
- Operating costs decrease by growing number of machines using the system.
Software – split screen
Multiple rollers – data interchange via radio
Parameters of the asphalt-compaction

Cool-down-behaviour

Cooling-down of the Asphalt

Time

°C

Optimal
Decision support: Compaction degree

HCQ - GPS

Schicht | Bodenart | Specimen | Extra | Messung
--- | --- | --- | --- | ---

GPS: Longitude 12.330986791 / Latitude 49.880979831
F.Z. W.: M1 550164, Type Dv/90°C, P="192.168.1.2.62002"
Bk: Aachner
Sch.: Tragfeste

RMV: 0 %
Freq.: 27.09 Hz
Amp.: 0.30 mm
Gesch.: 4.00 km/h

<90% | 92-94% | 94-96% | 96-97% | 97-98% | >98%
## Decision support: Compaction degree

<table>
<thead>
<tr>
<th>Passes</th>
<th>Temperature</th>
<th>Location</th>
<th>Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100</td>
<td>100° - 130°</td>
<td>bald</td>
<td>97-98%</td>
</tr>
<tr>
<td>1°</td>
<td>130°</td>
<td>100%</td>
<td>94-96%</td>
</tr>
</tbody>
</table>

- **Passes**: Number of passes made during compaction.
- **Temperature**: Temperature range during compaction.
- **Location**: Geographic location of the compaction event.
- **Compaction**: Degree of compaction indicated by the percentage range.
## Field Demonstration Projects

### 2012 Field Projects

<table>
<thead>
<tr>
<th>State</th>
<th>Dates</th>
<th>Materials</th>
<th>Rollers</th>
<th>Further Info</th>
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</thead>
<tbody>
<tr>
<td>Utah</td>
<td>Aug 6 to 9</td>
<td>Asphalt</td>
<td>HAMM and Sakai</td>
<td>Webpage</td>
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<tr>
<td>Florida</td>
<td>Oct 15 to 18</td>
<td>Asphalt</td>
<td>HAMM and Sakai</td>
<td>Webpage</td>
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### 2013 Field Projects

<table>
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<tr>
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<td>June 24-27</td>
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<td>HAMM and Sakai</td>
<td>Webpage</td>
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<tr>
<td>California</td>
<td>Mid-Aug</td>
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<td>TBA</td>
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### 2014 Field Projects

<table>
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<tbody>
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Intelligent Compaction Overview

Key: EDC IC
- 33 Committed
- National Leader